WASSCE JUNE 2015 GENERAL MATHEMATICS

MATHEMATICS (CORE) 2 THEORY QUESTIONS

SECTION A ***[40 marks] Answer all questions***

1. (a) Without using Mathematical tables or calculators, simplify: $3\frac{4}{9} \div (5\frac{1}{3} - 2\frac{3}{4}) + 5\frac{9}{10}$.

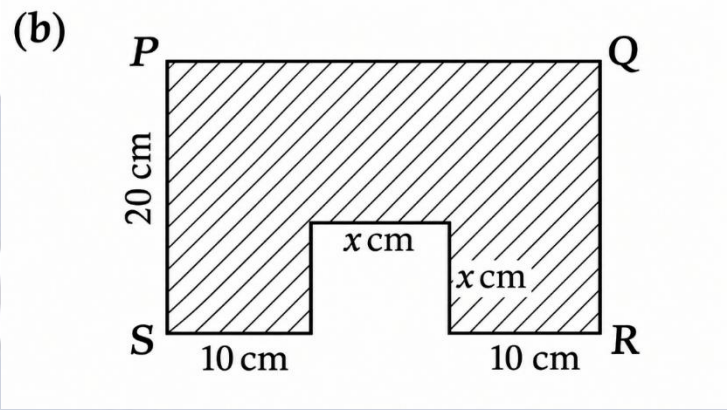
(b) A number is selected at random from each of the sets {2, 3, 4} and {1, 3, 5. Find the probability that the sum of the two numbers is greater than 3 and less than 7.

2. (a) Solve the inequality: $4 + \frac{3}{4}(x + 2) \leq \frac{3}{8}x + 1$.

(b)The diagram shows a rectangle PQRS from which a square of side x cm has been cut. If the area of the shaded portion is 484 cm^2, find the values of x.

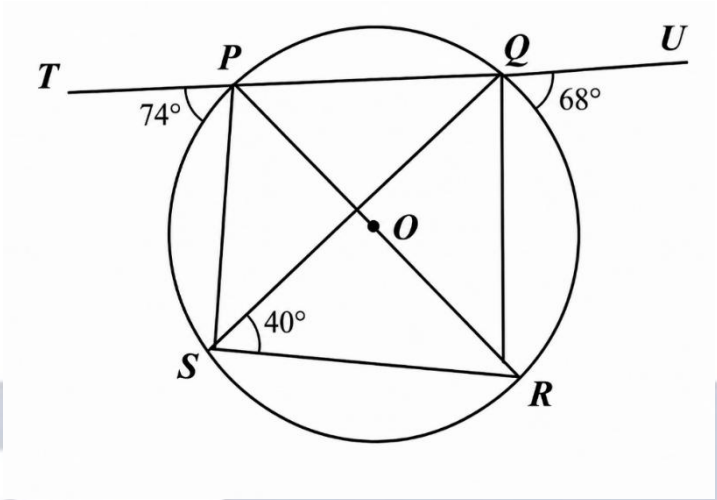
3. (a) The ratio of the interior angle to the exterior angle of a regular polygon is 5:2. Find the number of sides of the polygon.

(b)



(b)The diagram shows a circle PQRS with centre O, ∠UQR = 68°, ∠TPS = 74° and ∠QSR = 40°. Calculate the value of ∠PRS.

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4. (a) By how much is the sum of 3⅗ and 2⅕ less than 7?

(b) The height, h m, of a dock above sea level is given by h = 6 + 4cos(15p)°, 0 < p < 6. Find:

(i) the value of h when p = 4;

(ii) Correct to two significant figures, the value of p when h = 9 m.

5. A trapezium PQRS is such that PQ // RS and the perpendicular from P to RS is 40 cm. If |PQ| = 20 cm, |SP| = 50 cm and |SR| = 60 cm, calculate, correct to 2 significant figures, the:

(a) area of the trapezium;

(b) ∠QRS.

SECTION B [60 marks] *Answer five questions only. All questions carry equal marks.*

6. (a) (i) Illustrate the following statement in a Venn diagram: All good Literature students in a school are in the General Arts class.

(ii) Use the diagram to determine whether the following are valid conclusions from the given statement:

I. Vivian is in the General Arts class therefore she is a good Literature student;

II. Audu is not a good Literature student therefore he is not in the General Arts class;

III. Kweku is not in the General Arts class therefore he is not a good Literature student.

(b) The cost (c) of producing n bricks is the sum of a fixed amount, h, and a variable amount y, where y varies directly as n. If it costs

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GH¢950.00 to produce 600 bricks and GH¢1,030.00 to produce 1000 bricks,

(i) find the relationship between c, h and n;

(ii) calculate the cost of producing 500 bricks.

(table with x-values −3 to 5 and given y-values)

7. The table is for the relation $y = px^2 - 5x + q$.

x	−3	−2	−1	0	1	2	3	4	5
y	21	6		−12				0	13

(a) (i) Use the table to find the values of p and q.

(ii) Copy and complete the table.

(b) Using scales of 2 cm to 1 unit on the x-axis and 2 cm to 5 units on the y-axis, draw the graph of the relation for $-3 \leq x \leq 5$.

(c) Use the graph to find:

(i) y when x = 1.8;

(ii) x when y = −8.

8. (a) Using ruler and a pair of compasses only, construct a:

(i) trapezium WXYZ such that |WX| = 8 cm, |XY| = 5.5 cm, |XZ| = 8.3 cm, ∠WXY = 60° and WX // ZY;

(ii) rectangle PQYZ where P and Q are on WX.

(b) Measure:

(i) |QX|;

(ii) ∠XWZ.

9. (a) The first term of an Arithmetic Progression (AP) is −8. If the ratio of the 7th term to the 9th term is 5:8, find the common difference of the AP.

(b) A trader bought 30 baskets of pawpaw and 100 baskets of mangoes for ₦2,450.00. She sold the pawpaw at a profit of 40% and the mangoes at a profit of 30%. If her profit on the entire transaction was ₦855.00, find the:

(i) cost price of a basket of pawpaw;

(ii) selling price of the 100 baskets of mangoes.

10. (a) Without using Mathematical tables or calculators, simplify: (2tan60° + cos30°) / sin60°.

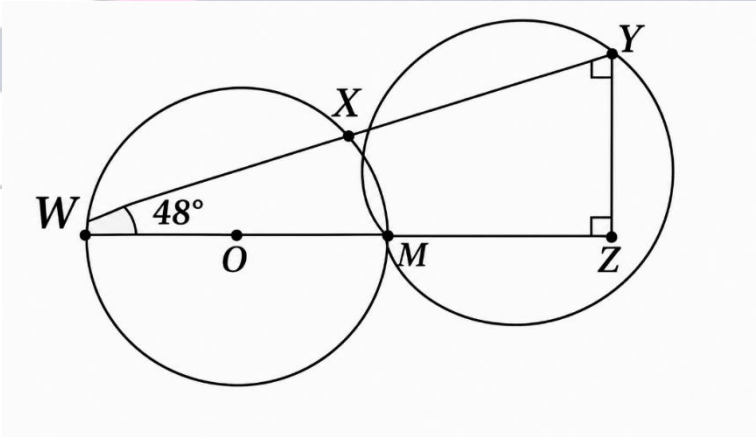
(b) From an aeroplane in the air and at a horizontal distance of 1050 m, the angles of depression of the top and base of a control tower at an instance are 36° and 41° respectively. Calculate, correct to the nearest metre, the:

(i) height of the control tower;

(ii) shortest distance between the aeroplane and the base of the control tower.

11.

(a)



Make m the subject of the relation h = mt / (d(m + p)).

(b) In the diagram, WY and WZ are straight lines, O is the centre of circle WXM and ∠XWM = 48°. Calculate the value of ∠WYZ.

(c) An operation ⊛ is defined on the set X = {1, 3, 5, 6} by m⊛n = m + n + 2 (mod 7), where m, n ∈ X.

(i) Draw a table for the operation.

(ii) Using the table, find the truth set of:

I. 3⊛n = 3;

II. n⊛n = 3.

12. A water reservoir in the form of a cone mounted on a hemisphere is built such that the plane face of the hemisphere fits exactly to the base of the cone, and the height of the cone is 6 times the radius of its base.

(a) Illustrate this information in a diagram.

(b) If the volume of the reservoir is $333\frac{1}{3}\pi$ m^3, calculate, correct to the nearest whole number, the:

(i) volume of the hemisphere;

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(ii) total surface area of the reservoir.

[Take π = 22/7]

13. The table shows the marks scored by some candidates in an examination.

(a) Construct a cumulative frequency table for the distribution and draw a cumulative frequency curve.

(b) Use the curve to estimate, correct to one decimal place, the:

(i) lowest mark for distinction if 5% of the candidates passed with distinction;

(ii) probability of selecting a candidate who scored at most 45%.

(ii) total surface area of the reservoir.

[Take π = 22/7]

13. The table shows the marks scored by some candidates in an examination.

(a) Construct a cumulative frequency table for the distribution and

Marks (%)	0–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89	90–99
Frequency	7	11	17	20	29	34	30	25	21	6

draw a cumulative frequency curve.

(b) Use the curve to estimate, correct to one decimal place, the:

(i) lowest mark for distinction if 5% of the candidates passed with distinction;

(ii) probability of selecting a candidate who scored at most 45%.

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WASSCE JUNE 2016 GENERAL MATHEMATICS

MATHEMATICS (CORE) 2 THEORY QUESTIONS

PART I

1. (a) Without using Mathematical tables or calculators, evaluate:

$$\frac{0.09 \times 1.21}{3.3 \times 0.00025}$$

leaving the answer in standard form (Scientific Notation).

(b) A principal of GH¢5,600 was deposited for 3 years at compound interest. If the interest earned was GH¢1,200.00, find, correct to 3 significant figures, the interest rate per annum.

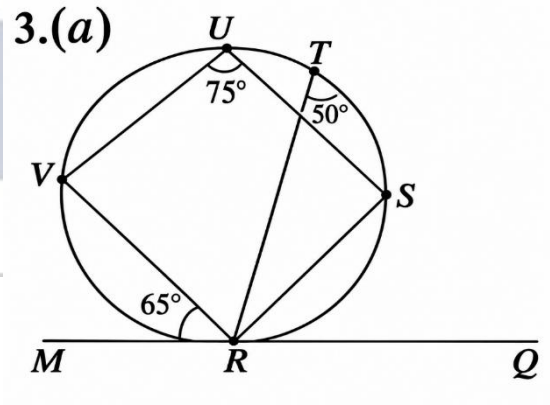
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2. (a) Solve:

$$7(x+4) - \frac{2}{3}(x-6) \leq 2[x - 3(x+5)].$$

(b) A transport company has a total 20 vehicles made up of tricycles and taxicabs. Each tricycle carries 2 passengers, while each taxicab carries 4 passengers. If the 20 vehicles carry a total of 66 passengers at a time, how many tricycles does the company have?

3.



In the diagram, $\angle RTS = 28°$, $\angle VRM = 46°$, and $MQ$is a tangent to the circle VRSTU at the point R. Find $\angle VUS$.

(b) A cylindrical tin, 7 cm high, is closed at one end. If its total surface area is 462 cm², calculate its radius.

[Take $\pi = \frac{22}{7}$]

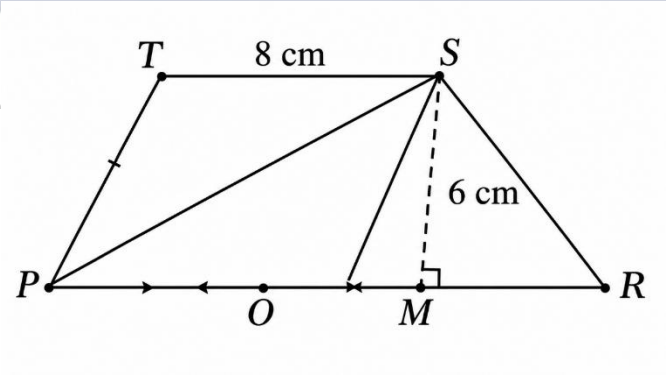
4.

Scores	**1**	**2**	**3**	**4**	**5**	**6**
Frequency	25	30	x	28	40	32

The table shows the outcome when a die is thrown several times. If the probability of obtaining a 3 is 0.225:

(a) How many times was the die thrown?

(b) Calculate the probability that a trial chosen at random gives a score of an even number or a prime number.



5. In the diagram, PQST is a parallelogram. $PR$is a straight line. $PS = 8$cm, $SM = 6$cm and the area of triangle $PSR = 36$ cm^2. Find the value of QR.

(b) A tree and a flagpole are on the same horizontal ground. A bird on top of the tree observes the top and bottom of the flagpole below it at angles of 45° and 60° respectively. If the tree is 10.65 m high, calculate, correct to 3 significant figures, the height of the flagpole.

PART II

6. (a) Find the sum of the Arithmetic Progression (AP):

$1,3,5, \ldots, 101.$

(b) Out of the 95 travellers interviewed, 7 travelled by bus and train only, 3 by train and car only, and 8 travelled by all three means of transport. The number, x, of travellers who travelled by bus only was equal to the number who travelled by bus and car only. If 47 people travelled by bus and 30 by train:

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(i) Represent this information in a Venn diagram.

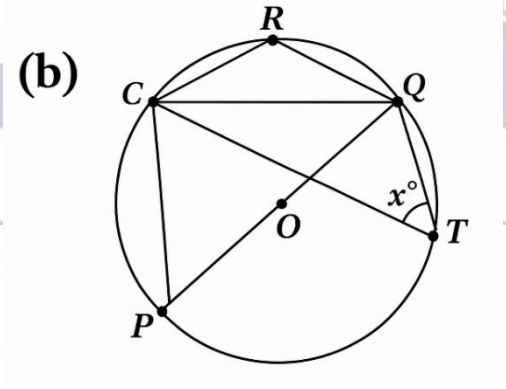
(ii) Calculate:

I. the value of x;

II. the number who travelled by at least two means.

7. (a) Using completing the squares method, solve, correct to 2 decimal places:

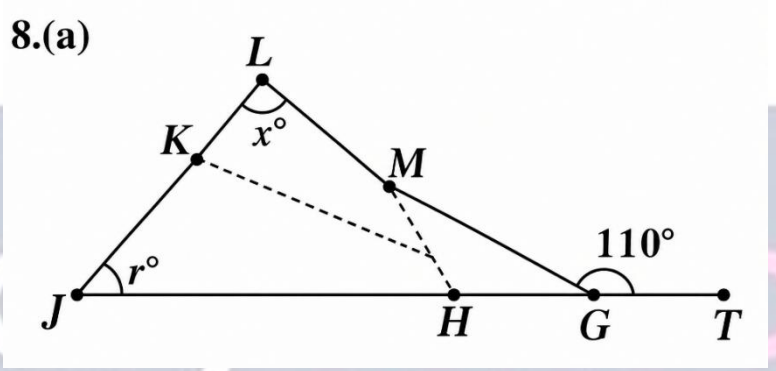
$\frac{x-2}{4} = \frac{x+2}{2x}$.



(b) In the diagram, PQRST is a circle with centre O. If $PS$is a diameter, $RS = QT$, $OR = RS$, and $\angle QTS = 52°$, find:

(i) $\angle SQT$;

(ii) $\angle POT$.



8. (a) In the diagram, $\angle J = r$, $\angle L = x$, $\angle JMK = y$and $\angle KGF = 110°$. If

$2x + y = r$,

find the value of x.

(b) Ten boys and twelve girls collected donations for a project. The total amount collected by the boys was ₦600.00 greater than that collected by the girls. If the average collection of the boys was ₦100.00 greater than the average collection of the girls, how much was collected by the two groups?

9. The weight (in kg) of 50 contestants at a competition is as follows:

65	**66**	**67**	**66**	**64**	**66**	**65**	**63**	**65**	**68**
64	62	66	64	67	65	64	66	65	67
65	67	66	64	65	64	66	65	64	65
66	65	64	65	63	63	67	65	63	64
66	64	68	65	63	65	64	67	66	64

(a) Construct a frequency table for discrete data.

(b) Calculate, correct to 2 decimal places, the:

(i) mean;

(ii) standard deviation of the data.

10. Using a ruler and a pair of compasses only:

(a) Construct:

(i) $\triangle XYZ$ such that $XY = 10$cm, $\angle XYZ = 30°$ and $\angle YXZ = 45°$.

(ii) Locus l_1 of points equidistant from Y and Z.

(iii) Locus l_2 of points parallel to XY through Z.

(b) Locate point A, the point of intersection of l_1 and l_2.

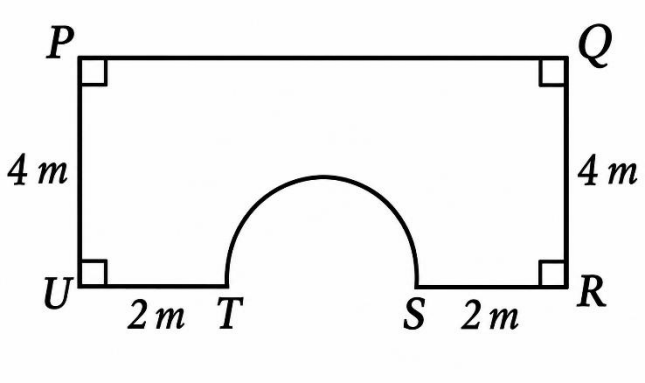
(c) Measure $\angle AYZ$.

11. (a) If $\frac{3p+4q}{3p-4q} = 2$,

find $p : q$.

(b) The diagram shows the cross-section of a bridge with a semi-circular hollow in the middle. If the perimeter of the cross-section is 34 m,

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Calculate:

(i) the length PQ;

(ii) the area of the cross-section.

[Take $\pi = \frac{22}{7}$]

12. (a) Copy and complete the table of values, correct to one decimal place, for the relation

$y = 3 \sin x + 2 \cos x$

for

$0° \leq x \leq 360°$.

x	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°		300°	330°	360°
y	2.0			3.0	1.6		-2.0		-3.6	-3.0				2.0

(b) Using scales of 2 cm to 30° on the x-axis and 2 cm to 1 unit on the y-axis, draw the graph of the relation

$y = 3\sin x + 2\cos x$

for

$0° \leq x \leq 360°$.

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(c) Use the graph to solve:

(i) $3\sin x + 2\cos x = 0$;

(ii) $2 + 2\cos x + 3\sin x = 0$.

13. (a) Find the equation of a straight line which passes through the point $(2, -3)$ and is parallel to the line

$$2x + y = 6.$$

by

(b) The operation Δ is defined on the set

$T = \{2, 3, 5, 7\}$

$$x\Delta y = (x + y + xy) \pmod 8.$$

(i) Construct a modulo 8 table for the operation Δon the set T.

(ii) Use the table to find:

I. $2\Delta 7$;

II. $2\Delta n = 5\Delta 7$.

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WASSCE JUNE 2017 GENERAL MATHEMATICS

MATHEMATICS (CORE) 2 THEORY QUESTIONS

[40 marks]

Answer all the questions in this section. All questions carry equal marks.

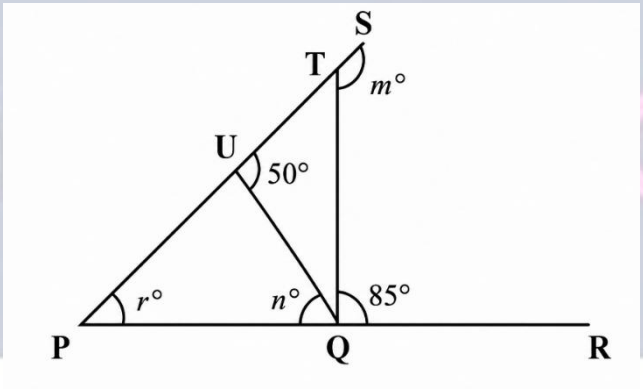
1(a) If $(y-1)\log_{10}4 = y\log_{10}16$, without using Mathematical tables or a calculator, find the value of y.

(b) When I walk from my house to the office at 4km/h, I will get to the office 30 minutes later than when I walk at 5km/h. Calculate the distance between my house and office.

2(a) Solve the equation:

$2/3(3x-5) - 3/5(2x-3) = 3$

(b)



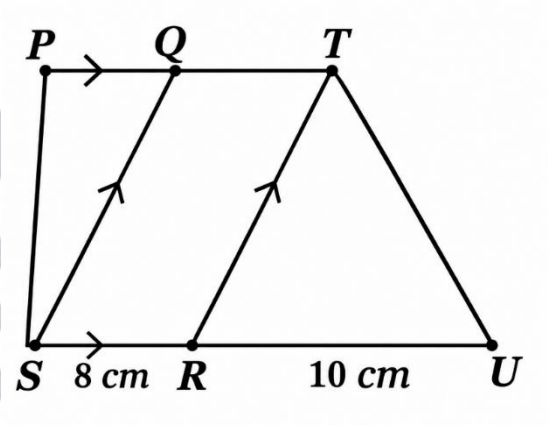
In the diagram, ∠STQ = m, ∠TUQ = 80°, ∠UPQ = r°, ∠PQU = n° and ∠RQT = 88°. Find the value of (m + n)°.

3(a) The angle of depression of point P on the ground from the top T of a building is 23.6°. If the distance from P to the foot of the building is 50m, calculate, correct to the nearest metre, the height

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of the building.

(b) In the diagram above, PT//SU, QS//TR, |SR| = 6cm and |RU| = 10cm. If the area of ΔTRU = 45cm², calculate the area of trapezium QTUS.



4. If the sixth term of an Arithmetic Progression (A.P.) is 37 and the sum of the first six terms is 147, find the:

First term;

Sum of the first fifteen terms.

5. Out of 120 customers in a shop, 45 bought both bags and shoes. If all the customers bought either bags or shoes and 11 more customers bought shoes than bags:

(a) Illustrate this information in a diagram;

(b) Find the number of customers who bought shoes;

(c) Calculate the probability that a customer selected at random bought bags.

SECTION B

[60 marks]

Answer five questions only from this section. All questions carry equal marks.

6(a) A manufacturing company requires 3 hours of direct labour to process every #87.00 worth of raw materials. If the company uses #30,4550.000 worth of raw materials, what amount should it budget for direct labour at #18.25 per hour?

(b) An investor invested #x in bank M at the rate of 6% simple interest per annum and #y in bank N at the rate of 8% simple interest per annum. If a total of #8,000,000.00 was invested in the two banks and the investor received a total of #2,320,000.00 as interest from the two banks after 4 years, calculate the:

(i) Values of x and y

(ii) Interest paid by the second bank

7(a) Copy and complete the table of values for the equation

$y = 2x^2 - 7x - 9$ for $-3 \leq x \leq 6$

x	−3	−2	−1	0	1	2	3	4	5	6
y		13		−9	−14		−12		6	

(b) Using scales of 2cm to 1 unit on the x-axis and 2cm to 4 units on the y-axis, draw the graph of $y = 2x^2 - 7x - 9$ for $-3 \leq x \leq 6$

(c) Use the graph to estimate the:

(i) Roots of the equation $2x^2 - 7x = 26$

(ii) Coordinates of the minimum point of y

(iii) Range of values for which $2x^2 - 7x < 9$

8. The table shows the distribution of marks scored by some students in a test:

Marks	1	2	3	4	5
No of students	m+2	m−1	2m−3	m+5	3m−4

(a) If the mean mark is 3 6/23, find the value of m

(b) Find the:

(i) interquartile range;

(ii) probability of selecting a student who scored at least 4 marks in the test.

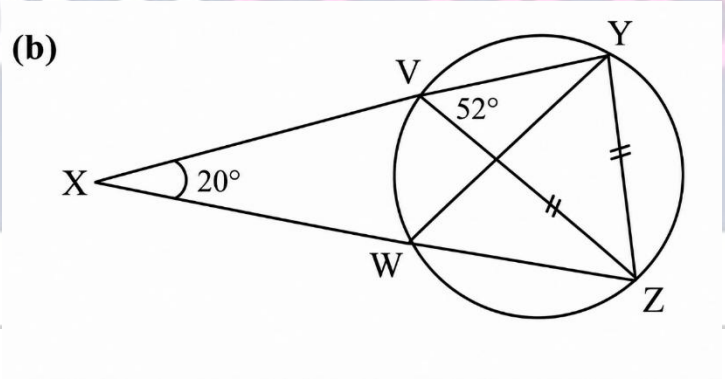
9(a) PQ is a tangent to a circle ∠RST at the point S. ∠PRT is a straight line, ∠TPS = 34° and ∠TSQ = 65°.

(i) Illustrate the information in a diagram.

(ii) Find the value of:

(A) ∠RTS; (B) ∠SRP

(b)



In the diagram above, |VZ| = |YZ|, ∠YXZ = 20° and ∠ZVY = 52°. Calculate the size of ∠WYZ.

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10(a) Given that sin x = 5/13, 0° < x < 90°, find:

(cos x − 2 sin x) / (2 tan x)

(b) A ladder, LA, leans against a vertical pole at a point L which is 9.6 metres above the ground. Another ladder, LB, 12 metres long, leans on the opposite side of the pole and at the same point L. If A and B are 10 metres apart and on the same straight line as the foot of the pole, calculate, correct to 2 significant figures, the:

(i) Length of ladder LA;

(ii) Angle which LA makes with the ground

11(a) It takes 8 students two-thirds of an hour to fill 12 tanks with water. How many tanks of water will 4 students fill in one-third of an hour at the same rate?

(b) A chord, 20cm long, is 12cm from the centre of the circle. Calculate, correct to one decimal place, the:

(i) Angle subtended by the chord at the centre of the circle;

(ii) Perimeter of the minor segment cut off by the chord.

[Take π = 3.142]

12(a) Using the completing the square method, solve, correct to 2 decimal places, the equation $3y^2 - 5y + 2 = 0$

(b) Given that M = (1 2 / 4 3), N = (m x / n y) and MN = (2 1 / 3 4), find the matrix N.

13(a) The operation () is defined on the set of real numbers, R, by x()y = (x+y)/2, x, y ∈ R.

(i) Evaluate 3() 2/5

(ii) If 8()y = 8 1/4, find the value of y

(b) In ΔABC, $\overrightarrow{AB}$ = (−4 / 6) and $\overrightarrow{AC}$ = (3 / −8). If P is the midpoint of AB, express $\overrightarrow{CP}$ as a column vector.

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WASSCE JUNE 2018 GENERAL MATHEMATICS

MATHEMATICS (CORE) 2 THEORY QUESTIONS

SECTION A

1(a) Evaluate without using a calculator:

$[(1/4 \times 9\ 1/7) + 2/5(2/3 + 3/4)] \div (2/5 - 1/4)$

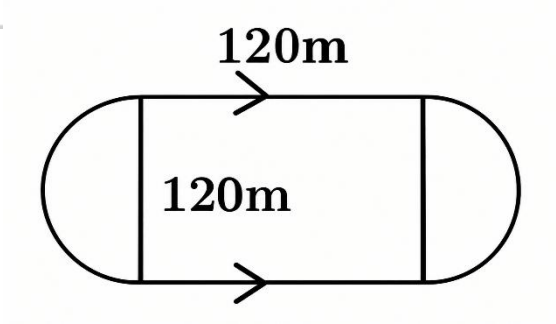
(b) A hunter walked 250m from point P to Q on a bearing of 042°. Calculate, correct to the nearest metre, the vertical distance he has moved.

2. Musa is three years older than Manya. Seven years ago, Musa was twice as old as Manya.

(a) How old are they now?

(b) When will the sum of their ages be 45?

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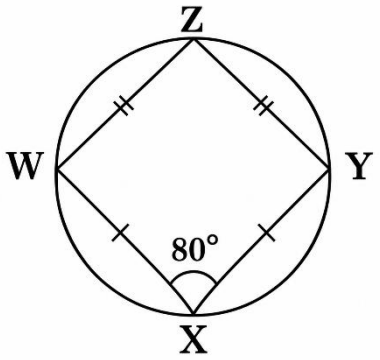


3. The diagram shows athletics track with two parallel sides and two semi-circular ends. Each parallel side is 60 metres long, and the diameter of each semi-circular end is 120 metres.

(a) Calculate the distance covered by an athlete who runs the track two times. [Take π = 22/7].

(b) If the athlete spends 200 seconds for the race, calculate the speed in km/h.

4(a) A man was charged 2 kobo per month for every #1.00 he borrowed from a bank. At what rate per annum was the interest charged?



(b) SEE DIAGRAM — In the diagram, |WX| = |XY| = |YZ| and ∠WXY = 80°. What is the size of ∠XWZ?

5. The table shows the distribution of scores

obtained when a fair die was rolled 50 times.

Score: 1, 2, 3, 4, 5, 6

Frequency: 2, 5, 13, 11, 9, 10

(a) Draw a bar chart for the distribution.

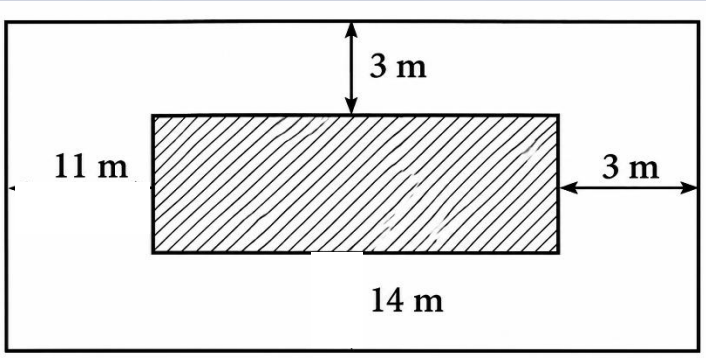
(b) Calculate the mean score of the distribution.

SECTION B [60 marks]

6(a) If tan x = 5/12, 0° < x < 90°, evaluate without using Mathematical tables or calculator:

$\sin x / [(\sin x)^2 + \cos x]$

(b) The diagram shows a rectangular lawn measuring 14m by 11m. A path of uniform width x m surrounds it. If the total area of the path is



186m², how wide is the path?

7. A shop had two reduction sales during which prices of all items were reduced by 40% in the first sale and 30% in the second.

(a) If a shirt was sold at GH¢3,500 during the second reduction sale, find the price before the first sale.

(b) If the price of an article before the first reduction sale was GH¢180.00, find:

(i) the reduction in the price due to the sales;

(ii) the percentage reduction in the price of the article.

8(a) Using ruler and a pair of compasses only, construct:

(i) a trapezium PQRS such that |PQ| = 6.8cm, ∠PQR = 120°, QR//PS, |PS| = 10.6cm and |PR| = 9.3cm;

(ii) locus l_1 of points equidistant from P and R;

(iii) locus l_2 of points equidistant from Q and R.

(b) Measure:

(i) |QR|;

(ii) ∠PSR;

(iii) |QY|, where Y is the point of intersection of l_1 and l_2.

9(a) A donkey is tied with a rope to a post which is 15m from a fence. If the length of the rope between the donkey and the post is

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17m, calculate the length of the fence within the reach of the donkey.

(b) The base of a right pyramid with vertex V is a square PQRS of side 15cm. If the slant edge is 32cm long:

(i) represent the information in a diagram;

(ii) calculate its:

I. height, correct to one decimal place;

II. volume, correct to the nearest cm^3.

10(a) Copy and complete the following table of values for $y = 2\cos x - \sin x$, $0° \leq x \leq 300°$. SEE DIAGRAM (table)

(b) Using scales of 2cm to 30° on the x-axis and 2cm to 1 unit on the y-axis, draw the graph of $y = 2\cos x - \sin x$ for $0° \leq x \leq 300°$.

(c) Use the graph to find the value(s) of x for which:

(i) $2\cos x - \sin x = 1$;

(ii) $\tan x = 2$.

11(a) If $\log_a(y^{12}) = 1 + \log_a(x)$, find x in terms of y.

(b) The table below shows the distribution of timber production in five communities in a certain year:

Community	Timber Production (tonnes)
Bibiani	600
Amenfi	900
Oda	1800
Wiawso	1500
Sankore	2400

Draw a pie chart to represent the information.

(i) What percentage of timber produced that year was from Amenfi?

(ii) If a tonne of timber is sold at $560.00, how much more revenue would Oda community receive than Bibiani?

12(a) Mr. John paid #8,400.00 in #1.00 ordinary shares of a company which sold at #2.50 per share. If dividend was declared at 25k per share, how much dividend did he get?

(b) Using the method of completing the square, solve:

$(1-x)/x + x/(1-x) = 5/2$

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13(a) The points R(3,−6) and T(p, q) are on the x–y plane. If (1/3)OR + OS + OT = RS, find the coordinates of T.

(b) If 2(3, m) + (1, 2) = (8, 4), find the values of m and n.

(c) Given that w*u = w + u + 1. If (y*4)*y = 12, find the value of y.

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GENERAL MATHEMATICS 2

2019 WAEC QUESTIONS

SECTION A [40 marks]

Answer all the questions in this section. All questions carry equal marks.

1.(a) Given that $110_x = 40_{(five)}$, find the value of x.

(b) Simplify $15/\sqrt{75} + \sqrt{108} + \sqrt{432}$, leaving the answer in the form $a\sqrt{b}$, where a and b are positive integers.

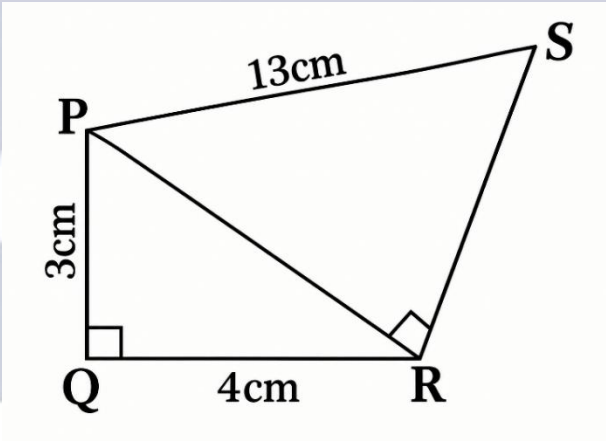
2.(a) Find the equation of the line which passes through the points A(–2, 7) and B(2, –3).

(b) Given that $(5b - a)/(8b + 3a) = 1/5$, find, correct to two decimal places, the value of a/b.

3.(a) Ali, Musah and Yusif shared #420,000.00 in the ratio 3:5:8 respectively. Find the sum of Ali and Yusif's shares.

(b) Solve: 2(1/8)^x = 32^(x–1)

4.



(In the diagram above, PQRS is a quadrilateral, ∠PQR = ∠PRS = 90°, |PQ| = 3cm, |QR| = 4cm and |PS| = 13cm. Find the area of the quadrilateral.

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5. Three red balls, five green balls and several blue balls are put together in a sack. One ball is picked at random from the sack. If the probability of picking a red ball is 1/6, find:

(a) the number of blue balls in the sack;

(b) the probability of picking a green ball.

SECTION B

Answer five questions only from this section. All questions carry equal marks.

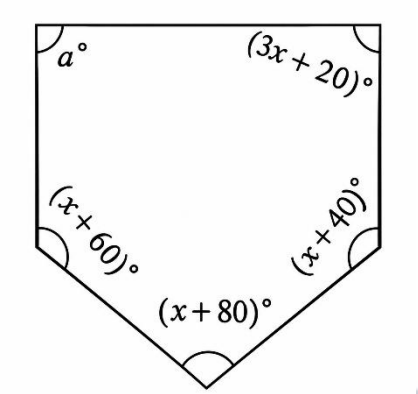
6.(a) The force of attraction, F, between two bodies varies directly as the product of their masses, m_1 and m_2, and inversely as the square of the distance, d, between them. Given that F = 20N, when m_1 = 25kg, m_2 = 10kg and d = 5m, find:

(i) An expression for F in terms of m_1, m_2 and d;

(ii) the distance, d when f = 30N, m_1 = 7.5kg and m_2 = 4kg.

(b)

Find the value of x in the diagram. (Diagram shows angles labelled (2x+20)°, (x+90)°, (x+80)°, (2x+40)°, x° — NOT DRAWN TO SCALE)



7. The data show the marks obtained by students in a Biology test:

52	56	25	56	68	73	66	64	56	48
20	39	9	50	46	54	54	40	50	96
36	44	18	97	65	21	60	44	54	32
92	49	37	94	72	88	89	35	59	34
15	88	53	16	84	52	72	66	40	42

(a) Construct a frequency distribution table using the class interval 0–9, 10–19, 20–29, …

(b) Draw a cumulative frequency curve for the distribution. (SEE DIAGRAM)

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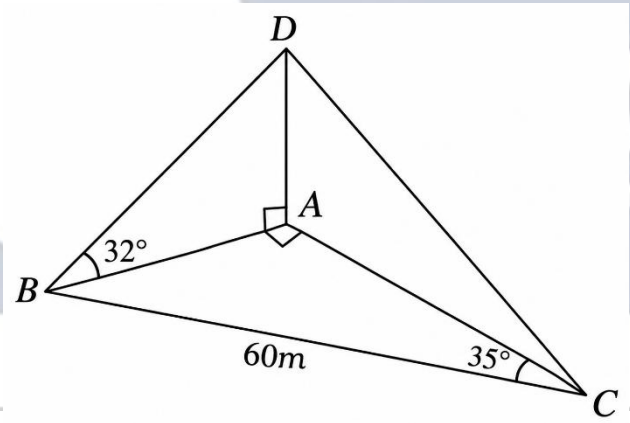
(c) Use the graph to estimate the:

(i) Median;

(ii) Percentage of students who scored at least 66 marks, correct to the nearest whole number.

8.(a) Solve the inequality:

$\frac{1}{3}x - \frac{1}{4}(x + 2) \geq 3x - 1\frac{1}{3}$



(b) In the diagram above, ABC is a right-angled triangle on a horizontal ground. |AD| is a vertical tower. ∠BAC = 90°, ∠ACB = 35°, ∠ABD = 52° and |BC| = 66m.

Find, correct to two decimal places:

(i) the height of the tower;

(ii) the angle of elevation of the top of the tower from C.

9.(a) Copy and complete the table of values for $y = 2\cos x + 3\sin x$ for $0° \leq x \leq 360°$.

x	0°	60°	120°	180°	240°	300°	360°
y	2.0					–3.6	

(b) Using a scale of 2cm to 60° on the x-axis and 2cm to 1 unit on the y-axis, draw the graph of $y = 2\cos x + 3\sin x$ for $0° \leq x \leq 360°$.

(c) Using the graph to:

(i) solve $2\cos x + 3\sin x = -1$;

(ii) find, correct to one decimal place, the value of y when x = 342°.

---

10. A woman bought 130kg of tomatoes for #52,000.00. She sold half of the tomatoes at a profit of 30%. The rest of the tomatoes began to go bad, she then reduced the selling price per kg by 12%. Calculate:

(a) The new selling price per kg;

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(b) The percentage profit on the entire sales if she threw away 5kg of bad tomatoes.

11.(a) The third and sixth terms of Geometric progression (G.P.) are 1/4 and 1/32, respectively. Find:

(i) The first term and common ratio;

(ii) The seventh term;

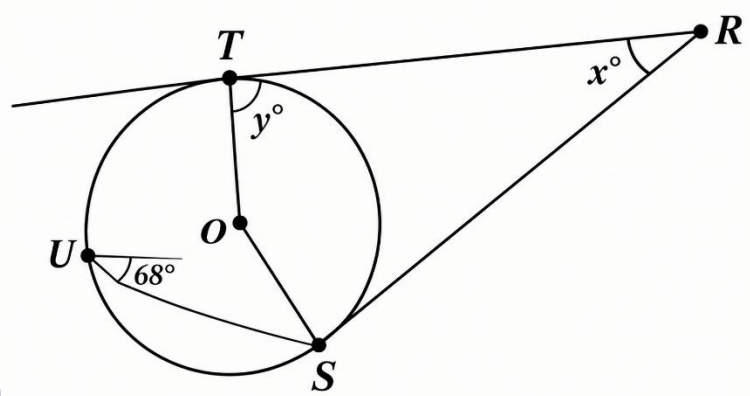
(b) Given that 2 and –3 are the roots of the equation $ax^2 + bx + c = 0$, find the values of a, b and c.

12.(a) Given that sin y = 8/17, find the value of:

tan y / (1 + 2 tan y)

(b) An amount of #300,000.00 was shared among Otobo, Ada and Adeola. Otobo received #60,000.00, Ada received 5/12 of the remainder, while the rest went to Adeola. In what ratio was the money shared?

13.



(a) In the diagram above, lines |RS| and |RT| are tangent to the circle with centre O, ∠TUS = 68°, ∠SRT = x° and ∠UTO = y°. Find the value of x°.

(b) Two tanks A and B are filled to capacity with diesel. Tank A holds 600 litres of diesel more than tank B. If 100 litres of diesel was pumped out of each tank, tank A would then contain 3 times as much diesel as tank B. Find the capacity of each tank.

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WAEC MATH ESSAY

PAPER 2 (SC) 2020

SECTION A

[40 marks] ***Answer all the questions in this section. All questions carry equal marks.***

1. (a) If A = {multiples of 2}, B = {multiples of 3} and C = {factors of 6} are subsets of μ = {x : 1 ≤ x ≤ 10}, find A′ ∩ B′ ∩ C′.

(b) Tickets for a movie premiere cost $18.50 each while the bulk purchase price for 5 tickets is $80.00. If 4 gentlemen decide to get a fifth person to join them so that they can share the bulk purchase price equally, how much would each person save?

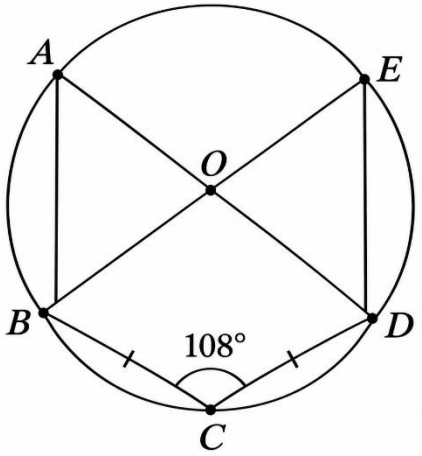
2. (a) Given that P = (rk/Q − ms)^(2/3):

(i) make Q the subject of the relation;

(ii) find, correct to two decimal places, the value of Q when P = 3, m = 15, s = 0.2, k = 4 and r = 10.

(b) Given that (x + 2y)/5 = x − 2y, find x : y.

3.



In the diagram, O is the centre of the circle ABCDE, |BC| = |CD| and ∠BCD = 108°. Find ∠CDE.

(NOT DRAWN TO SCALE)

(b) Given that tan x = √3, 0° ≤ x ≤ 90°, evaluate ((cos x)² − sin x) / ((sin x)² + cos x).

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4. The total surface area of a cone of slant height l cm and base radius r cm is 224π cm^2. If r : l = 2 : 5, find:

(a) correct to one decimal place, the value of r;

(b) correct to the nearest whole number, the volume of the cone.

[Take $\pi = 22/7$]

5. A die was rolled a number of times. The outcomes are shown in the table.

Number	**1**	**2**	**3**	**4**	**5**	**6**
Outcomes	32	m	25	40	28	45

If the probability of obtaining 2 is 0.15, find the:

(a) value of m;

(b) number of times the die was rolled;

(c) probability of obtaining an even number.

SECTION B

[60 marks]

Answer five questions only from this section. All questions carry equal marks.

6. (a) Copy and complete the table of values for the relation y = 3 sin 2x.

x	**0°**	**15°**	**30°**	**45°**	**60°**	**75°**	**90°**	**105°**	**120°**	**135°**	**150°**
y	0.0					1.5					−2.6

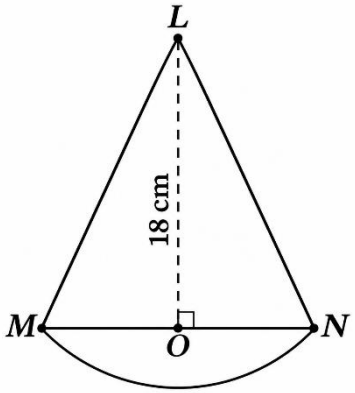
(b) Using a scale of 2 cm to 15° on the x-axis and 2 cm to 1 unit on the y-axis, draw the graph of y = 3 sin 2x for $0° \leq x \leq 150°$.

(c) Use the graph to find the truth set of:

(i) 3 sin 2x + 2 = 0;

(ii) (3/2) sin 2x = 0.25.

7.



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The diagram shows a wooden structure in the form of a cone, mounted on a hemispherical base. The vertical height of the cone is 48 m and the base radius is 14 m. Calculate, correct to three significant figures, the surface area of the structure. [Take π = 22/7]

(NOT DRAWN TO SCALE)

(b) Five years ago, Musah was twice as old as Sesay. If the sum of their ages is 100, find Sesay's present age.

8. (a) Ms. Mauren spent 1/4 of her monthly income at a shopping mall, 1/3 at an open market and 2/5 of the remaining amount at a Mechanic workshop. If she had ₦225,000.00 left, find:

(i) her monthly income;

(ii) the amount spent at the open market.

(b) The third term of an Arithmetic Progression (A.P.) is 4m − 2n. If the ninth term of the progression is 2m − 8n, find the common difference in terms of m and n.

9. Two cyclists X and Y leave town Q at the same time. Cyclist X travels at the rate of 5 km/h on a bearing of 049° and cyclist Y travels at the rate of 9 km/h on a bearing of 319°.

(a) Illustrate the information on a diagram.

(b) After travelling for two hours, calculate, correct to the nearest whole number, the:

(i) distance between cyclists X and Y;

(ii) bearing of cyclist X from Y.

(c) Find the average speed at which cyclist X will get to Y in 4 hours.

10. The table shows the distribution of marks obtained by students in an examination.

Marks (%)	**0–9**	**10–19**	**20–29**	**30–39**	**40–49**	**50–59**	**60–69**	**70–79**	**80–89**	**90–99**
Frequency	7	11	17	20	29	34	30	25	21	6

(a) Construct a cumulative frequency table for the distribution.

(b) Draw the cumulative frequency curve for the distribution.

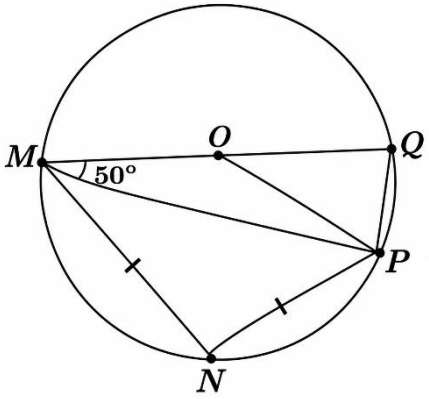
(c) Using the curve, find, correct to one decimal place, the:

(i) median mark;

(ii) lowest mark for distinction if 5% of the students passed with distinction.

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11.



In the diagram, MNPQ is a circle with centre O. |MN| = |NP| and ∠OMN = 50°. Find:

(i) ∠MNP;

(ii) ∠POQ.

(NOT DRAWN TO SCALE)

(b) Find the equation of the line which has the same gradient as 8y + 4x = 24 and passes through the point (−8, 12).

12.

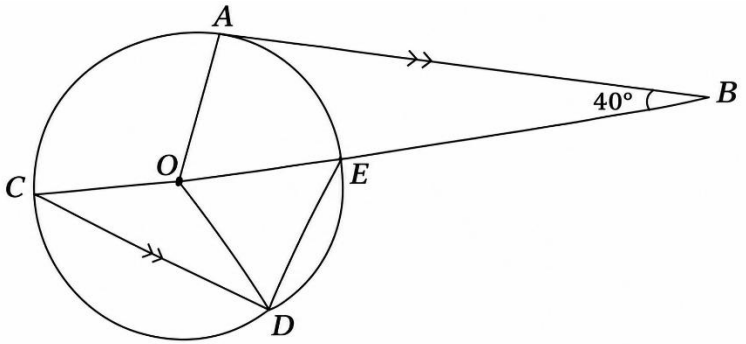
In the diagram, AB is a tangent to the circle with centre O and COB is a straight line. If CD // AB and ∠ABE = 40°, find ∠ODE.
(NOT DRAWN TO SCALE)

(b) ABCD is a parallelogram in which |CD| = 7 cm, |AD| = 5 cm and ∠ADC = 125°.

(i) Illustrate the information in a diagram. SEE DIAGRAM

(ii) Find, correct to one decimal place, the area of the parallelogram.

(c) If $x = \frac{1}{2}(1 - \sqrt{2})$, evaluate $(2x^2 - 2x)$.



13. (a) Using a ruler and a pair of compasses only, construct:

(i) (α) ΔABC with |AB| = 7.5 cm, |AC| = 13.5 cm and ∠ABC = 120°;

(β) locus, l_1 of points equidistant from A and B;

(γ) locus, l_2 of points equidistant from B and C.

(ii) Using N, the point of intersection of l_1 and l_2 as centre, draw a circle to pass through points A, B and C.

(b) Using the method of completing the square, solve $4x^2 - 4\sqrt{3}x + 3 = 0$, leaving the answer in surd form.

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PAPER 2 (SC) 2021: MATHEMATICS

SECTION A [40 marks]

Answer all the questions in this section. All questions carry equal marks.

1. (a) Mr Sarfo borrowed $25,000.00 from AFLAK Financial Services at 21% simple interest per annum for 3 years. If he repaid the loan in 2 years in equal yearly instalments, how much did he pay each year?

(b) The consecutive numbers are such that the sum of thrice the smaller and twice the larger is 17. Find, correct to three significant figures, the smaller number as a percentage of the sum of the two numbers.

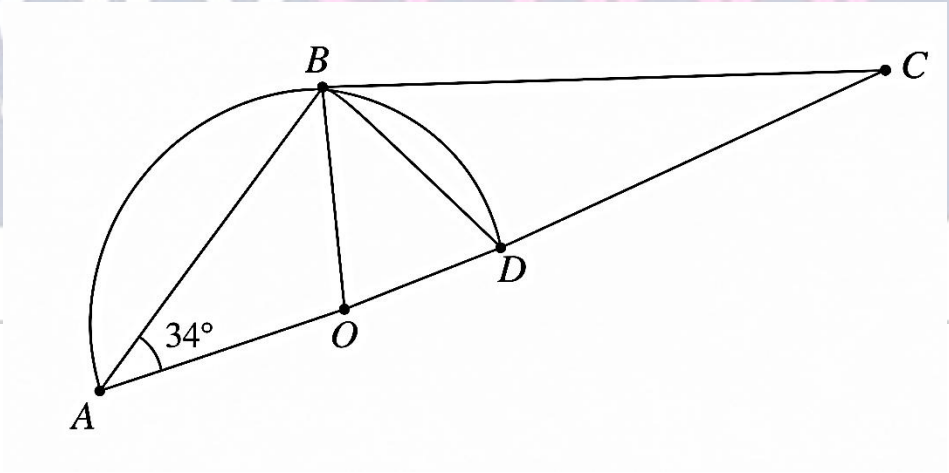
2. A man left town M at 10:00 a.m. and travelled by car to town N at average speed of 72 km/h. He spent 2 hours for a meeting and returned to town M by bus at an average speed of 40 km/h. If the distance covered by the bus was 2 km longer than that of the car and he arrived at town M at 1:55 p.m, calculate the distance from M to N.

3. The points X, Y and Z are located such that Y is 15 km south of X, Z is 20 km from X on a bearing of 270°. Calculate, correct to:

(a) two significant figures, |YZ|;

(b) the nearest degree, the bearing of Y from Z.

4.



In the diagram, AD is a diameter of a circle with centre O. If ABD is a triangle in a semi-circle and ∠OAB = 34°, find:

(a) ∠OBD;

(b) ∠OCB.

(NOT DRAWN TO SCALE)

5. (a) A man shared his property among his children as follows:

Child's name	Ann	Afia	Kojo	Nuno	Akosua
Percentage share	5	15	10	45	25

Represent the information on a pie chart.

(b) A box contains 5 red, 3 green and 4 blue identical beads. Calculate the probability that a girl takes away two red beads, one after the other, from the box.

SECTION B [60 marks]

Answer five questions only from this section. All questions carry equal marks.

6. (a) In a class of 80 students, 3/4 study Biology and 3/5 study Physics. If each student studies at least one of the subjects:

(i) draw a Venn diagram to represent this information; (ii) how many students study both subjects;

(iii) find the fraction of the class that study Biology but not Physics.

(b) Johnson and Jocatol Ltd. owned a business office with floor measuring 15 m by 8 m which was to be carpeted. The cost of carpeting was GH¢ 890.00 per square metre. If a total of GH¢ 216,120.00 was spent on painting and carpeting, how much was the cost of painting?

7. (a) Copy and complete the table of values for the relation $y = 2x^2 - x - 2$ for $-4 \leq x \leq 4$.

x	−4	−3	−2	−1	0	1	2	3	4
y		19			−2				26

(b) Using a scale of 2 cm to 1 unit on the x-axis and 2 cm to 5 units on the y-axis, draw the graph of $y = 2x^2 - x - 2$ for $-4 \leq x \leq 4$. SEE DIAGRAM

(c) On the same axes, draw the graph of $y = 2x + 3$. SEE DIAGRAM

(d) Use the graph to find the:

(i) roots of the equation $2x^2 - 3x - 5 = 0$;

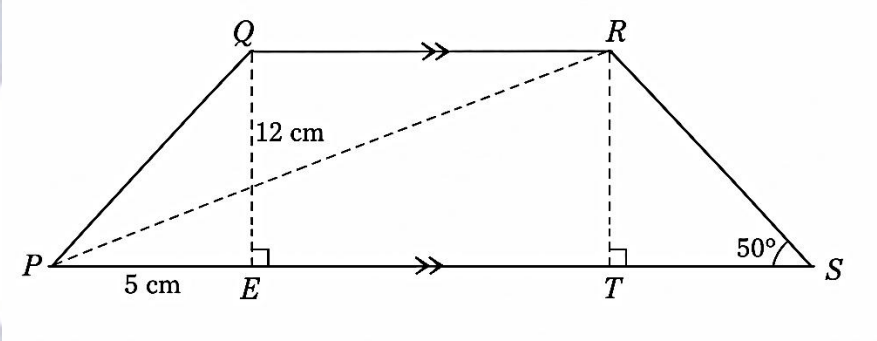
(ii) range of values of x for which $2x^2 - x - 2 < 0$.

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8. (a) In ΔPQR, ∠PQR = 90°. If its area is 216 cm² and |PQ| : |QR| is 3 : 4, find |PR|.

(b) The present ages of a man and his son are 47 years and 17 years respectively. In how many years would the man's age be twice that of his son?

9.



In the diagram, PQRS is a trapezium with QR // PS. U and T are points on PS such that |PU| = 5 cm, |QU| = 12 cm and ∠PUQ = ∠STR = 90°. If the area of ΔPQR = 20 cm², calculate to the nearest whole number, the:

(a) perimeter;

(b) area;

of the trapezium.

(NOT DRAWN TO SCALE; the diagram also shows an angle of 50° at S.)

10. (a) A cottage is on a bearing of 200° and 110° from Dogbe's and Manu's farms respectively. If Dogbe walked 5 km and Manu 3 km from the cottage to their farms, find, correct to:

(i) two significant figures, the distance between the two farms;

(ii) the nearest degree, the bearing of Manu's farm from Dogbe's.

(b) A ladder 10 m long leaned against a vertical wall x m high. The distance between the wall and the foot of the ladder is 2 m longer than the height of the wall. Calculate the value of x.

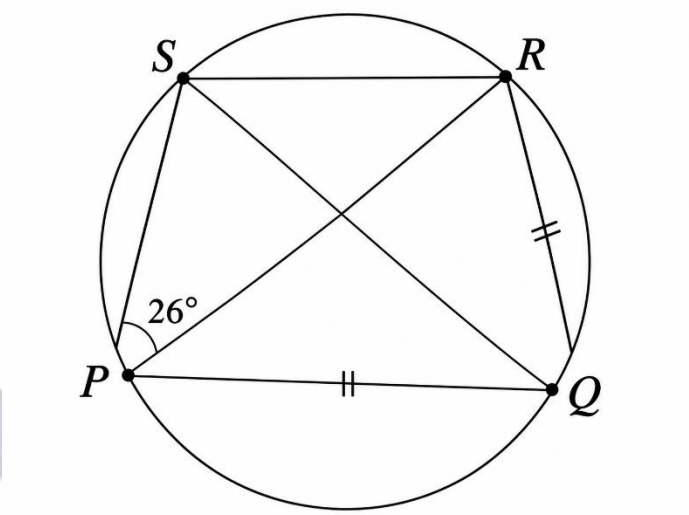
11. The table shows the distribution of the number of hours per day spent in studying by 50 students.

Number of hours per day	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Number of students	5	7	5	9	12	4	3	5

Calculate, correct to two decimal places, the:

(a) mean;

(b) standard deviation.



12. (a) In the diagram, PQRS is a circle, |PQ| = |QS|, ∠SPR = 26° and the interior angles of ΔPQS are in the ratio 2 : 3 : 3. Calculate:

(i) ∠PQR;

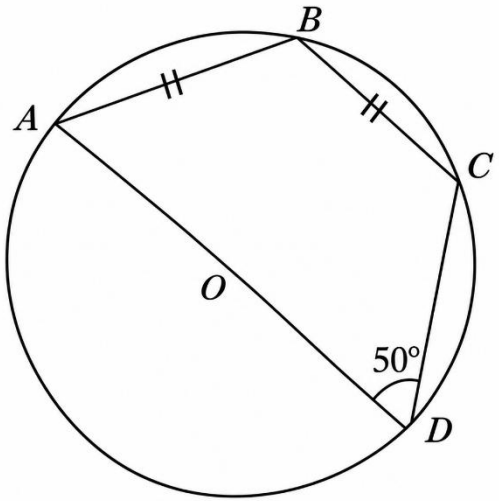
(ii) ∠RPQ;

(iii) ∠PRQ.

(b) The coordinates of two points P and Q in a plane are (7, 3) and (5, x) respectively, where x is a real number. If |PQ| = √29 units, find the value of x.

13. (a) On Sam's first birthday celebration, his grandfather deposited an amount of $1,000.00 in a bank compounded at 4% interest annually. Find how much is in the account if Sam is 4 years old.

(b)



In the diagram, A, B, C and D are points on the circle centre O. If |AB| = |BC| and ∠ADC = 50°, find ∠BAD.

(NOT DRAWN TO SCALE)

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MATHEMATICS ESSAY 2022

SECTION A [40 marks]

Answer all the questions in this section. All questions carry equal marks.

1. (a) Given that (7 − 2x), 9, (5x + 17) are consecutive terms of a Geometric Progression (G.P.) with common ratio, r > 0, find the values of x.

(b) Two positive numbers are in the ratio 3 : 4. The sum of thrice the first number and twice the second is 68. Find the smaller number.

2. Given that y = (pr/m − p²r)^(−3/2),

(a) make r the subject;

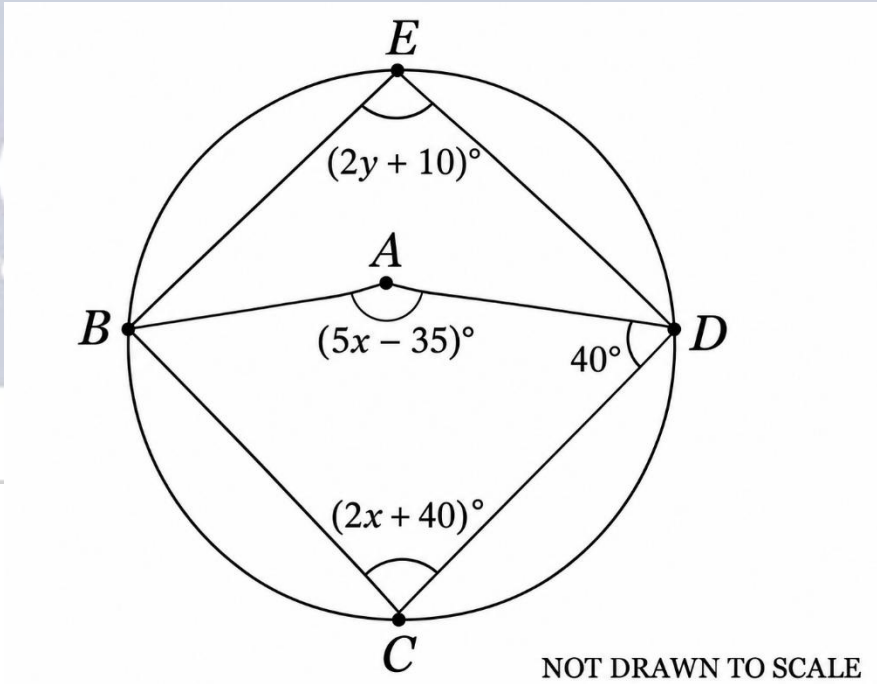
(b) find the value of r when y = −8, m = 1 and p = 3.

3. A chord subtends an angle of 72° at the centre of a circle of radius 24.5 m. Calculate the perimeter of the minor segment. [Take π = 22/7]

4. In the diagram, BCDE is a circle with centre A. ∠BCD = (2x + 40)°, ∠BAD = (5x − 35)°, ∠BED = (2y + 10)° and ∠ADC = 40°. Find:

(a) the values of x and y;

(b) ∠ABC.



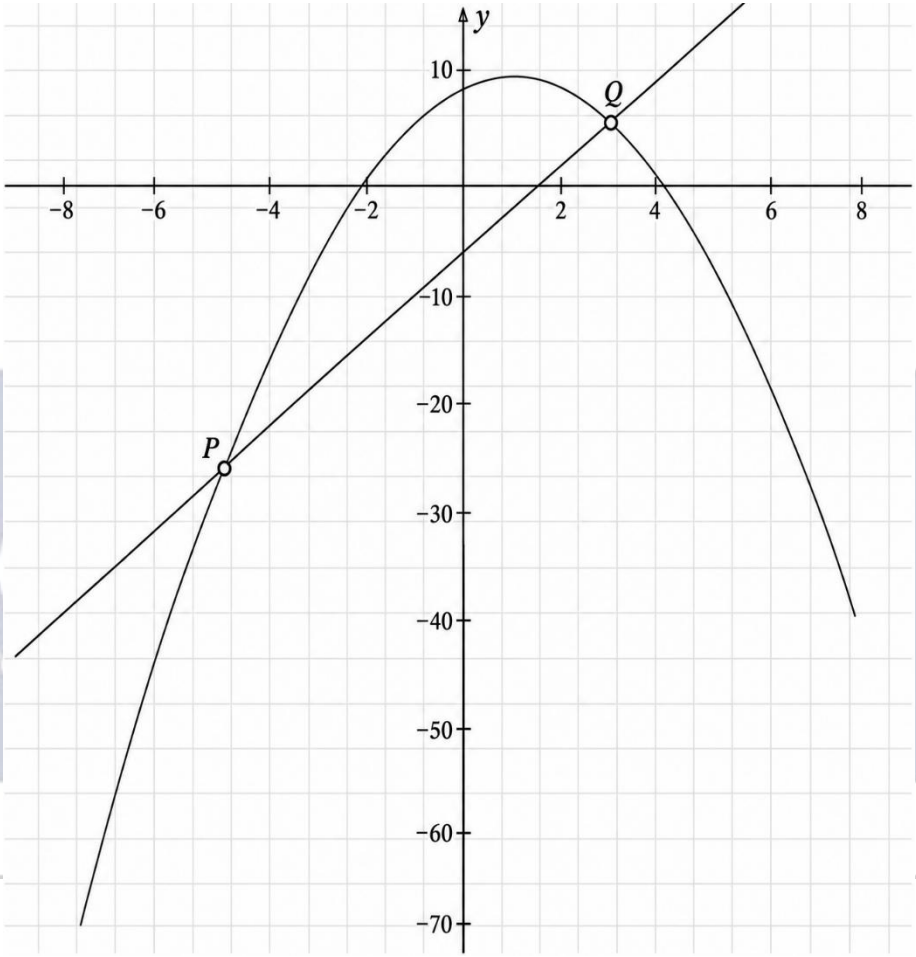
5. (a) Given that m = tan 30° and n = tan 45°, simplify, without using a calculator, (m − n)/(mn), leaving the answer in the form p + √q.

(b) There are 20 women in a bus. 15 of them wear glasses and 10 wear wrist watches. If a woman is chosen at random from the bus, find the probability that she wears both glasses and wrist watch.

SECTION B [60 marks]

Answer five questions only from this section. All questions carry equal marks.

6.



The graph shows the relation of the form $y = mx^2 + nx + r$, where m, n and r are constants. Using the graph:

(a) state the scale used on both axes;

(b) find the values of m, n and r;

(c) find the gradient of the line through P and Q;

(d) state the range of values of x for which $y > 0$.

7. (a) A man purchased 180 copies of a book at ₦250.00 each. He sold y copies at ₦300.00 each and the rest at a discount of 5 kobo

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in the Naira of the cost price. If he made a profit of ₦7,125.00, find the value of y.

(b) A trader bought x bags of rice at a cost, c = 24x + 103 and sold them at a price, s = 33x − $x^2/20$.

(i) Find the expression for the profit.

(ii) If 20 bags of rice were sold, calculate the percentage profit.

8. The table shows the monthly expenditure (in percentage) of Mr. Okafor's salary.

Item	**Food & drinks**	**Fuel**	**Rent**	**Building Project**	**Education**	**Savings**
Percentage (%)	35	7.5	10	15	17.5	x

(a) Calculate the percentage of Mr. Okafor's salary that was put into savings.

(b) Illustrate the information on a pie chart.

(c) If Mr. Okafor's annual gross salary is ₦28,800.00 and he pays tax of 12%, calculate:

(i) his monthly tax;

(ii) the amount saved each month.

9. (a) Copy and complete the table of values for y = 3 sin x + 7 cos x for 0° ≤ x ≤ 180°.

x	**0°**	**20°**	**40°**	**60°**	**80°**	**100°**	**120°**	**140°**	**160°**	**180°**
y	7.0				4.2		−0.9			

(b) SEE DIAGRAM. Using a scale of 2 cm to 20° on the x-axis and 2 cm to 2 units on the y-axis, draw the graph of y = 3 sin x + 7 cos x for 0° ≤ x ≤ 180°.

(c) Using the graph, find:

(i) the value of y when x = 150°;

(ii) the range of values of x for which y > 0.

10. The table shows the distribution of ages of a number of children in a school.

Age (years)	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

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Number of Children	2	6	5	x	6	9	8	5

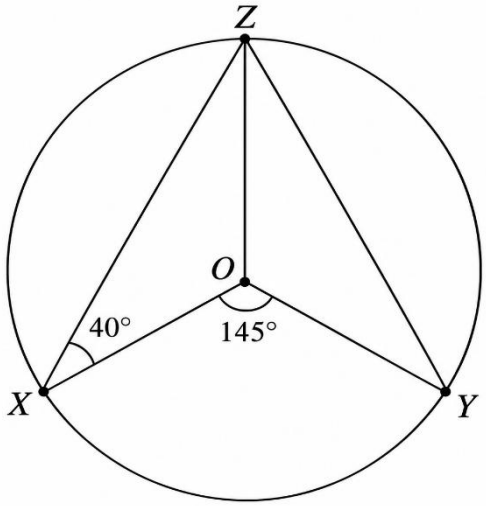
If the mean of the distribution is 7, find the:

(a) value of x;

(b) standard deviation of their ages.

11. (a) The exterior angles of a polygon are 42°, 38°, 57°, x°, (x + y)°, (2x − 15)° and (3x − y)°. If x is 7° less than y, find the values of x and y.

(b)



NOT DRAWN TO SCALE

In the diagram, O is the centre of the circle XYZ. ∠ZXO = 34° and ∠XOY = 146°. Find ∠OYZ.

12. (a) The probability that an athlete will not win any of the three races is 1/4. If the athlete runs in all the races, what is the probability that the athlete will win:

(i) only the second race;

(ii) all the three races;

(iii) only two of the races?

(b) A cone with perpendicular height 24 cm has a volume of 1200 cm^3. Find the volume of a cone with the same base radius and height 84 cm. [Take π = 22/7]

13. (a) The diameter of a cylinder closed at both ends is 7 cm. If the total surface area is 209 cm^2, calculate the height. [Take π = 22/7]

(b) The points X and Y, 19 m apart, are on the same side of a tree. The angles of elevation of the top, T, of the tree from X and Y on the horizontal ground with the foot of the tree are 43° and 38° respectively.

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(i) Illustrate the information in a diagram. SEE DIAGRAM

(ii) Find, correct to one decimal place, the height of the tree.

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PAPER 2 (SC) 2023

SECTION A [40 marks]

Answer all the questions in this section. All questions carry equal marks.

1. (a) A car travels a distance of 112 km at an average speed of 70 km/h. It then travels further for 60 km at an average speed of 50 km/h. Calculate, for the entire journey, the total time taken.

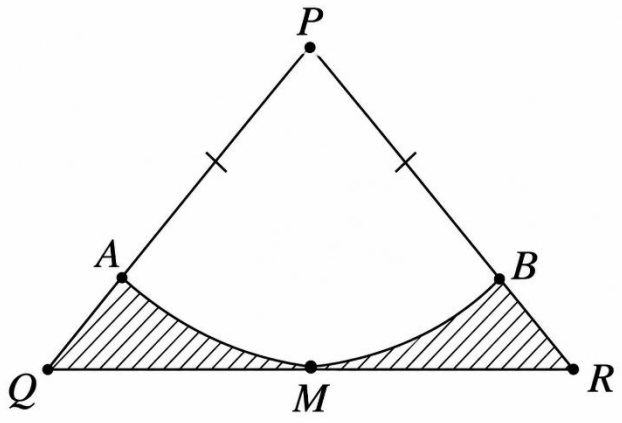
(b) If x/y = 2 and y/z = 3, find the value of (x + y)/(y + z).

2. In a football match, the tickets for children and adults were sold at D 3.00 and D 5.00 respectively. If 400 people attended the football match and D 1,700.00 was collected in ticket sales,

(a) How many tickets were sold to adults?

(b) Mr Sonko sold 250 tickets. If 175 of the tickets were for adults, how much sales did he make altogether?

3. In the diagram, PQR is an equilateral triangle of side 18 cm. M is the midpoint of QR. An arc of a circle with centre P touches QR at M and meets PQ at A and PR at B. Calculate, correct to two decimal places, the area of the shaded region. [Take π = 22/7]



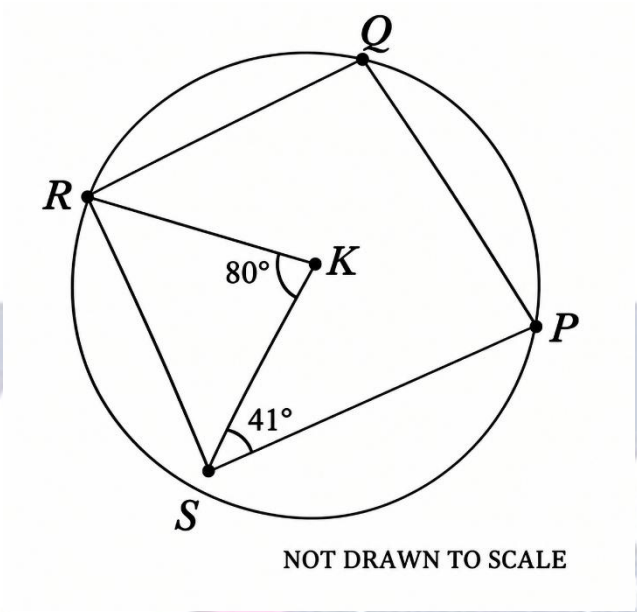
Not Drawn to Scale

4. In the diagram, P, Q, R and S are points on the circle centre K. KR is a bisector of ∠SRQ. ∠KSP = 41° and ∠SKR = 80°. Find:

(a) ∠RQP;

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(b) ∠SPQ.



5. A boy stands at a point M on the same horizontal level as the foot, T, of a vertical building. He observes an object on the top, P of the building at an angle of elevation of 66°. He moves directly backwards to a new point C and observes the same object at an angle of elevation of 53°. If |MT| = 50 m:

(a) illustrate the information in a diagram;

(b) calculate, correct to one decimal place:

(i) the height of the building;

(ii) |MC|.

SECTION B [60 marks]

Answer five questions only from this section. All questions carry equal marks.

6. (a) M = {n : 2n − 3 ≤ 37}, where n is a counting number.

(i) Write down all the elements in M.

(ii) If a number is selected at random from M, what is the probability that it is a:

(α) multiple of 3;

(β) factor of 10.

(b) A shop owner gave an end-of-year bonus to two of his attendants, Kontor and Gapson, in the ratio of their ages. Kontor's age is one and a half times that of Kontor who is 20 years old. If Kontor received Le 200,000.00, find:

(i) the total amount shared;

(ii) Gapson's share.

7. (a) The sum of three numbers is 81. The second number is twice the first. Given that the third number is 6 more than the second, find the numbers.

(b) Given the points P (3, 5) and Q (−5, 7) on the cartesian plane such that R (x, y) is the midpoint of PQ, find the equation of the line that passes through R and perpendicular to PQ.

8. (a) Copy and complete the table of values for $y = 2x^2 - x - 4$ for $-3 \leq x \leq 3$.

x	**−3**	**−2**	**−1**	**0**	**1**	**2**	**3**
y	17			−4			

(b) Using a scale of 2 cm to 1 unit on the x-axis and 2 cm to 2 units on the y-axis, draw the graph of $y = 2x^2 - x - 4$ for $-3 \leq x \leq 3$.

(c) Use the graph to find the:

(i) roots of the equation $2x^2 - x - 4 = 0$;

(ii) values of x for which y increases as x increases;

(iii) minimum point of y.

9.

Height (m)	**3**	**4**	**5**	**6**	**7**	**8**
Number of trees	4	6	4	5	6	2

The table shows the height of teak trees harvested by a farmer.

(a) Find the median height.

(b) Calculate, correct to one decimal place, the:

(i) mean;

(ii) standard deviation.

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10. In a town, Chief X resides 60 m away on a bearing of 057° from the palace P, while Chief Y resides on a bearing of 150° from the same palace P. The residence of X and Y are 180 m apart.

(a) Illustrate the information in a diagram.

(b) Find, correct to three significant figures, the:

(i) bearing of X from Y;

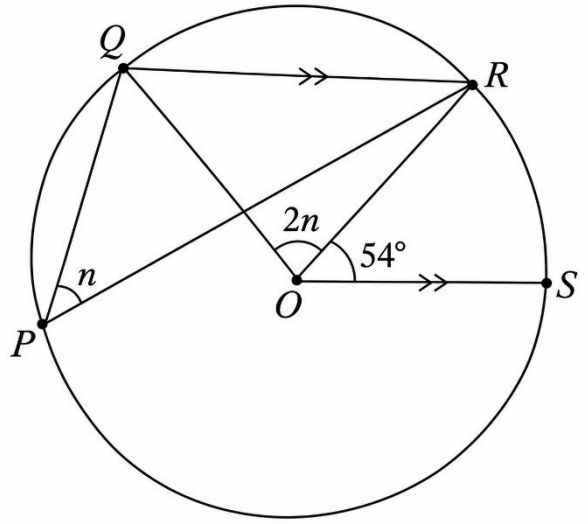
(ii) distance between P and Y.

11. (a) Two regular polygons P and Q are such that the number of sides of P is twice the number of sides of Q. The difference between the exterior angle of Q and P is 45°. Find the number of sides of P.

(b) The area of a semi-circle is 32π cm². Find, in terms of π, the circumference of the semi-circle.

12. (a) In the diagram, P, Q, R and S are points on the circle with centre O. QR // OS, ∠QOR = 2m, ∠QPR = n and ∠SOR = 54°. Find the values of m and n.

(b)

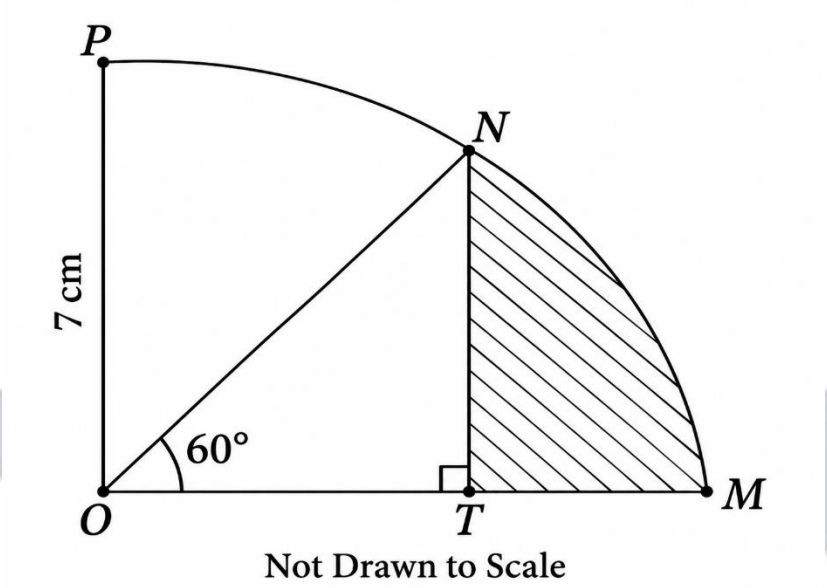


NOT DRAWN TO SCALE

The length of a rectangle is 4 cm more than the width. If the perimeter is 40 cm, find the area.

13. (a) In the diagram, the radius of the sector of circle centre O, is 7 cm and ∠MON is 60°. Find, correct to one decimal place, the area of the shaded portion. [Take π = 22/7]

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(b) The x and y intercepts of a straight line are −3/4 and 2/7 respectively. Find the equation of the line.

GENERAL MATHEMATICS (SC) 2024

SECTION A

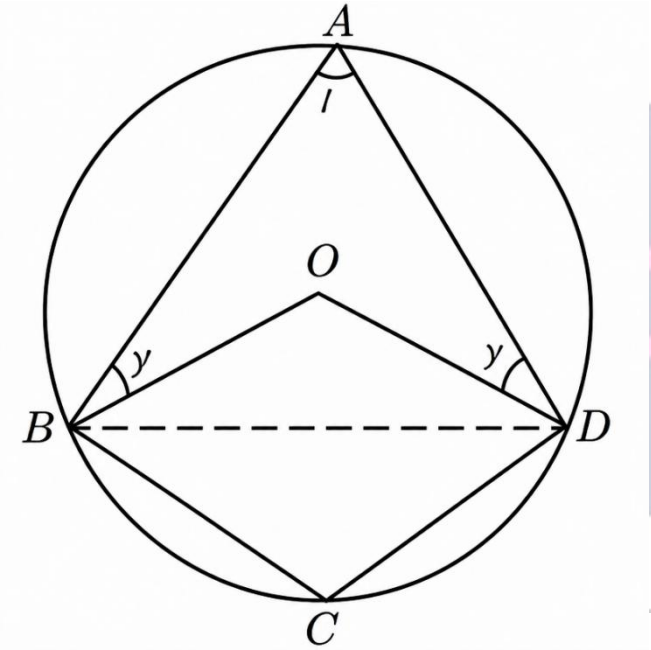
Answer all the questions in this section. All questions carry equal marks. [40 marks]

1. The time taken to buy fuel at a filling station varies directly as the number of vehicles (V) in a queue and varies inversely as the number of pumps (p), available at the station. In a station with 5 pumps, it took 10 minutes to fuel 20 vehicles. Find the:
(a) relationship between t, p and V;
(b) time it takes to fuel 50 vehicles at a station with 2 pumps;
(c) number of pumps required to fuel 40 vehicles in 20 minutes.

2. A car travelled a distance of (2x + 13) km at 67.5 km/h and (5x − 20) km at 72 km/h. If the total time for the entire journey was 90 minutes, find the value of x.

3. A circular floor of a building is to be tiled with ceramic tiles each of side 40 cm × 40 cm. If the perimeter of the floor is 66 m, calculate, correct to the nearest whole number, the number of tiles required to completely tile the floor. [Take π = 22/7]

4.



In the diagram, ABCD is a circle centre O. The quadrilateral OBCD is a rhombus such that ∠ADO = ∠OBA = y and ∠BAD = r. Find:
(a) the value of r;
(b) the value of y;

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(c) ∠ADC.

(NOT DRAWN TO SCALE)

5. A basket contains 3 gold-plated marbles, 4 diamond marbles and some silver marbles, all of the same size and shape. Two marbles were drawn from the basket at random one after the other without replacement. If the probability that the two marbles were all silver is 1/15, find the number of silver marbles.

SECTION B

[60 marks]

Answer five questions only from this section. All questions carry equal marks.

6. Given that (x + 2), (4x + 3) and (7x + 24) are consecutive terms of a Geometric Progression (G.P), find the:

(a) value of x;

(b) common ratio.

7. The table shows the ages of 20 children in a household.

Age	**5**	**6**	**7**	**8**	**9**	**10**
Frequency	2	2x − 1	y + 2	4	2	y − 1

Given that x : y = 1 : 2, find the:

(a) values of x and y;

(b) mean age of the children.

8. Two observers Abu and Badu, 46 m apart, observe a bird on a vertical pole from the same side of the bird. The angles of elevation of the bird from Abu's and Badu's eye are 40° and 48° respectively. If at the foot of the pole, Abu and Badu are on the same horizontal:

(a) illustrate the information in a diagram; SEE DIAGRAM

(b) calculate, correct to one decimal place, the height of the pole.

9. The diameter of a circle centre O is 26 cm. If a chord PQ is drawn such that it is 5 cm from O to the centre of the chord, calculate, correct to the nearest whole number, the:

(a) ∠POQ;

(b) area of the minor segment formed by the chord PQ.

[Take π = 22/7]

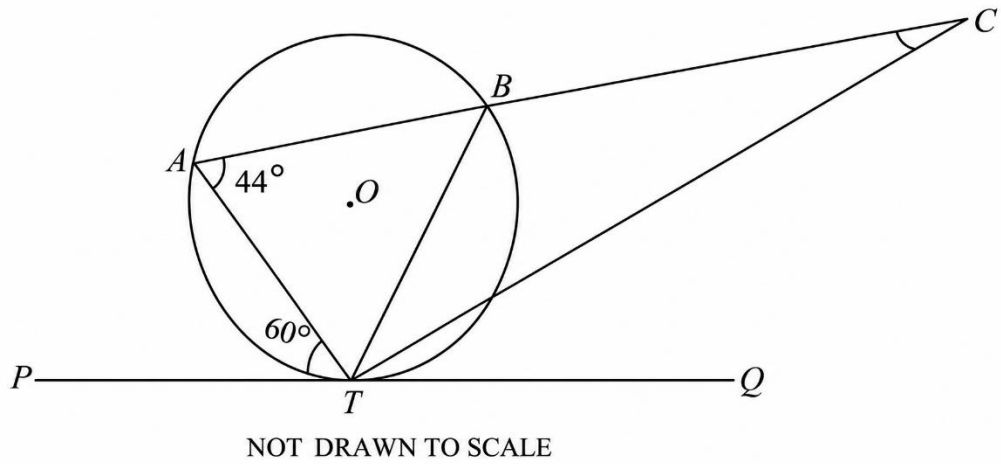
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10. (a) In a man's will, he gave 2/5 of the total acres of his cocoa farm to the wife and 1/3 of what is left to the family. The rest of the farm was to be shared amongst his three children in the ratio 3 : 5 : 2. Given that the child who had the least share received 8 acres, calculate the:

(i) total acres the man left;

(ii) number of acres the wife received.

13.



NOT DRAWN TO SCALE

(a) In the diagram, ABT is a circle centre O. PQ is a tangent to the circle at T and ABC is a straight line. TC bisects ∠BTQ, ∠BAT = 44° and ∠PTA = 60°. Find ∠ACT.

((b) The circumference of the base of a cylindrical tank is 11 m. The height of the tank is 3 m more than 6 times the base radius. Calculate the:

(i) radius; (ii) height; (iii) volume of the tank.

[Take π = 22/7]

ANSWERS TO WASSCE JUNE 2015 GENERAL MATHEMATICS 2 ESSAY (THEORY)

PART ONE

A1. (a) $3\frac{4}{9} \div (5\frac{1}{3} - 2\frac{3}{4}) + 5\frac{9}{10}$

Changing all to improper fractions:

31/9 ÷ (16/3 − 11/4) + 59/10

= 31/9 ÷ ((64−33)/12) + 59/10

= 31/9 ÷ 31/12 + 59/10

= 31/9 × 12/31 + 59/10

= 12/9 + 59/10

= (120+531)/90 = 651/90 = 217/30

= 7 7/30

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(b) Table for $\oplus$ on {1,3,5} and {2,3,4:

$\oplus$	**2**	**3**	**4**
1	3	4	5
3	5	6	7
5	7	8	9

Sums greater than 3 and less than 7 are: 4, 5, 5, 6 = 4 numbers

Probability = 4/9

2. (a) $4 + \frac{3}{4}(x+2) \leq \frac{3x}{8} + 1$

Multiplying through by 8: $32 + 6(x+2) \leq 3x + 8$

$32 + 6x + 12 \leq 3x + 8$

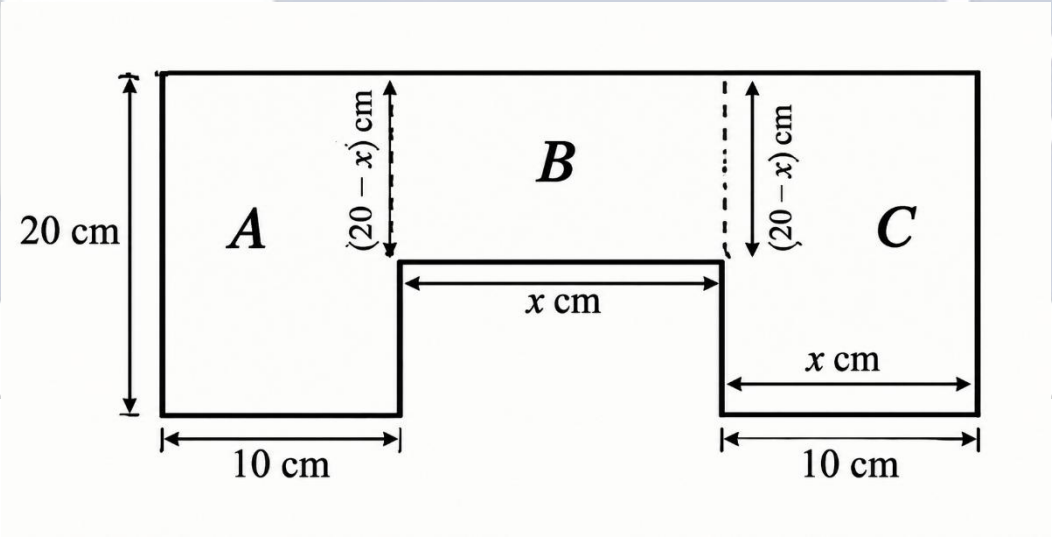
$44 + 6x \leq 3x + 8$

$6x - 3x \leq 8 - 44$

$3x \leq -36$

$x \leq -12$

(b) (shows rectangle split into regions A, B, C)



Areas of A, B, C: $(20\times10) + (20-x)x + (20\times10) = 484$

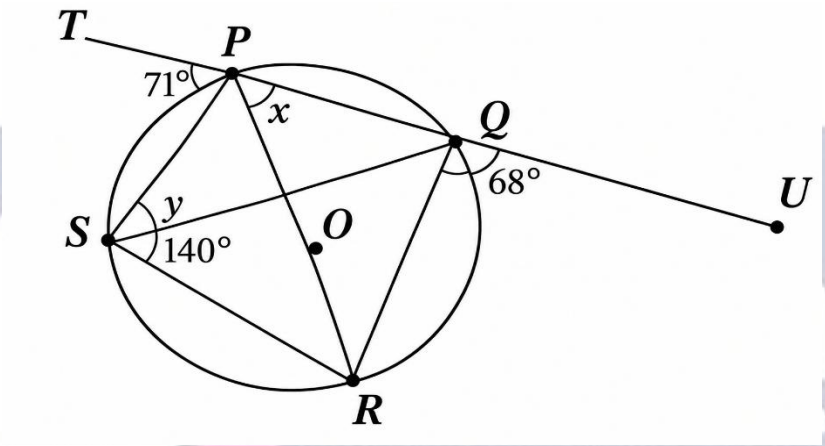
$200 + 20x - x^2 + 200 = 484$

$400 + 20x - x^2 = 484$

$x^2 - 20x + 84 = 0$

$(x-6)(x-14) = 0$

$x = 6$ cm or $x = 14$ cm



3. (a) Let interior angle = x, exterior angle = y

Ratio $x/y = 5/2 \rightarrow 2x = 5y$

Also, $x + y = 180°$ (angles on a straight line)

$5y/2 + y = 180$

$7y = 360 \rightarrow y = 360/7$

Number of sides $= 360 \div (360/7) = 7$

(b)

$y + 40 = 68$ (exterior angle of cyclic quadrilateral) → $y = 28°$

$\angle RPQ = 40°$ (angle in same segment)

$74 + x + 40 = 180$ (angles in a triangle) → $x = 66°$

$\angle PRS = 180 - (40+28+66) = 180 - 134 = 46°$

4. (a) $3\frac{3}{3} + 2\frac{1}{5} = 11/3 + 11/5 = (55+33)/15 = 88/15$

$7 - 88/15 = (105-88)/15 = 17/15 = 1\ 2/15$

(b)(i) $h = 6 + 4\cos(15p)°$, when $p = 4$:

$h = 6 + 4\cos60° = 6 + 4(½) = 6 + 2 = 8$ m

(ii) When $h = 9$: $9 = 6 + 4\cos(15p)°$

$3 = 4\cos15p \rightarrow \cos15p = 0.75$

$15p = \cos^{-1}(0.75) = 41.409°$

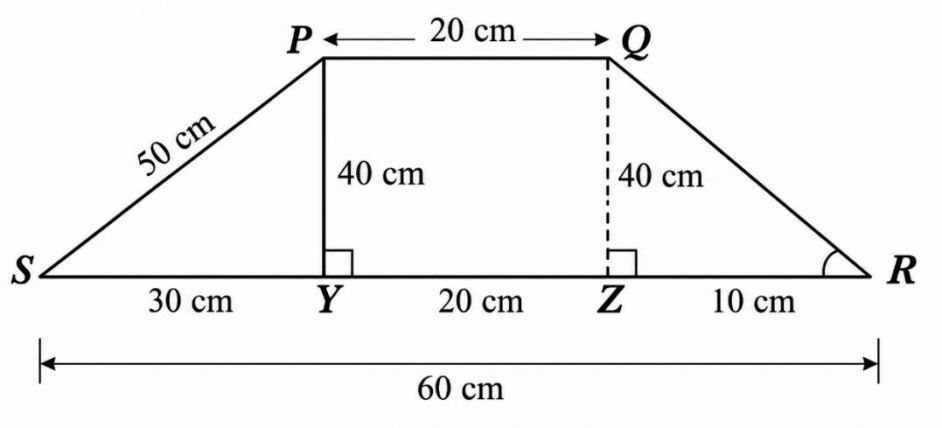
$p = 41.409/15 = 2.8$

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5. (trapezium with drop perpendiculars)

(a) Area = ½(sum of parallels)×height = ½(20+60)×40 = ½(80)(40) = 1600 cm²



(b) In ΔPSY (Pythagoras): $|SY|^2 = 50^2 - 40^2 = 2500-1600 = 900 \rightarrow |SY| = 30$ cm

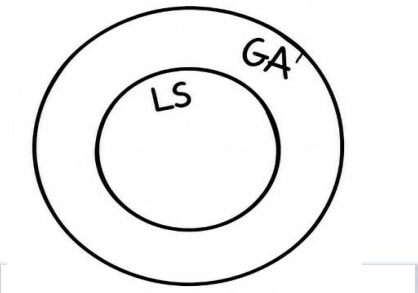
In ΔQZR: TanQRS = 40/10 = 4.000 → ∠QRS = $Tan^{-1}(4.000) = 76°$

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SECTION B

6.

(a)



Let GA represent General Art Class

Let LS represent All good literature students

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(Venn diagram: GA circle containing LS circle)

(i) Not valid (ii) Not valid (iii) Valid

x	-3	-2	-1	0	1	2	3	4	5
y	9	21	6	-5	-12	-15	-14	-7	13

(b) C = h + kn (y varies directly as n)

When c=950, n=600: 950 = h + 600k …(1)

When c=1030, n=1000: 1030 = h + 1000k …(2)

Subtracting: 80 = 400k → k = 0.2

From (1): 950 = h + 120 → h = 830

Relationship: C = 830 + ⅕n

(ii) When n=500: C = 830 + ⅕(500) = 830+100 = GH¢930.00

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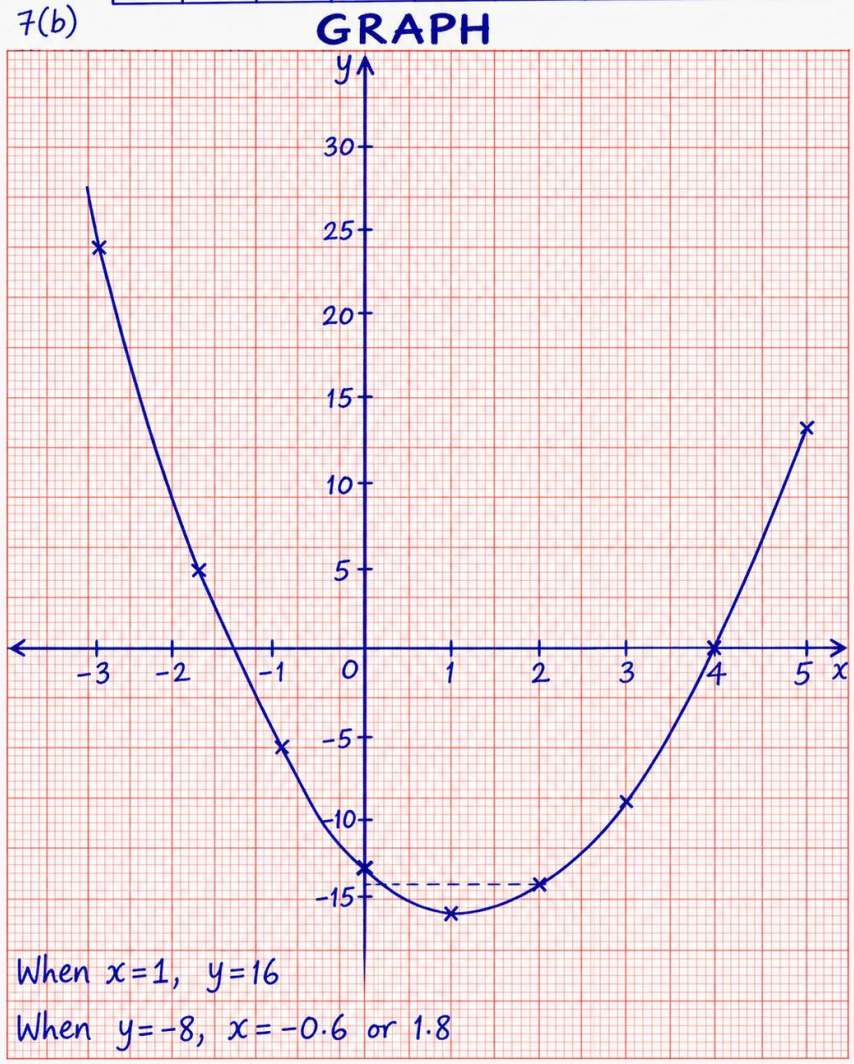
7. Table:

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7. Graph of $y = 2x^2 - 5x - 12$

x	-3	-2	-1	0	1	2	3	4	5
y	27	6	-5	-12	-16	-14	-9	0	13

7(b)



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(a) $y = px^2 - 5x + q$

When y=0, x=4: $16p + q = 20$ …(1)

When x=0, y=−12: $q = -12$

Substituting into (1): $16p - 12 = 20 \rightarrow p = 2$

Relation: $y = 2x^2 - 5x - 12$

Completed values: x=−1→y=−5; x=1→y=−15; x=2→y=−14; x=3→y=−9

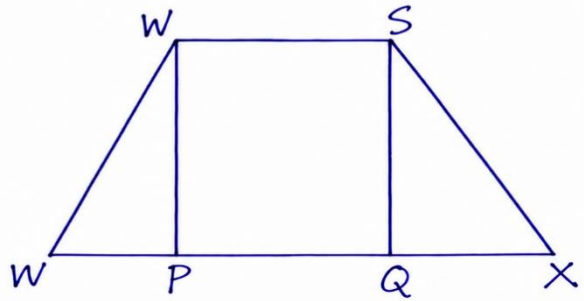
(b)

(c) (i) When x = 1.8, y = −14.5

(ii) When y = −8, x = −0.6 or 1.8

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8(a)



(b)(i) $|QX| = 2.8\text{cm}$

(ii) $\angle XWZ = 75°$

(construction of trapezium WXYZ and rectangle PQYZ)

(b)(i) |QX| = 2.8 cm

(ii) ∠XWZ = 75°

9. (a) a = −8, $T_7/T_9 = 5/8$ (T_7=a+6d, T_9=a+8d)

(−8+6d)/(−8+8d) = 5/8

Cross-multiplying: 8(−8+6d) = 5(−8+8d)

−64+48d = −40+40d

8d = 24 → d = 3

(b) Let P = cost of pawpaw basket, M = cost of mangoes basket

30P + 100M = 2450 …(1)

Profit relation gives SP(pawpaw) = 42P, so profit = 12P

Profit relation gives SP(mangoes) = 130M, so profit = 30M

12P + 30M = 855 …(2)

Multiplying (1)×2 and (2)×5:

60P+200M=4900 …(3)

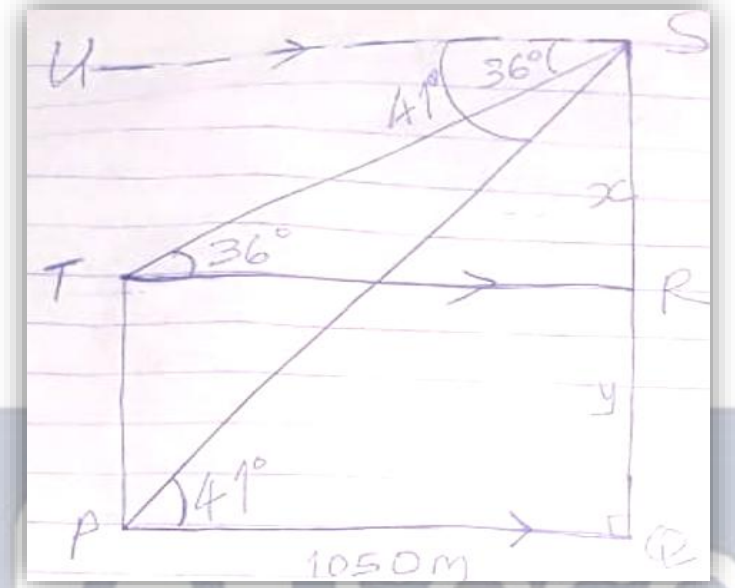
60P+150M=4275 …(4)

Subtracting: 50M = 625 → M = 12.5 (cost price of mangoes = ₦12.50)

Substitute into (2): 12P + 375 = 855 → P = 480/12 = ₦40.00 (i)

(ii) Selling price for 100 baskets of mangoes = 100 × 130(12.5)/100... = 130×12.5 = ₦1625.00

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10. (a) (2tan60° + cos30°)/sin60°

= (2√3 + √3/2) ÷ (√3/2)

= (5√3/2) × (2/√3)

= 5

(b)(i) (control tower/aeroplane setup)

In ΔSPQ: x+y = 1050 Tan41° = 1050(0.8693) = 912.765 m

In ΔSTR: x = 1050 Tan36° = 1050(0.7265) = 762.825 m

Height of control tower = 912.765 − 762.825 = 149.940 ≈ 150 m

(ii) Shortest distance between aeroplane and base of tower = x+y = 912.765 ≈ 913 m

11. (a) $h = mt/(d(m+p))$

$hd(m+p) = mt$

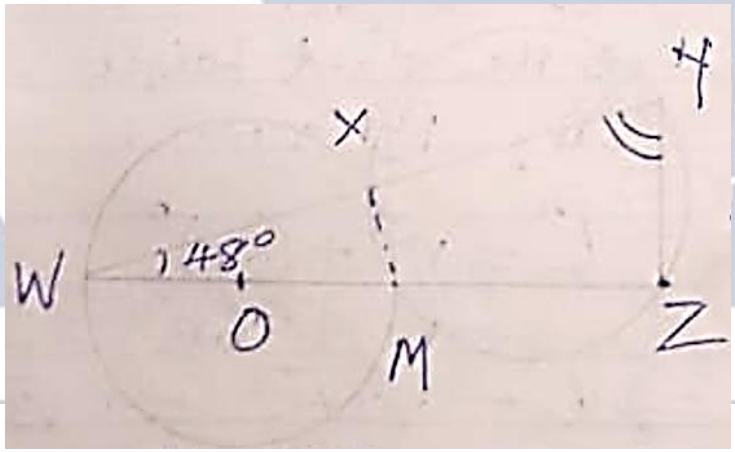
$hdm + hdp = mt$

$hdp = mt - hdm = m(t-hd)$

$m = hdp/(t-hd)$

(b)

Draw line XM. ∠WXM = 90° (angle in a semicircle)



∠WMX = 180 − (90+48) = 42° (angles in a triangle)

∠XMZ = 180 − 42 = 138° (angles on a straight line)

XYZM is a cyclic quadrilateral: ∠XMZ + ∠XYZ = 180

∠XYZ = 180 − 138 = 42°

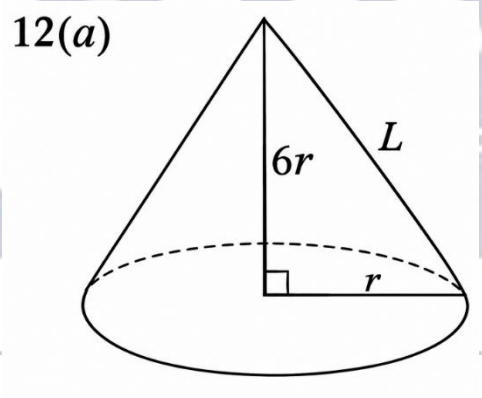
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(c)(i) Table for m⊛n = m+n+2 (mod 7):

⊛	**1**	**3**	**5**	**6**
1	4	5	1	2
3	6	1	3	4
5	1	3	5	6
6	2	4	6	0

(ii) I. 3⊛n = 3 → n = 5

II. n⊛n = 3 → n = Ø (no solution)



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2. (a) (cone on hemisphere)

If base radius = r, height of cone = 6r; slant height L: $L^2 = r^2 + 36r^2 = 37r^2 \rightarrow L = r\sqrt{37}$

Volume = $\frac{1}{3}\pi r^2(6r) + \frac{2}{3}\pi r^3$

$333\frac{1}{3}\pi = 2\pi r^3 + \frac{2}{3}\pi r^3 = 8/3\ \pi r^3$

$r^3 = 1000/8 \rightarrow r = 5$ m

(b)(i) Volume of hemisphere = $\frac{2}{3}\pi r^3 = \frac{2}{3} \times 22/7 \times 125 = 5500/21 = 262\ m^3$

(ii) TSA = $\pi rl + 2\pi r^2 = \pi r(r\sqrt{37}) + 2\pi r^2$

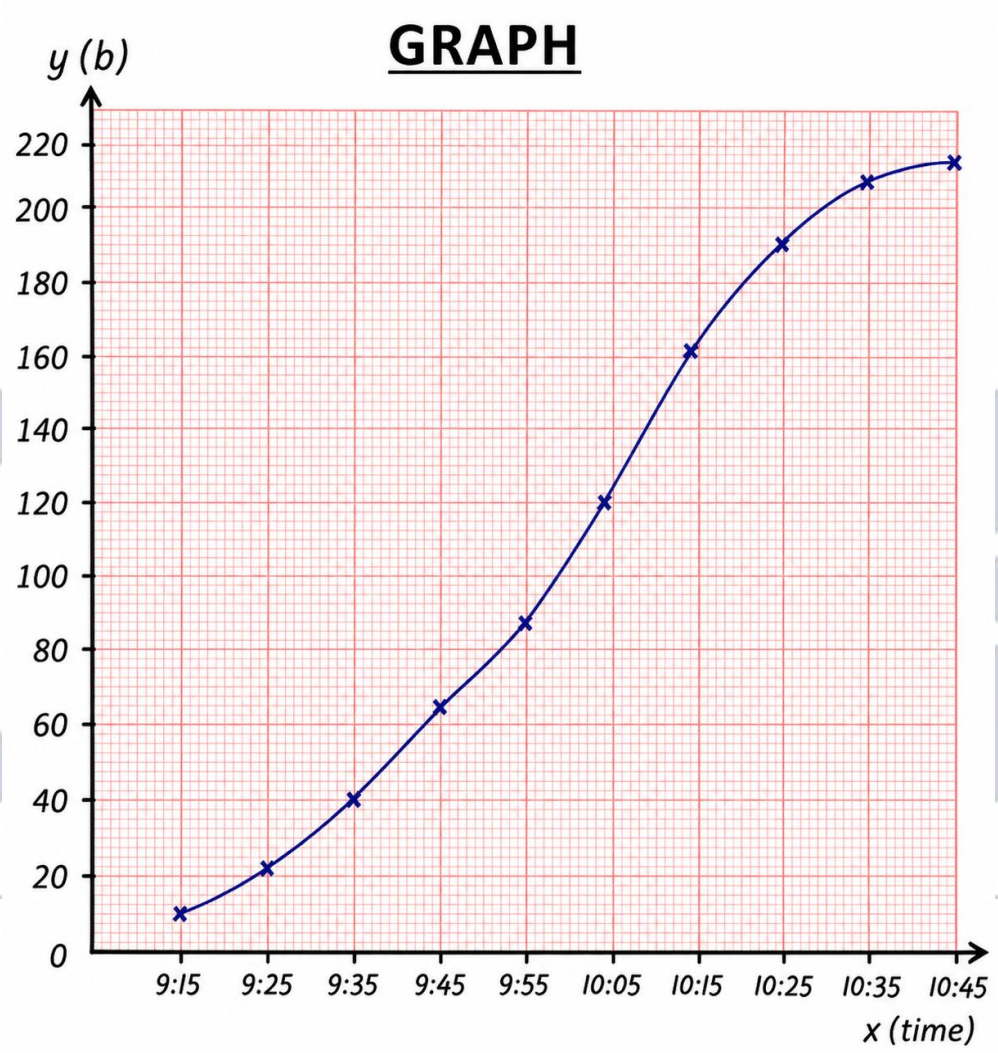
$= (22 \times 25\sqrt{37})/7 + (44 \times 25)/7$

$= 3345.65/7 + 1100/7 = 4445.65/7 = 635\ m^2$

13. (a) Cumulative frequency table:

Marks%	Freq	Class Boundaries	Cum. Freq
0–9	7	–0.5–9.5	7
10–19	11	9.5–19.5	18
20–29	17	19.5–29.5	35
30–39	20	29.5–39.5	55
40–49	29	39.5–49.5	84
50–59	34	49.5–59.5	118
60–69	30	59.5–69.5	148
70–79	25	69.5–79.5	173
80–89	21	79.5–89.5	194
90–99	6	89.5–99.5	200

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GRAPH
y (b)
220
200
180
160
140
120
100
80
60
40
20
0
9:15
9:25
9:35
9:45
9:55
10:05
10:15
10:25
10:35
10:45
x (time)

(ogive/cumulative frequency curve)

(b)(i) 5% of 200 = 10 candidates → fall within class boundary 79.5–89.5

Lowest mark for distinction = 79.5%

(ii) Candidates scoring at most 45% fall within 39.5%–49.5% boundary

Probability = 29/200 = 0.145

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ANSWERS TO WASSCE JUNE 2016 GENERAL MATHEMATICS 2 ESSAY (THEORY)

PART I

1(a) $(0.09 \times 1.21) / (3.3 \times 0.00025)$

$= (9.0 \times 10^{-2} \times 1.21) / (3.3 \times 2.5 \times 10^{-4})$

$= (9.0 \times 1.21 \times 10^{-2-(-4)}) / (3.3 \times 2.5)$

$= (10.89 \times 10^{-2+4}) / 8.25$

$= (10.89 \times 10^{2}) / 8.25$

$= \mathbf{1.32 \times 10^{2}}$

[Long division shown: 1089 ÷ 825 = 1.32]

1(b) P = GH¢5,600; T = 3 yrs; I = GH¢1,200; R = ?

Using I = PRT/100

⇒ R = (100 × I)/(P × T) = (100 × 1,200)/(5,600 × 3) = 120000/16800 = 7.142

R = 7.14%

Interest rate per annum = (P × T × R)/100

= (5600 × 1 × 7.14)/100

= 56 × 7.14

= 399.84

≈ **GH¢400**

2(a) $7(x + 4) - \frac{2}{3}(x - 6) \leq 2\{2x - 3(x + 5)\}$

$7x + 28 - \frac{2}{3}x + 4 \leq 2(2x - 3x - 15)$

$7x + 28 - 2x/3 + 4 \leq 2x - 6x - 30$

$7x - 2x/3 - 2x + 6x \leq -30 - 4 - 28$

$(21x - 2x - 6x + 18x)/3 \leq -62$

$31x/3 \leq -62$

$\Rightarrow 31x \leq 3(-62)$

$31x \leq -186$

$\therefore \mathbf{x \leq 6}$ *(as written — note: this should be $x \leq -6$; see flag below)*

2(b) Let the number of tricycles be x; let the number of taxicabs be y.

From the 1st sentence: x + y = 20 … ①

From the 2nd sentence: 2x + 4y = 66 … ②

Solving simultaneously:

x + y = 20 … ×2

2x + 4y = 66 … ×1

2x + 2y = 40

2x + 4y = 66 (subtracting)

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$-2y = -26$

$\Rightarrow y = -26/-2 = 13$

Put y = 13 in equation ①: $x + 13 = 20$

$\therefore x = 20 - 13 = 7$

$\Rightarrow$ **The number of tricycles = 7**

3(a) Joining point U to R:

$\Rightarrow \angle VUR = 46°$ — angle in alternate segment

$\angle RUS = 28°$ — same reason

Hence, **$\angle VUS = 46 + 28 = 74°$**

3(b) Total Surface Area of a Cylinder = $2\pi rh + \pi r^2$

$\Rightarrow 462 = \pi r(2h + r)$

$= (22/7)r(2(7) + r)$

$7(462) = 22r(14 + r)$

$\Rightarrow 3234 = 308r + 22r^2$

Rearranging to get a quadratic equation:

$22r^2 + 308r - 3234 = 0$

Dividing through by 22: $r^2 + 14r - 147 = 0$

$r^2 - 7r + 21r - 147 = 0$

$r(r - 7) + 21(r - 7) = 0$

$(r - 7)(r + 21) = 0$

Hence, either $r - 7 = 0 \Rightarrow r = 7cm$, or $r + 21 = 0 \Rightarrow r = -21cm$

Since radius cannot be negative, therefore **radius = 7cm**

4(a) Total frequency = 25 + 30 + x + 28 + 40 + 32 = 155 + x

If probability of obtaining a 3 is 0.225

$\Rightarrow 0.225 = x/(155 + x)$

Such that $0.225(155) + 0.225(x) = x$

$\Rightarrow 34.875 = x - 0.225x$

$34.875 = 0.775x$

$\therefore x = 34.875/0.775 = 45$

$\Rightarrow$ **x = 45**

The die was thrown for (25 + 30 + 45 + 28 + 40 + 32) times = **200 times**

4(b) Pr (Even or Prime)

$\Rightarrow 175/200 = 35/40 =$ **7/8**

5(a) Area of $\triangle PSR = 36cm^2$

$\Rightarrow$ ½(Base) × H = 36

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⇒ ½ × B/1 × 6/1 = 36

6B/2 = 36/1

⇒ 6B = 2(36)

∴ B = 72/6 = 12

⇒ Base = 12cm

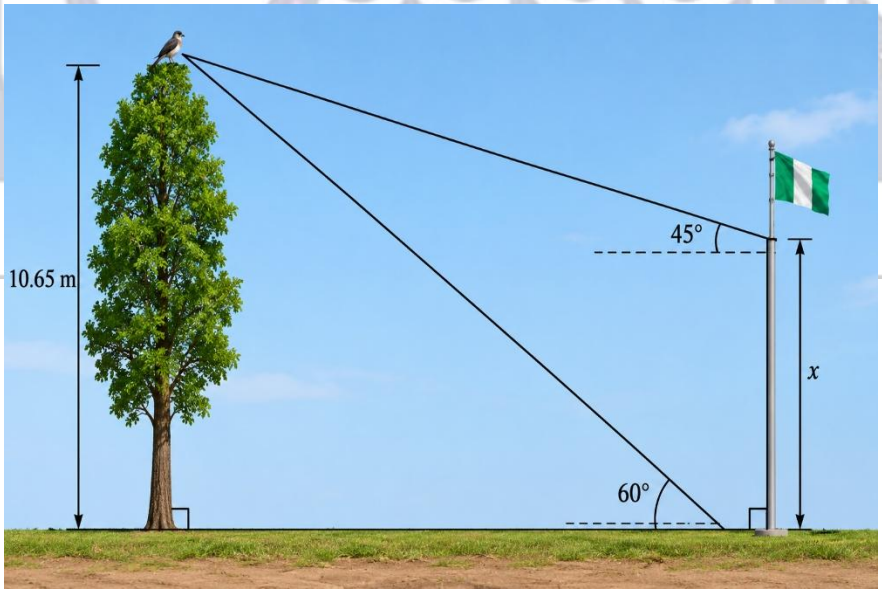
But |PQ| + |QR| = |PR| (Base) = 12

⇒ **|QR| = 12 − 8 = 4cm**

5(b)

Let |ST| = Tree = 10.65m; |PQ| = Flagpole = x

(10.65 − x)/Tan 45 = 10.65/Tan 60



⇒ (10.65 − x)/1 = 10.65/1.732

⇒ 10.65(1.732) − 1.732x = 10.65

18.4458 − 10.65 = 1.732x

= 7.7958 = 1.732x

∴ x = 7.7958/1.732 = 4.50104

⇒ **The Flagpole = 4.50cm high** *(units as written; presumably metres)*

PART II

6(a) Sum of 1, 3, 5, … 101

a = 1, d = 2, l = 101

Using $S_n = n/2 (a + l)$

But $T_n = a + (n − 1)d = l$

⇒ $T_n = 1 + (n − 1)2 = 101$

= 1 + 2n − 2 = 101

= 2n − 1 = 101

2n = 101 + 1

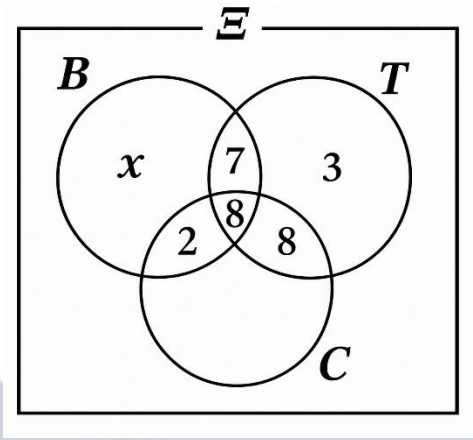
2n = 102

∴ n = 102/2 = 51

Sum, S_n = 51/2 (1 + 101) = 51/2 (102) = 51 × 51 = **2,601**

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6(b)



(i) (Venn diagram with three sets B, T, C)

Let Bus = B, Let Train = T, Let Car = C

n(ε) = 95, n(B) = 47, n(T) = 30

(ii) n(B) = x + x + 8 + 7 = 47

⇒ 2x + 15 = 47

2x = 47 − 15

⇒ 2x = 32

∴ x = 32/2 = 16

Number who travelled by at least two means = x + 3 + 7 + 8

= 16 + 3 + 7 + 8 = 34

Hence, **34 people travelled by at least two means**

7(a) (x − 2)/4 = (x + 2)/2x

2x(x − 2) = 4(x + 2)

$2x^2 - 4x = 4x + 8$

$2x^2 - 4x - 4x - 8 = 0$

$2x^2 - 8x - 8 = 0$

Dividing through by 2: $x^2 - 4x - 4 = 0$

$x^2 - 4x = 4$

$x^2 - 4x + k = 4 + k$ (where k makes it a perfect square)

$x^2 - 4x + (-4/2)^2 = 4 + (-4/2)^2$

$(x - 2)^2 = 4 + (-2)^2$

$(x - 2)^2 = 4 + 4$

$(x - 2)^2 = 8$

$x - 2 = \sqrt{8}$

⇒ $x = 2 \pm \sqrt{8} = 2 \pm 2.828$

= 4.828 or −0.828

∴ **x = 4.83 or −0.83**

7(b)(I) SEE DIAGRAM (cyclic quadrilateral PQRS)

∠SPQ = 52° — angles in same segment

In cyclic quadrilateral PQRS: ∠QRS = 180° − 52° — opposite angles of

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cyclic quad

⇒ **∠QRS = 128°**

(II) In △QRS: ∠RQS = ∠RSQ = (180 − 128)/2 = 26°

Hence, ∠SQT = 26° — alternate angle

But ∠PQS = 90° — angle subtended by a semicircle

⇒ ∠PQT = 90° − 26° = **64°**

8(a) SEE DIAGRAM — x + y = ∠JKM (exterior angle of a triangle)

But ∠KGJ = 180 − 110 (sum of angles in △)

⇒ ∠KGJ = 70°

In △JKG: r + (x + y) + 70 = 180° (sum of angles in a △)

⇒ r + x + y + 70 = 180 … ①

Since y = 2x = r

Substituting in equation ①, we have:

2x + x + 2x + 70 = 180

⇒ 5x + 70 = 180

5x = 180 − 70

⇒ 5x = 110

∴ x = 110/5 = **22°**

8(b) Let the total collections for girls = x

Implying that total for boys = x + 600

⇒ For ten boys, Average = (x + 600)/10

For twelve girls, Average = x/12

Suppose y represents the average, then:

y + 100 = (x + 600)/10 (for Boys)

and y = x/12 (for Girls)

Such that: 10(y + 100) = x + 600

or 10y + 1000 = x + 600 … ①

and 12y = x … ②

Substituting x = 12y in equation ①:

10y + 1000 = 12y + 600

⇒ 12y − 10y = 1000 − 600

2y = 400

∴ y = 400/2 = 200

To find the value of x, recall that x = 12y

⇒ x = 12(200) = 2,400

Hence, total for Girls = x = 2,400

Total for Boys = 2400 + 600 = 3,000

∴ Total sum collected by the groups = 2,400 + 3,000 = **5,400**

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9(a) Frequency table:

Weight (x)	Frequency (f)	fx	$(x - \bar{x})$	$(x - \bar{x})^2$
62	1	62	−3.06	9.3636
63	5	315	−2.06	4.2436
64	12	768	−1.06	1.1236
65	14	910	−0.06	0.0036
66	10	660	0.94	0.8836
67	6	402	1.94	3.7636
68	2	136	2.94	8.6436
Total	**50**	**3253**		**28.0352**

9(b)(i) Mean $(\bar{x}) = \Sigma fx/\Sigma f$

$\Rightarrow \bar{x} = 3253/50 =$ **65.06**

(ii) Standard Deviation S.D. $= \sqrt{[\Sigma(x - \bar{x})^2/\Sigma f]}$

$= \sqrt{(28.0352/50)}$

$= \sqrt{0.560704}$

$= 0.74880 \approx$ **0.75**

10(a) SEE DIAGRAM — Construction showing triangle XY with angles 45° at X and 30° at Y, point M, point Z, with construction arcs and loci l_1 and l_2 marked.

10(c) ∠ZMY = 120°

11(a) $(3p + 4q)/(3p - 4q) = 2$

$2(3p - 4q) = 3p + 4q$

$\Rightarrow 6p - 8q = 3p + 4q$

$6p - 3p = 4q + 8q$

$3p = 12q$

Dividing through by 3: $3p/3 = 12q/3$

$1p = 4q$

Hence, $p/q = 1/4$

Ratio of p : q = 1 : 4

11(b)(i) Let the radius of the semicircle be x, such that the length of PQ $= 2 + x + x + 2 = (4 + 2x)$m

Now, the circumference of the semicircle will be $2\pi r/2 = \pi r = \pi x$ $(r = x)$

$\Rightarrow$ Circumference $= \pi x = (22/7)x$

If perimeter of the cross section = 34m, it implies that:

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|PQ| + |PU| + |UT| + Arc TS + |TS| + |SR| + |RQ| = 34

4 + 2x + 4 + 2 + (22/7)x + 2x + 2 + 4 = 34

4 + 4 + 2 + 2 + 4 + 2x + 2x + (22/7)x = 34

⇒ 16 + 4x + (22/7)x = 34

7(4x) + 22x = 34 − 16

⇒ (28x + 22x)/7 = 18

50x = 7(18)

50x = 126

⇒ x = 126/50 = 2.52m

Length of |PQ| = 4 + 2x = 4 + 2(2.52) = 4 + 5.04 = 9.04

∴ **|PQ| = 9.0m**

(ii) Area of Cross Section = Area of Rectangle − Area of semicircle

= L × B − ½πr²

= 9 × 4 − ½ × (22/7)(2.5)²

= 36 − (11/7)(6.25)

= 36 − 68.75/7

= 36 − 9.82

∴ **Area = 26.18m²**

12. y = 3sin x + 2cos x

x	**0°**	**30°**	**60°**	**90°**	**120°**	**150°**	**180°**	**210°**	**240°**	**270°**	**300°**	**330°**	**360°**
y	2.0	3.2	3.6	3.0	1.6	−0.2	−2.0	−3.2	−3.6	−3.0	−1.6	0.2	2.0

From the equation:

(i) When x = 30°: y = 3sin30° + 2cos30° = 1.5 + 1.732 = 3.232 ≈ **3.2**

(ii) When x = 60°: y = 3sin60° + 2cos60° = 2.598 + 1.000 = 3.598 ≈ **3.6**

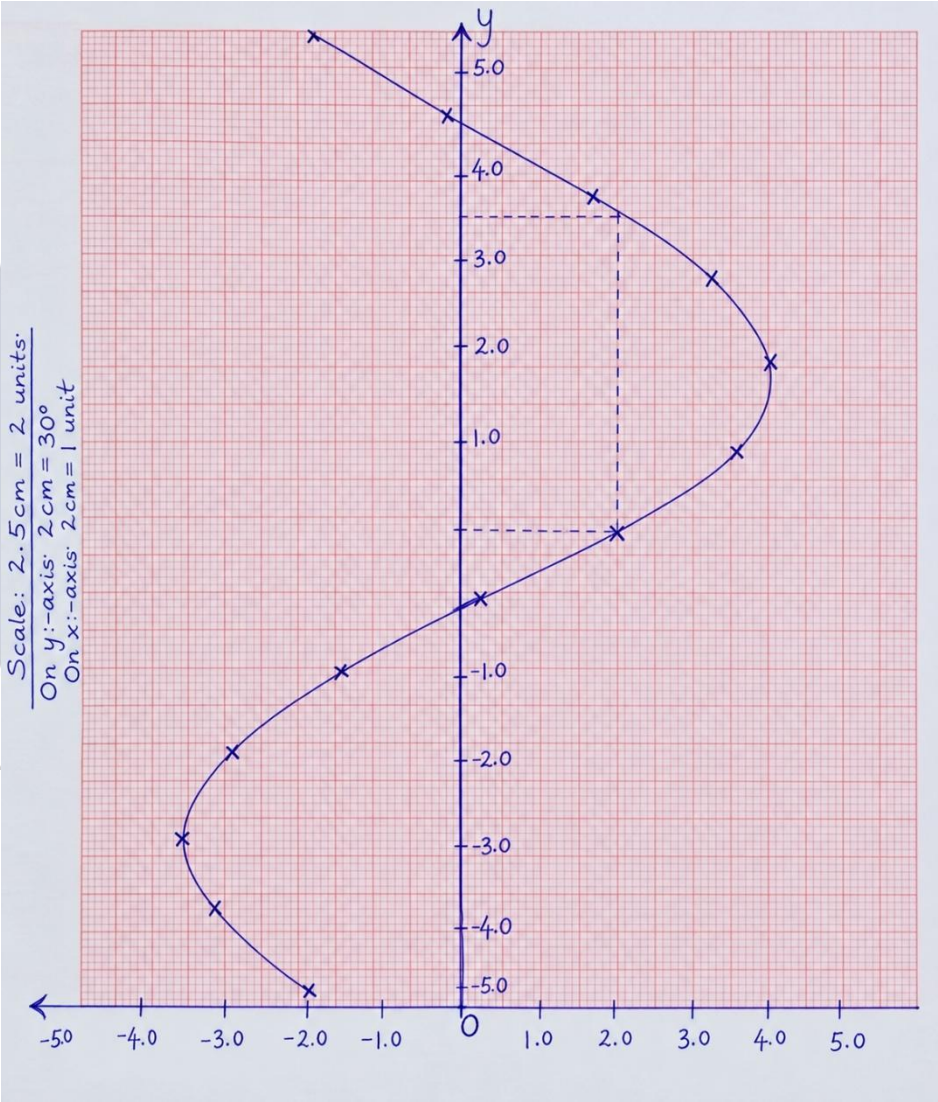
(iii) When x = 150°: y = 3sin150° + 2cos150° = 1.5 + (−1.732) = 1.5 − 1.732 ≈ **−0.2**

(iv) When x = 210°: y = 3sin210° + 2cos210° = −1.5 + (−1.732) = −1.5 − 1.732 = −3.232 ≈ **−3.2**

(v) When x = 300°: y = 3sin300° + 2cos300° = −2.598 + 1.000 = −1.598 ≈ **−1.6**

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(vi) When x = 330°: y = 3sin330° + 2cos330° = −1.5 + 1.732 = 0.232 ≈ **0.2**



SEE DIAGRAM — Graph of y = 3sin x + 2cos x

Scale: on x-axis, 2cm rep. 30°; on the y-axis, 2cm rep. 1 unit.

12(c)(i) Solution to 3sin x + 2cos x = 0 using the graph

⇒ Where (the points) the graph cuts the x-axis

⇒ **x = 147° and 327°**

(ii) 2 + 2cos x + 3sin x = 0

⇒ 3sin x + 2cos x = −2

Comparing with the original equation, implies that y = −2. Hence, from graph, when y = −2, **x = 180° and 294°**

13(a) 2x + y = 6

y = −2x + 6 (of the form y = mx + c)

⇒ m = −2 = gradient of the line passing through (2, −3)

Equation of the line using: $y - y_1 = m(x - x_1)$

⇒ y − (−3) = −2(x − 2)

y + 3 = −2x + 4

⇒ y + 2x = 4 − 3

⇒ **y + 2x = 1** — the required equation

or **y = −2x + 1**

13(b)(i) Operation table for △:

△	**2**	**3**	**5**	**7**
2	0	3	1	7
3	3	7	7	7
5	1	7	3	7
7	7	7	7	7

(ii)(I) 2 △ (5 △ 7)

From the table: 5 △ 7 = 7

Hence **2 △ 7 = 7**

(II) 2 △ n = 5 △ 7

But 5 △ 7 = 7

⇒ 2 △ n = 7

From the table; **n = 7**

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SOLUTION TO WASSCE JUNE 2017 GENERAL MATHEMATICS 2 — THEORY

PART I

1(a) $(y - 1)\log_{10}4 = y \log_{10}16$

Expanding: $y \log_{10}4 - \log_{10}4 = y \log_{10}16$

$\Longrightarrow y \log_{10}4^y - y \log_{10}16^y = \log_{10}4^1$

Cancelling $\log_{10}$ on both sides: $4^y/16^y = 4^1$

$\Longrightarrow 4^y/4^{(2y)} = 4^1$

$\Longrightarrow 4^{(y-2y)} = 4^1$

$\Longrightarrow -y = 1$

$\therefore y = -1$

1(b) Speed = Distance/Time $\Longrightarrow V = d/t \Longrightarrow t = d/V$

Difference in time for the two speeds = 30 minutes = ½ hour.

At 4km/h: $4 = d/(t + ½) \Longrightarrow 4 = 2d/(2t+1) \Longrightarrow 4(2t+1) = 2d$

$\Longrightarrow 8t + 4 = 2d \Longrightarrow 4t + 2 = d$ ... (1)

At 5km/h: $5 = d/t \Longrightarrow 5t = d$ ... (2)

Substituting (2) into (1): $4t + 2 = 5t \Longrightarrow 2 = 5t - 4t \Longrightarrow t = 2$

So $d = 5t = 5\times2 = 10$

$\therefore$ Distance between house and office = 10 km

2(a) $2/3(3x-5) - 3/5(2x-3) = 3$

Multiply through by 15: $10(3x-5) - 9(2x-3) = 45$

$\Longrightarrow 30x - 50 - 18x + 27 = 45$

$\Longrightarrow 12x - 23 = 45 \Longrightarrow 12x = 68$

$\therefore x = 68/12 = 17/3 = 5⅔$

2(b) $\angle UQT = 180 - (n+88)$ ($\angle$s on a straight line) $= 92 - n$

$\angle UTQ = 180 - m$ ($\angle$s on a straight line)

Sum of $\angle$s in triangle UTQ = 180°:

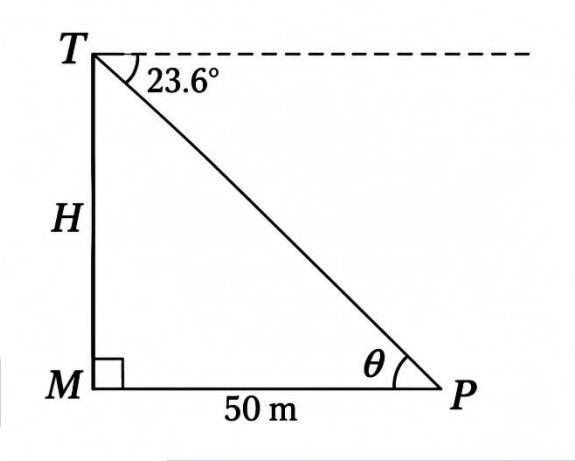
$(180-m) + (92-n) + 80 = 180$

$\Longrightarrow 352 - m - n = 180$

$\therefore m + n = 172°$

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3(a)



θ = 23.6° (alternate angles). In ΔTMP:

H/50 = Tan 23.6 ⟹ H = 50 × 0.4369 = 21.845

∴ Height of building ≈ 22 m

3(b) Area of ΔRTU = 45cm² ⟹ ½(10)H = 45 ⟹ H = 9cm

Area of Trapezium QTUS = ½(sum of parallels)×height = ½(6+16)×9

= ½(22)×9 = 99

∴ Area of trapezium QTUS = 99 cm²

4(a) T_6=37, S_6=147, n=6, l=37

S_n = n/2(a+l) ⟹ 147 = 3(a+37) ⟹ 49 = a+37

∴ a = 12

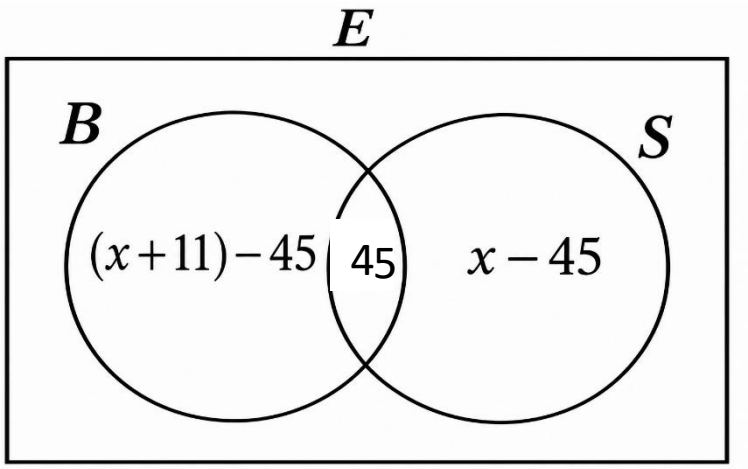
4(b) Using S_n = n/2{2a+(n−1)d}

From T_6=37: a+5d=37 ⟹ 12+5d=37 ⟹ d=5

S_{15} = 15/2{2×12+(14×5)} = 15/2(24+70) = 15/2(94) = 15×47

∴ S_{15} = 705

5(a)/(b)/(c)



n(ε)=120. Let n(Bags)=x, n(Shoes)=n(Bags)+11=x+11, both=45

n(ε) = (x+11−45) + 45 + (x−45) = 120

⟹ 2x − 34 = 120 ⟹ 2x = 154 ⟹ x = 77 (bought bags)

Shoes = 77+11 = 88

(c) Pr(a bag) = 77/120

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PART II

6(a) 3 hours = ₦87.00 ⟹ 1 hour = ₦29.00

For ₦30,450 of materials: 30,450/29 = 1,050 hours

Budget at ₦18.25/hr: 1,050 × 18.25 = ₦19,162.50

6(b) Bank M: P=x, R=6%, T=4yrs; Bank N: P=y, R=8%, T=4yrs

x + y = 8,000,000 ... (1)

$I_m = 24x/100$, $I_n = 32y/100$

24x/100 + 32y/100 = 2,320,000 ... (2)

Substituting x = 8,000,000 − y into (2):

8y = 232,000,000 − 192,000,000 = 40,000,000

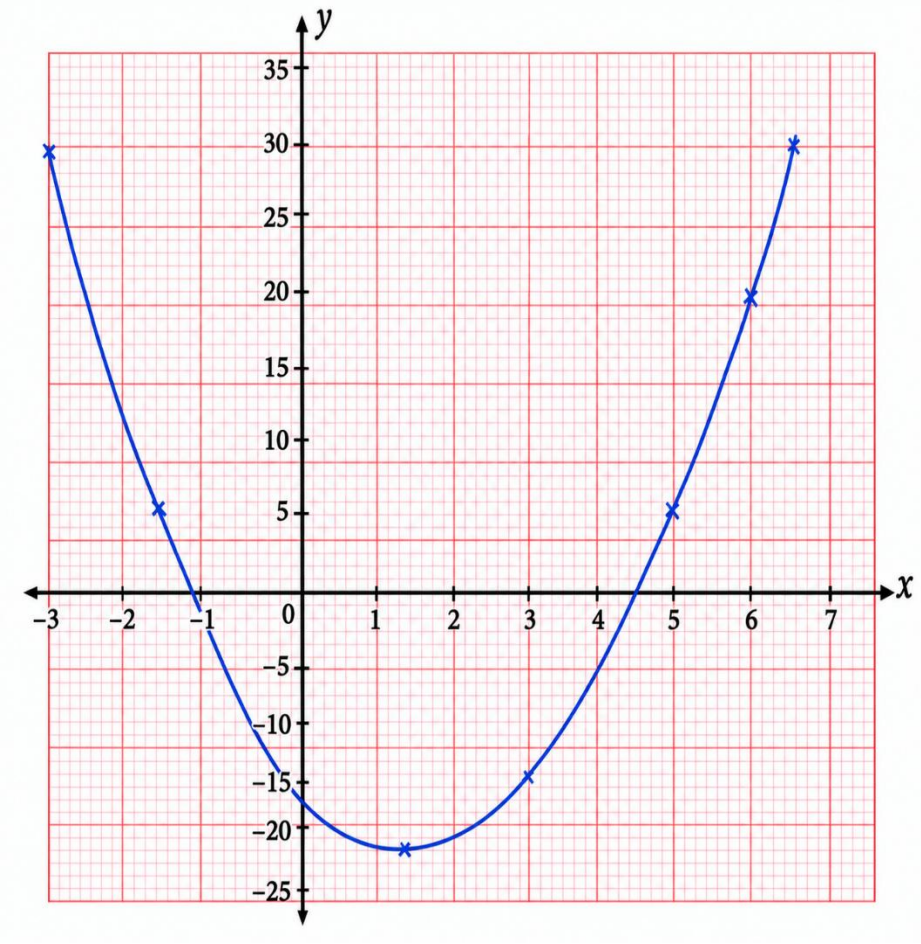
⟹ y = ₦5,000,000, x = ₦3,000,000

(ii) Interest from Bank N = (5,000,000×8×4)/100 = ₦1,600,000

7(a) $y = 2x^2 - 7x - 9$

x	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**	**6**
y	30	13	0	-9	-14	-15	-12	-5	6	21

7(b) Graph plotted (scale: x-axis 2cm=1unit, y-axis 2cm=5units)



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7(c)(i) Roots of $2x^2-7x-9=0$: $x = -1$ and $x = 4.5$

(ii) Minimum point: $(2, -15)$

(iii) Roots of $2x^2-7x=26$ (i.e., $2x^2-7x-9=17$): $x = -2.4$ and 5.8

Range for which $2x^2-7x < 9$: $x < 8$

8(a) Mean $\bar{x} = \Sigma fx/\Sigma f = 75/23$

$75/23 = (28m-9)/(8m-1)$

$23(28m-9) = 75(8m-1)$

$\Longrightarrow 644m - 207 = 600m - 75$

$\Longrightarrow 44m = 132 \Longrightarrow m = 3$

8(b) Substituting $m=3$: frequencies become 5, 2, 3, 8, 5 ($N=23$)

(i) Q_1 position = $(24\times0.25) = 6$th $\rightarrow Q_1 = 2$

Q_3 position = $(24\times0.75) = 18$th $\rightarrow Q_3 = 4$

$\therefore$ Interquartile range $= 4 - 2 = 2$

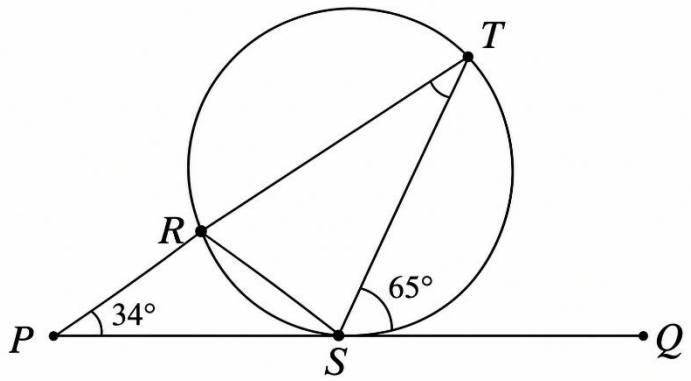
(ii) Pr(at least 4 marks) = $(8+5)/23 = 13/23$

9(a)(ii

$\angle TRS = 65°$ (angle in alternate segment)

$\angle PRS = 180-65 = 115°$ ($\angle$s on a straight line)

$\angle PSR = 180-(115+34) = 31°$ (sum of $\angle$s in triangle)



$\angle PSR = \angle STR = 31°$ (angle in alternate segment)

(A) $\angle RTS = 31°$ (B) $\angle SRP = 115°$

9(b) Construction: join V to W

Since $|VZ|=|YZ|$: $\angle ZVY = \angle ZYV$ (base $\angle$s of isosceles Δ)

$\angle XVZ = 180-52 = 128°$ ($\angle$s on a line)

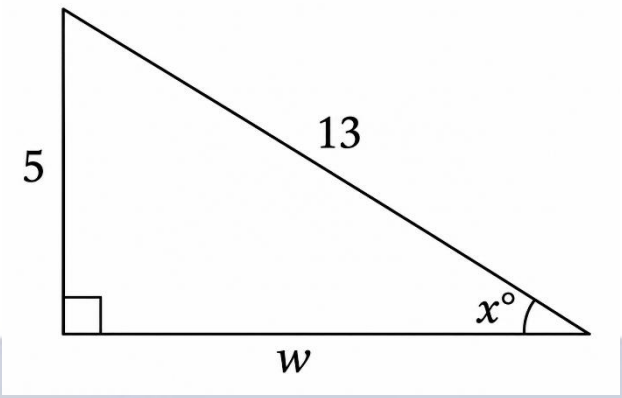
$\angle XZV = 180-(20+128) = 32°$ (sum of $\angle$s in Δ)

$\angle XZV = \angle VYW = 32°$ (angle in alternate segment)

$\therefore \angle WYZ = 52° - 32° = 20°$

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10(a)



Given sin x = 5/13

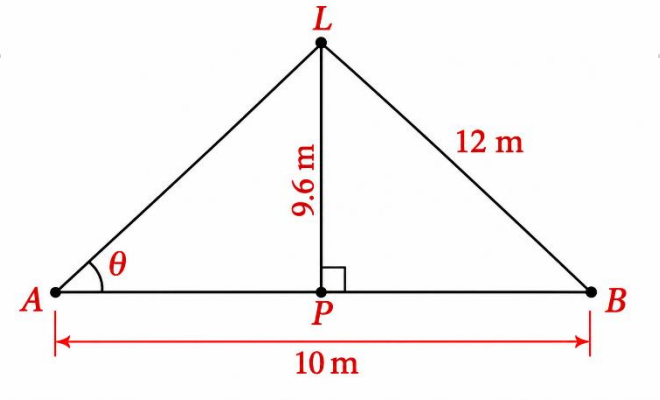
Adjacent side: $W^2 = 13^2 - 5^2 = 144 \Longrightarrow W = 12$

So cos x = 12/13, tan x = 5/12

(cos x − 2sin x)/(2tan x) = (12/13 − 10/13) ÷ (10/12) = (2/13) × (6/5)

= 12/65

10(b)(i)



In ΔBLP: $|PB|^2 = 12^2 - 9.6^2 = 51.84 \Longrightarrow |PB| = 7.2$

$|AP| = 10 - 7.2 = 2.8$

In ΔLAP: $|LA|^2 = 9.6^2 + 2.8^2 = 100 \Longrightarrow |LA| = 10m$

∴ Length of ladder LA = 10 m

(ii) $\cos\theta = |AP|/|LA| = 2.8/10 = 0.28$

$\theta = \cos^{-1}(0.28) = 73.7°$

∴ Angle LA makes with ground ≈ 74°

11(a) 8 students, ⅔hr → 16/3 hr = 12 tanks

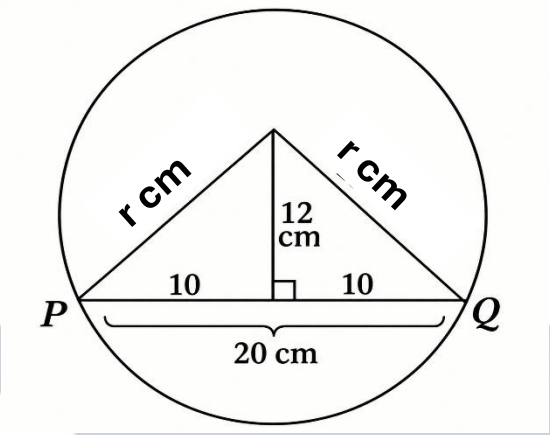
4 students, ⅓hr → 4/3 hr = x tanks

16/3 ÷ 4/3 = 12/x ⟹ 4 = 12/x ⟹ 4x=12

∴ x = 3 tanks

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11(b)(i)



Chord 20 cm, distance 12cm from centre

Tan θ = 10/12 = 0.8333 ⟹ θ = 39.8°

Angle at centre = 2θ = 79.6°

Radius: $r^2 = 12^2+10^2 = 244$ ⟹ r = √244

(ii) Perimeter of minor segment = Arc length + Chord length

= (79.6/360) × 2π(√244... as computed) + 20

= (79.6/360) × 31.24 × 3.142 + 20

= 21.703 + 20

≈ 41.7 cm

12(a) $3y^2-5y+2=0$ → divide by 3: $y^2 - 5/3y + 2/3 = 0$

Completing the square: $(y - 5/6)^2 = 1/36$

y = 5/6 ± 1/6

∴ y = 1 or y = 2/3

12(b) M=(1 2; 4 3), N=(m x; n y), MN=(2 1; 3 4)

m+2n=2, 4m+3n=3 → solving: n=1, m=0

x+2y=1, 4x+3y=4 → solving: y=0, x=1

∴ N = (0 1; 1 0)

13(a)(i) xy = (x+y)/2

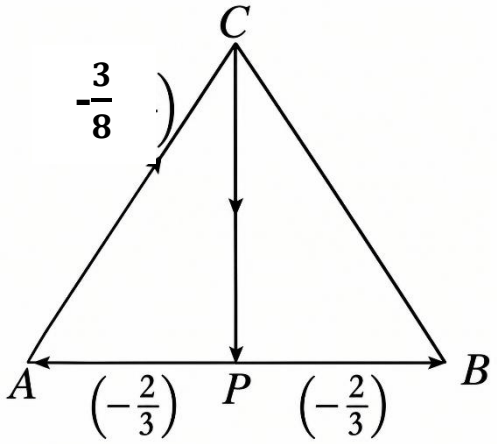
3()⅗ = (3+⅗)/2 = 17/10 = 1.7

(ii) 8(*)y = 8¼ ⟹ (8+y)/2 = 33/4

⟹ y = 33/2 − 8 = 17/2

∴ y = 8½

13(b)



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— Triangle ABC, P midpoint of AB

AB = (−4; 6), AC = (3; −8), AP = ½AB = (−2; 3)

CP = AP − AC = (−2; 3) − (3; −8)

∴ CP = (−5; 11)

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ANSWERS TO WASSCE JUNE 2018

GENERAL MATHEMATICS 2 ESSAY.

SECTION A

1(a)[¼ × 64/7 + ⅖(8+9/12)] ÷ [8-5/20]

⇒ [16/7 + ⅖(17/12)] ÷ [3/20]

[16/7 + 34/60] ÷ 3/20

= [16/7 + 17/30] × 20/3

[16(30)+17(7)/210] × 20/3

= (480+119/210)(20/3)

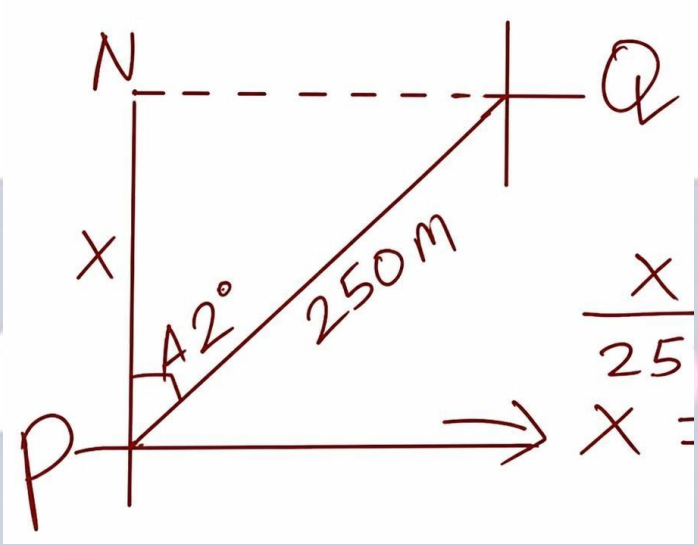
= 599/210 × 20/3

= 11,980/630 = 1198/63

= 19 1/63 = 19.015873

= 19 1/63 ≈ 19.02

(b)



Let the vertical distance be x in the sketch.

x/250 = Cos 42°

⇒ x = 250 Cos 42°

= 250 × 0.7431 = 185.775

∴ x ≈ 186 m

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2(a) Let Musa's present age be x.

Let Manya's present age be y.

From the information given:

x = 3 + y

⇒ x - y = 3 ... (1)

7 years ago

Musa's age was x-7 and Manya was y-7

From the 2nd information:

(x-7) = 2(y-7)

x - 7 = 2y - 14

⇒ x - 2y = -14 + 7

or x - 2y = -7 ... (2)

Subtracting eqn (2) from eqn (1)

x - x - y - (-2y) = 3 - (-7)

-y + 2y = 3 + 7

⇒ y = 10

Put y = 10 in equation (1)

x - 10 = 3

⇒ x = 3 + 10 = 13

∴ Musa's present age = 13 years and Manya's present age = 10 years

(b) In "P" years' time, the sum of their ages = 45

⇒ (x+P) + (y+P) = 45

x + P + y + P = 45

Substituting for x and y

13 + P + 10 + P = 45

2P + 23 = 45

2P = 45 - 23 = 22

∴ P = 22/2 = 11 years

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3(a) For an athlete to run the track twice:

Total distance covered = 2(Perimeter)

⇒ Circumference of 1st semicircle + 60m + Circumference of 2nd semicircle + 60m

= ½(πd) + 60m + ½(πd) + 60m

= 22/7 × 120 + 60/1 + 22/7 × 120 + 60/1

= ½(2640/7) + 60 + ½(2640/7) + 60

= ½(377.143) + 60 + ½(377.143) + 60

= 377.143/2 + 60 + 377.143/2 + 60

= 188.572 + 60 + 188.572 + 60

Perimeter = 497.143

⇒ Distance covered in running the track twice

= 497.143 × 2

= 994.286 m

(b) Speed of the athlete in 200 seconds

Using Speed = Total Distance Covered / Total time

= 994.286 m / 200s

= (994.286 ÷ 1000) km / (200 ÷ 3600) hr

= 0.994286 / 0.055556

= 17.89700 km/hr

∴ Speed = 17.9 km/hr

4(a) Interest charged = 2k/month for GH¢1.00

⇒ In 1 year (12 months) = 2×12 = 24k

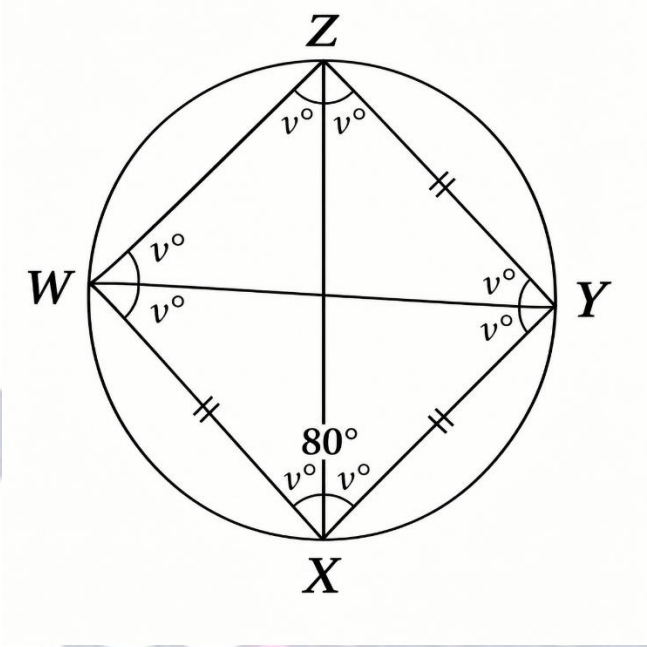
= 24/100 = GH¢0.24

Now I = PTR/100

⇒ R = 100×I / (P×T)

Hence, R = 100×0.24 / (1×1) = 24%

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(b)Let ∠WXZ = u

Let ∠ZWY = v

∠WXZ = ∠WYZ = u (∠s of same segment)

∠ZWY = ∠ZXY = v° (∠s of same segment)

∠YWX = ∠XZY = v° (∠s of same segment)

∠YZX = ∠YXZ = v° (base ∠s of isosceles Δ)

∠YWX = ∠WYZ = v° (base ∠s of isosceles Δ)

In Δ XYW:

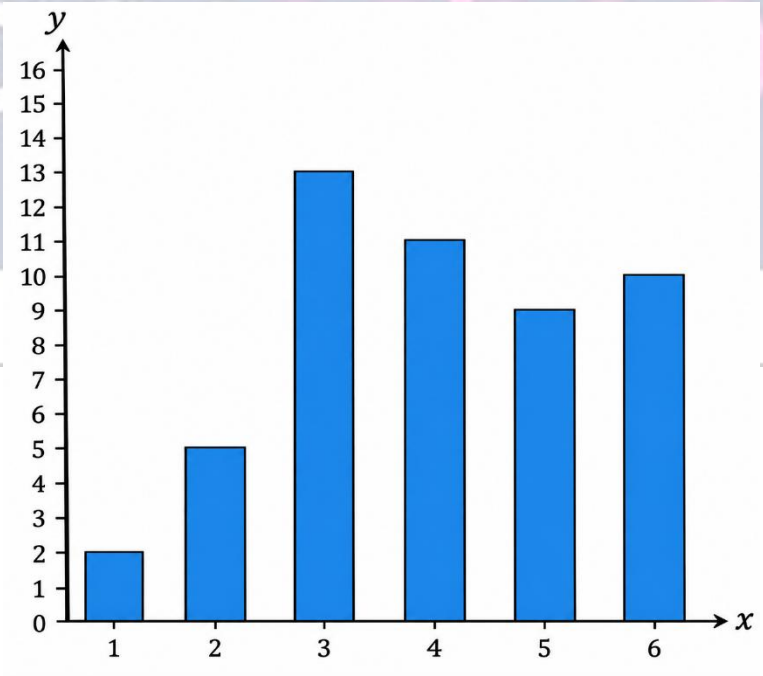
80° + v° + v° = 180° (sum of ∠s in a Δ)

⇒ 2v + 80 = 180

⇒ v = (180-80)/2 = 50°

Hence, ∠XWZ = v° + v° = 50° + 50° = 100°

5(a)(bar chart of Score (x) against Frequency (f))



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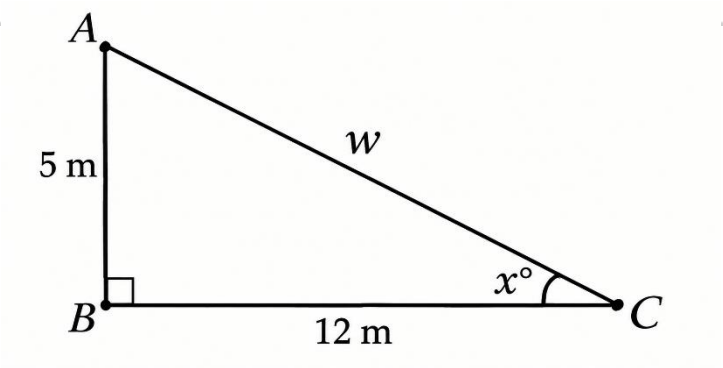
1 rep = 5m

Score (x)	Frequency (f)	fx
1	2	2
2	5	10
3	13	39
4	11	44
5	9	45
6	10	60
Σf = 50	Σfx = 200	

(b)Mean $\bar{x} = \Sigma fx/\Sigma f$; = 200/50 = 4; ∴ Mean of the distribution = 4

SECTION B

6(a) Tan x = 5/12 = Opposite/Adjacent



Let the hypotenuse side, |AC| be W

By Pythagoras theorem:

$W^2 = 5^2 + 12^2$

$W^2 = 25 + 144 = 169$

⇒ W = √169 = 13

Now: Sin x = Opposite/Hypotenuse = 5/13

and Cos x = Adjacent/Hypotenuse = 12/13

Substituting in the given expression:

Sin x / $[(\text{Sin } x)^2 + \text{Cos } x]$

= 5/13 ÷ $[(5/13)^2 + 12/13]$

= 5/13 ÷ [25/169 + 12/13]

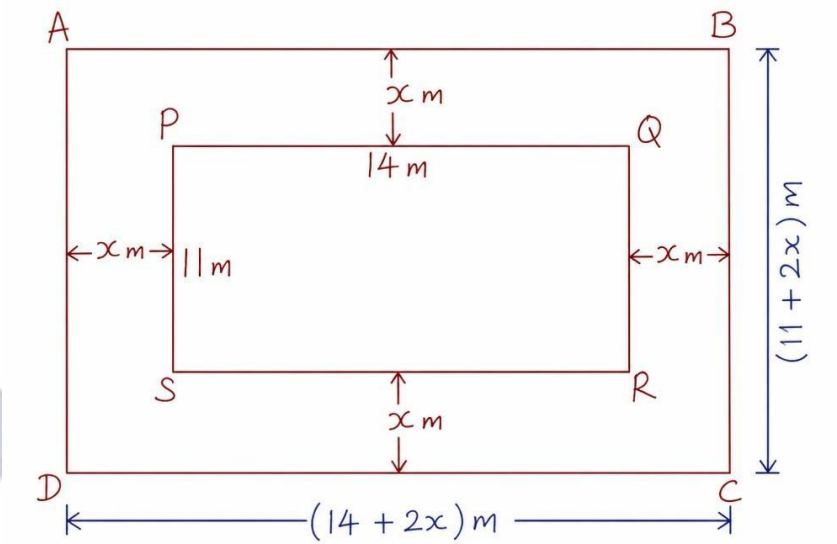
= 5/13 ÷ [(25+156)/169]

= 5/13 ÷ 181/169

= 5/13 × 169/181

= 65/181

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6(b) Length |AB| = |DC| = (14+2x)m

Width |AD| = |BC| = (11+2x)m

Area of Path = Area of Rect. ABCD − Area of Lawn PQRS

⇒ 186 = (14+2x)(11+2x) − (14)(11)

⇒ 186 = 154 + 28x + 22x + $4x^2$ − 154

⇒ 186 = $4x^2$ + 50x

⇒ $4x^2$ + 50x − 186 = 0

Dividing through by 2, we have:

$2x^2$ + 25x − 93 = 0

$2x^2$ − 6x + 31x − 93 = 0

2x(x−3) + 31(x−3) = 0

⇒ (2x+31)(x−3) = 0

Either 2x+31=0 ⇒ 2x=−31 ⇒ x = −31/2

or x−3=0 ⇒ x=3

⇒ x = −31/2 or 3

Since the value of x cannot be negative;

∴ x = 3m

Hence, the width of the path = 3m

7. Reduction for the 1st sales = 40% of Original Price

Reduction for the 2nd sales = 30% of the Original Price

(a) ⇒ Price before the 1st sales = Original Price = GH¢x

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At 2nd reduction of 30% of original will be given by:

30/100 of x = x − 3,500

⇒ 0.3x = x − 3,500

⇒ x − 0.3x = 3,500

= 0.7x = 3,500

⇒ x = 3,500/0.7 = 5,000

⇒ Price before the sales = GH¢5,000

(b) If original price of an article = GH¢180

(i) Reduction in 1st sales = 40/100 × 180 = GH¢72

Reduction in 2nd Sales = 30/100 × 180 = GH¢54

⇒ Total reduction = 72+54 = GH¢126

(ii) % Reduction of the price for both transactions

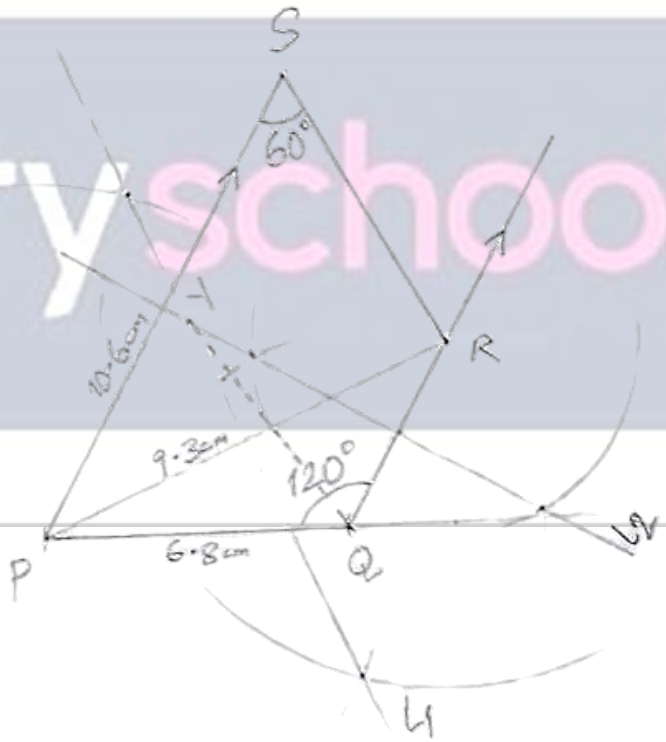
= Total reduction / Total price × 100%

= 126/(180+180) × 100

= 126/360 × 100 = 12600/360 = 35

∴ Percentage reduction in price = 35%

8(a)



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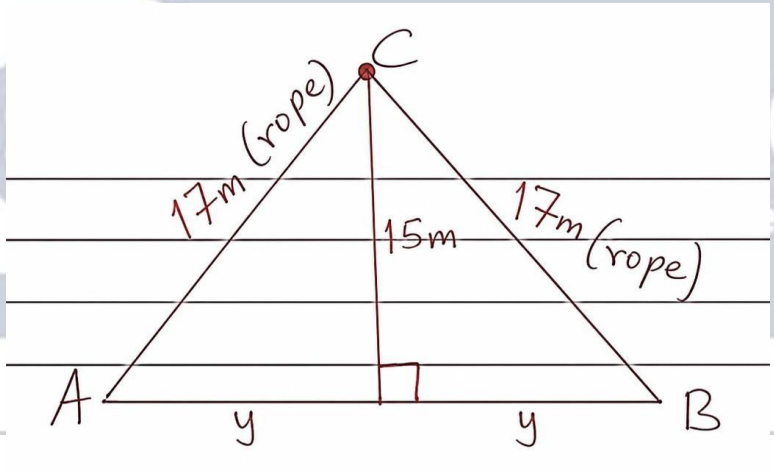
(construction of triangle PQS and PQR with angles 60° and 120°, and lengths 6.8cm, 9.3cm, 10.6cm)

(b)(i) |QR| = 4.4cm

(ii) ∠PSR = 60°

(iii) |QY| = 5.4cm

9(a)



Applying Pythagoras theorem:

$y^2 + 15^2 = 17^2$

$\Rightarrow y^2 = 17^2 - 15^2$

$= (17+15)(17-15)$

$= 32 \times 2 = 64$

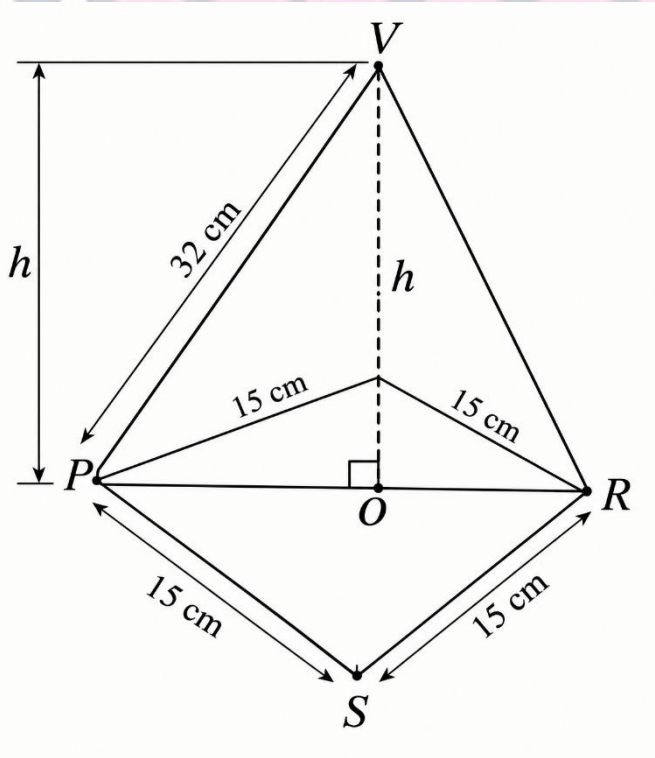
$\Rightarrow y^2 = 64$

$\therefore y = \sqrt{64} = 8m$

Distance accessible to the donkey = |AB|

= y + y = 8 + 8 = 16m

(b)



Let the height |VO| be h.

By Pythagoras:

$|PR|^2 = |PS|^2 + |SR|^2$

$= 15^2 + 15^2$

$= 225 + 225$

$\Rightarrow |PR|^2 = 450$

$\therefore |PR| = \sqrt{450} = 21.2cm$

But $|PO| = \frac{1}{2}|PR| = \frac{1}{2}(21.2) = 10.6cm$

In Δ VPO: $|VP|^2 = h^2 + |PO|^2$

$\Rightarrow 32^2 = h^2 + 10.6^2$

$\Rightarrow h^2 = 32^2 - 10.6^2$

$h^2 = 1024 - 112.36$

$= 911.64$

$\therefore h = \sqrt{911.64}$

$= 30.1934$

$\Rightarrow h = 30.2cm$ (1 decimal place)

(ii) Volume of the Pyramid:

Vol = ⅓(Base Area) × Height

$= \frac{1}{3}(15 \times 15) \times 30.2$

$= \frac{1}{3} \times 225 \times 30.2$

$= 6795/3$

$\therefore$ Volume = 2,265 cm^3

10(a)

x:	**30°**	**60°**	**90°**	**120°**	**150°**	**180°**	**210°**	**240°**	**270°**	**300°**	**360°**
y:	1.23	0.13	−1.00	−1.87	−2.23	−2.00	−1.23	−0.13	1.00	1.87	**2.00**

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When x=30°	**y=2Cos30−Sin30 ⇒ 2(0.866)−0.5=1.23**
When x=90°	y=2Cos90−Sin90 ⇒ 2(0)−1.00=−1.00
When x=240°	y=2Cos240−Sin240 ⇒ 2(−0.5)−(−0.866)=−0.13
When x=270°	y=2Cos270−Sin270 ⇒ 2(0)−(−1.00)=1.00
When x=300°	y=2Cos300−Sin300 ⇒ 2(0.5)−(−0.866)=1.87

(i) 2Cos x − Sin x = 1

From the graph, when 2Cos x − Sin x = 1

x = 36° and 270°

(ii) For tan x = 2

Recall: tan x = Sin x/Cos x

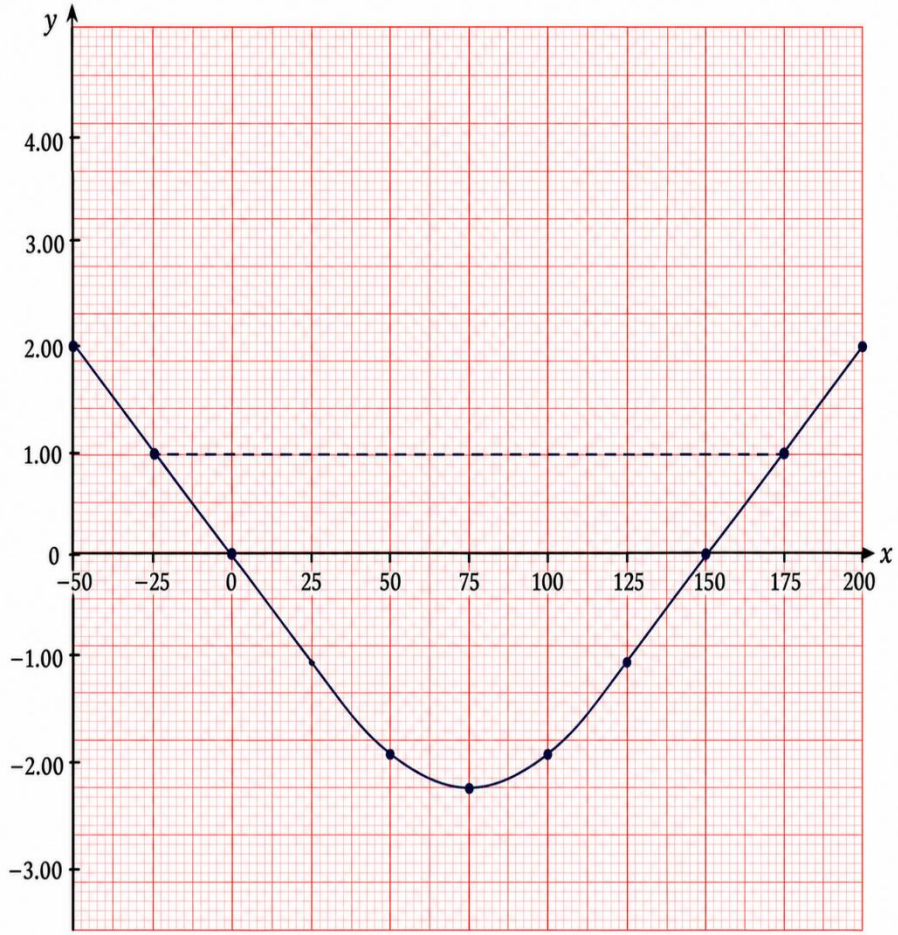
⇒ Sin x/Cos x = 2

⇒ 2Cos x = Sin x

⇒ 2Cos x − Sin x = 0

When y = 0; from the graph:

x = 63° and 243°



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(b) $y = 2\cos x - \sin x$

SEE DIAGRAM (Graph of $y=2\cos x-\sin x$)

11(a) $\log_a(y+2) = 1 + \log_a x$ ... (1)

$\log_a(y+2) = \log_a a + \log_a x$

$\Rightarrow \log_a(y+2) = \log_a(a\times x)$

$\Rightarrow y+2 = ax$

$\Rightarrow x = (y+2)/a$

Alternatively, from (1)

$\log_a(y+2) - \log_a x = 1$

$\Rightarrow \log_a[(y+2)/x] = \log_a a$

$\Rightarrow (y+2)/x = a$

$\Rightarrow ax = y+2$

$\therefore x = (y+2)/a$

12(a) Number of Shares bought = A¢5,400.00 / A¢2.50

= 3,360 shares

Dividend on 3,360 shares = 3,360 × 25k

= 3,360 × A¢0.25

= A¢840.00

(b) $(1-x)/x + x/(1-x) = 5/2$

$(1-x)^2 + x^2 / x(1-x) = 5/2$

$\Rightarrow (1-x)^2 + x^2 = 5/2(x-x^2)$

$(1-x)(1-x) + x^2 = 5/2(x-x^2)$

$1-2x+x^2+x^2 = 5/2(x-x^2)$

$2(1-2x+2x^2) = 5(x-x^2)$

$\Rightarrow 2-4x+4x^2 = 5x-5x^2$

$5x^2+4x^2-4x-5x = -2$

$\Rightarrow 9x^2-9x = -2$

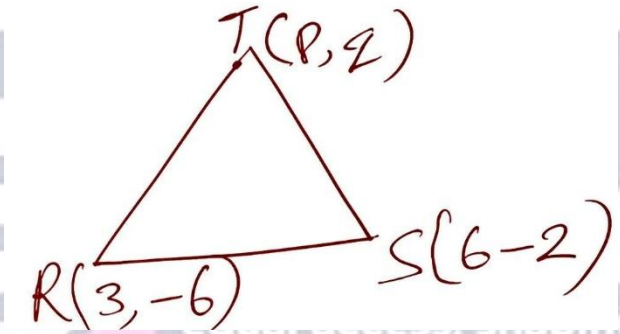
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$9x^2-9x+2 = 0$

Using $x = [-b\pm\sqrt{(b^2-4ac)}]/2a$

$\therefore x = 2/3$ or $1/3$

13(a)



T(p,2)

R(3,−6)

S(6,−2)

OR = (3,−6)

OS = (6,−2)

OT = (p,2) [O=(0,0)]

$\Rightarrow \frac{1}{3}OR + OS + OT = RS$

$\Rightarrow \frac{1}{3}(3,-6)+(6,-2)+(p,q)$

= OS − OR = (S−R)

$\Rightarrow (1,-2)+(6,-2)+(p,q)$

$= (6,-2)-(3,-6)$

$\Rightarrow (7+p,q-4) = (3,4)$

$\Rightarrow 7+p = 3$

or $p = 3-7 = -4$

$q-4 = 4$

$\Rightarrow q = 4+4 = 8$

Hence T = (p,q) = (−4,8)

(b) $2(3,m) + n(1,2) = (8,4)$

$= (6,2m) + (n,2n) = (8,4)$

$\Rightarrow 6+n = 8; \therefore n = 8-6 = 2$

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Substituting for n in: 2m+2n = 4

⇒ 2m+2(2) = 4

⇒ 2m+4 = 4

∴ 2m = 4−4

⇒ m = 0

∴ m = 0 and n = 2

14(b) Bibiani = 600

Amenfi = 900

Oda = 1,800

Wiawso = 1,500

Sankore = 2,400

Total = 7,200

Converting to degrees:

Bibiani = 600/7200 × 360/1 = 30°

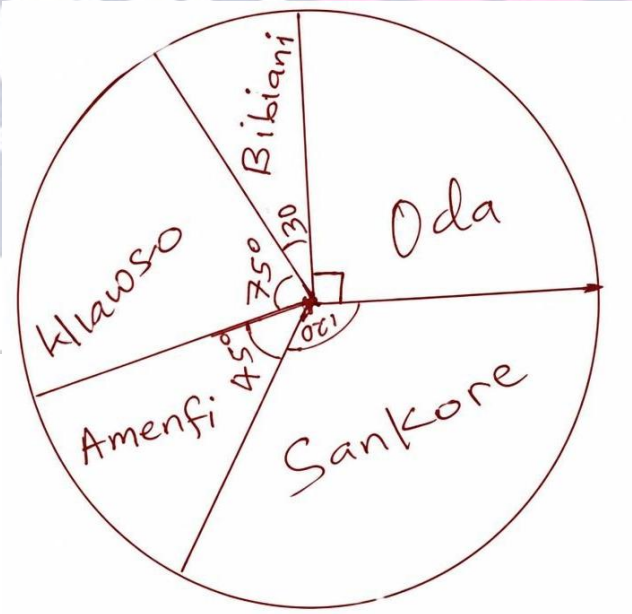
Amenfi = 900/7200 × 360/1 = 45°

Oda = 1800/7200 × 360/1 = 90°

Wiawso = 1500/7200 × 360/1 = 75°

Sankore = 2400/7200 × 360/1 = 120°

Represented on a pie chart:



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15(i) % of Amenfi = 900/7200 × 100 = 90,000/7200

= 12.5%

(ii) If 1 ton is sold for $560.00

⇒ 600 tonnes for Bibiani = 600×560 = $336,000

= 1,008,000 − 336,000

= $672,000

Hence, Oda Community would receive $672,000 more than Bibiani Community.

For Oda Community = 1800×560 = $1,008,000

Difference:

Oda − Bibiani

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(c) wu = w+u+1 and

(y4)y = 12

⇒ y4 = (y+4+1)

= y+5

(y*4)*y = (y+5)+y+1 = 12

⇒ 2y+6 = 12

⇒ 2y = 12−6

∴ y = 6/2 = 3

SOLUTIONS TO WASSCE JUNE 2019
GENERAL MATHEMATICS 2

ESSAY: SECTION A

1(a) $110_x = 40_{(five)}$

Converting both sides to Denary (base 10):

$1\times x^2 + 1\times x + 0\times x^0 = 4\times 5^1 + 0\times 5^0$

$x^2 + x + 0 = 20 + 0$

$\Rightarrow x^2 + x - 20 = 0$

Solving the quadratic equation by factor method:

$x^2 + 5x - 4x - 20 = 0$

$(x^2 + 5x) - (4x + 20) = 0$

$x(x + 5) - 4(x + 5) = 0$

$(x - 4)(x + 5) = 0$

Either $x - 4 = 0 \Rightarrow x = 4$

or $x + 5 = 0 \Rightarrow x = -5$

Since the number base cannot be negative, the value of x = **4**

1(b) $15/\sqrt{75} + \sqrt{108} + \sqrt{432}$

Simplifying through:

$= 15/\sqrt{(25\times 3)} + \sqrt{(36\times 3)} + \sqrt{(144\times 3)}$

$= 15/(5\sqrt{3}) + 6\sqrt{3}/1 + 12\sqrt{3}/1$

$= (15/5\sqrt{3}) \times (5\sqrt{3}/5\sqrt{3}) + 6\sqrt{3} + 12\sqrt{3}$

$= 75\sqrt{3}/25(3) + 6\sqrt{3} + 12\sqrt{3}$

$= 75\sqrt{3}/75 + 6\sqrt{3} + 12\sqrt{3}$

$= \sqrt{3} + 6\sqrt{3} + 12\sqrt{3}$

$= \mathbf{19\sqrt{3}}$

2(a) Equation of the line passing through points A(–2, 7) and B(2, –3)

$x_1 = -2$, $x_2 = 2$, $y_1 = 7$, $y_2 = -3$

Using the formula: $(y - y_1)/(x - x_1) = (y_2 - y_1)/(x_2 - x_1)$

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$(y - 7)/(x - (-2)) = (-3 - 7)/(2 - (-2))$

$(y - 7)/(x + 2) = -10/4$

$4(y - 7) = -10(x + 2)$

$4y - 28 = -10x - 20$

$4y + 10x - 28 + 20 = 0$

$4y + 10x - 8 = 0$

Dividing through by 2:

$2y + 5x - 4 = 0$

∴ The equation of the line = **$2y + 5x - 4 = 0$**

2(b) $(5b - a)/(8b + 3a) = 1/5$

Cross multiplying:

$5(5b - a) = 1(8b + 3a)$

$25b - 5a = 8b + 3a$

Collecting like terms:

$25b - 8b = 3a + 5a$

$17b = 8a$

Hence, $a = 17b/8$

Evaluating $a/b = (17b/8) \div b$

$= (17b/8) \times (1/b)$

$= 17b/8b$

$= 17/8 = 2⅛ = 2.125$

∴ The value of a/b = **2.13** (2 decimal places)

3(a) Total Amount shared = ₦420,000.00

Ali : Musah : Yusif = 3 : 5 : 8

Total ratio = 3 + 5 + 8 = 16

Ali's share = 3/16 × 420,000 = 1,260,000/16 = ₦78,750

Musah's share = 5/16 × 420,000 = 2,100,000/16 = ₦131,250

Yusif's share = 8/16 × 420,000 = 3,360,000/16 = ₦210,000.00

Ali and Yusif's shares = ₦78,750 + ₦210,000

= **₦288,750**

3(b) 2(1/8)^x = 32^(x–1)

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$\Rightarrow 2(8^{-1})^x = 32^{(x-1)}$

$\Rightarrow 2(8^{-x}) = 32^{(x-1)}$

$2^1(2^{-3x}) = 2^{5(x-1)}$

$2^{(1-3x)} = 2^{(5x-5)}$

Since the bases are the same, we equate the indices thus:

$1 - 3x = 5x - 5$

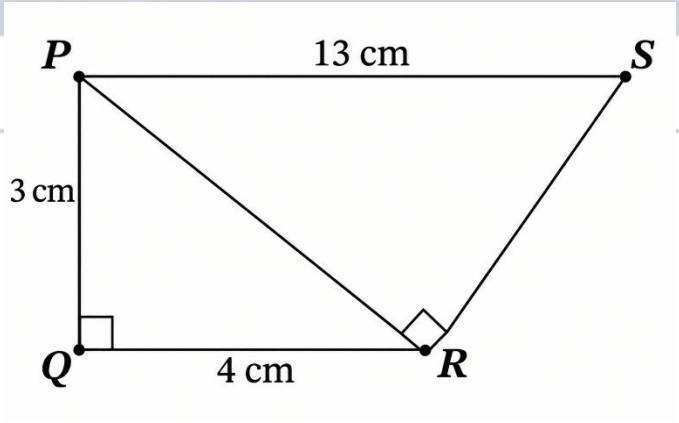
Collecting like terms:

$1 + 5 = 5x + 3x$

$6 = 8x$

$\therefore x = 6/8 = \mathbf{3/4}$

4(a)



(quadrilateral PQRS with |PQ| = 3cm, |QR| = 4cm, |PS| = 13cm, right angles at Q and R)

In ΔPQR:

$|PR|^2 = 3^2 + 4^2$ (Pythagoras)

$\Rightarrow |PR|^2 = 9 + 16 = 25$

$\therefore |PR| = \sqrt{25} = 5$

In ΔPRS:

By Pythagoras: $|RS|^2 = |PS|^2 - |PR|^2$

$= 13^2 - 5^2$

$= 169 - 25 = 144$

$\Rightarrow |RS| = \sqrt{144}$

$\therefore |RS| = 12$

Area of the quadrilateral = Area of ΔPQR + Area of ΔPRS

$= \frac{1}{2}(4\times3) + \frac{1}{2}(5\times12)$

$= 12/2 + 60/2$

$= 6 + 30 = 36$

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∴ Area of the figure PQRS = **36 cm²**

---

5. Red balls = 3

Green balls = 5

Blue balls = y

Total number of balls = (3 + 5 + y) balls = (8 + y) balls

(a) Pr(Red ball) = 1/6 — Given

⇒ 1/6 = 3/(8+y) (Cross multiplying)

1(8 + y) = 3(6)

8 + y = 18

⇒ y = 18 – 8 = 10 balls

Hence, Blue balls = **10**

(b) Pr(Green Ball) = 5/(8+10) = 5/18 = **5/18**

SECTION B

6(a) Force = F, Masses M_1 and M_2, distance = d

From the information:

$F \propto M_1M_2/d^2$

(i) ⇒ $F = kM_1M_2/d^2$ ... (1) (where k = constant)

When F = 20, M_1 = 25, M_2 = 10, d = 5

Substituting in equation (1):

$20 = k(25\times10)/5^2$

⇒ 20 = k(250)/25

⇒ 250k = 20×25

∴ k = 500/250 = 2

Putting k = 2 in equation (1), we have:

$F = 2M_1M_2/d^2$ — The expression for F in terms of M_1, M_2 and d.

(ii) When F = 30N, M_1 = 7.5kg and M_2 = 4kg

From the above expression (law/relation):

$Fd^2 = 2M_1M_2$

⇒ $d^2 = 2M_1M_2/F$

⇒ $d = \sqrt{(2M_1M_2/F)}$

Substituting the values for F, M_1 and M_2, we have:

$d = \sqrt{(2\times7.5\times4/30)}$

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= √(60/30) = √2

∴ d = √2 = 1.414

⇒ d = **1.414m** (distance)

6(b) Sum of interior angles of a polygon is given by (2n – 4)90°,

where n = number of sides.

In the given polygon, n = 5

⇒ Sum of interior angles = (2×5 – 4)90° = (10–4)90° = 6×90° = 540°

Hence, x + (x+20) + (x+40) + (x+80) + (x+60) = 540

⇒ x + x + 20 + x + 40 + x + 80 + x + 60 = 540

5x + 200 = 540

5x = 540 – 200

5x = 340

∴ x = 340/5 = 68°

⇒ x = **68°**

7(a) *(frequency distribution table and cumulative frequency curve)*

Frequency Distribution Table:

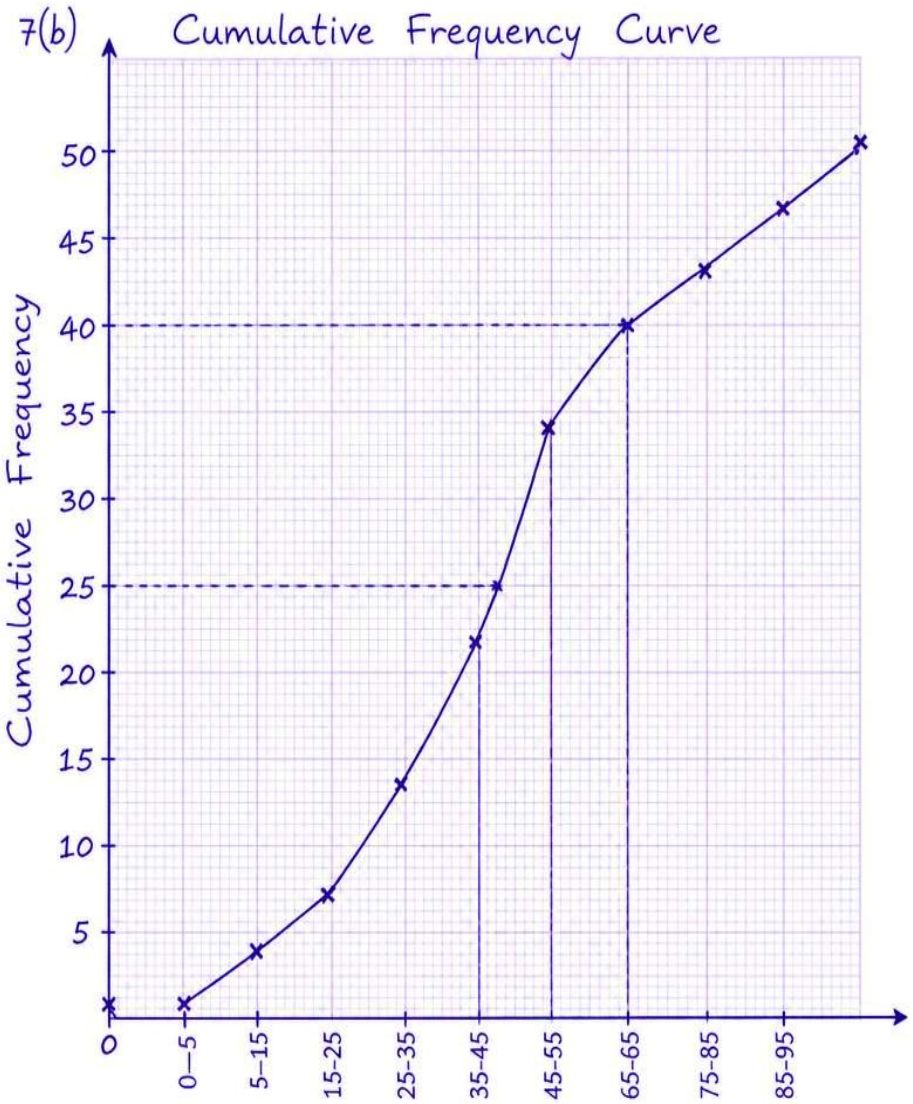
Class Interval	Frequency (f)	Cumulative Frequency	Class Boundary
0–9	1	1	–0.5 – 9.5
10–19	3	4	9.5 – 19.5
20–29	3	7	19.5 – 29.5

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30–39	6	13	29.5 – 39.5
40–49	8	21	39.5 – 49.5
50–59	12	33	49.5 – 59.5
60–69	6	39	59.5 – 69.5
70–79	3	42	69.5 – 79.5
80–89	4	46	79.5 – 89.5
90–99	4	50	89.5 – 99.5

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7(b) *(cumulative frequency curve plotted against class boundaries)*



7(c)(i) Median = ½(N)th = (½ × 50)th = 25th

From the graph, Median = **53.5 Marks**

(ii) % of students who scored at least 66 marks

From class boundary 66.5, we obtain 37.5 ≈ 38

⇒ The number of students who scored at least 66 = 50 – 38 = 12 students

Hence, % of students who scored at least 66 = 12/50 × 100 = **24%**

8(a) ⅓x – ¼(x+2) ≥ 3x – 1⅓

⇒ x/3 – (x+2)/4 ≥ 3x/1 – 4/3

Multiplying through by 12, we have:

12(x/3) – 12((x+2)/4) ≥ 12(3x/1) – 12(4/3)

⇒ 4x – 3(x+2) ≥ 36x – 16

⇒ 4x – 3x – 6 ≥ 36x – 16

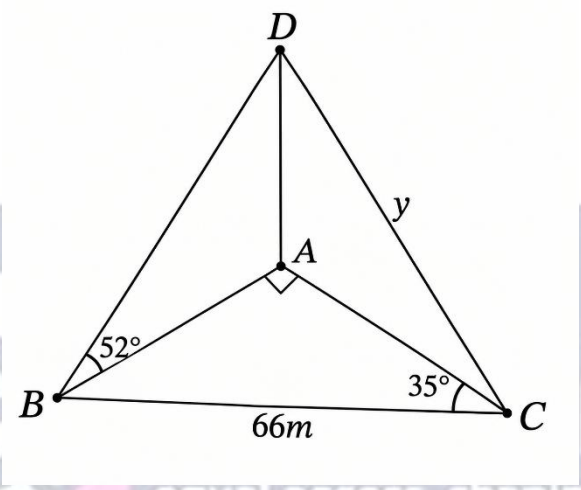
⇒ x – 36x ≥ –16 + 6

⇒ –35x ≥ –10

∴ x ≤ –10/–35

⇒ x ≤ **2/7**

8(b)



(triangle ABC with AD as vertical tower, ∠BAC = 90°, ∠ABD = 52°, ∠ACB = 35°, |BC| = 66m)

In ΔABC:

|AB|/66 = Sin 35°

⇒ |AB| = 66 Sin 35°

= 66 × 0.5736

= 37.8576

⇒ |AB| ≈ 37.86m

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In ΔABD:

|AD|/|AB| = Tan 52°

⇒ |AD|/37.86 = Tan 52

⇒ |AD| = 37.86 × Tan 52

= 37.86 × 1.280

= 48.4608

∴ |AD| ≈ 48.46m

Hence,

(i) Height of Tower (|AD|) = **48.46m**

(ii) Angle of elevation of the top of the tower from C:

In ΔACD:

|AC|/66 = Cos 35°

⇒ |AC| = 66 Cos 35°

= 66 × 0.8192

= 54.0672

⇒ |AC| = 54.07m

But in ΔACD (let ∠ACD be y°)

|AD|/|AC| = Tan y

⇒ 48.46/54.07 = Tan y

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⇒ Tan y = 0.896246

⇒ y = Tan^{-1}(0.896246) ≈ 41.9

∴ y = 41.9°

Hence, the elevation of D from C = **41.9°**

9(a) y = 2 Cos x + 3 Sin x

x	**0°**	**60°**	**120°**	**180°**	**240°**	**300°**	**360°**
y	2.0	3.6	2.9	–2.0	–3.6	–1.6	2.0

When x = 60°; y = 2Cos60 + 3Sin60

= 2(0.5) + 3(0.866)

= 1.0 + 2.598 ≈ 3.6

When x = 120°; y = 2Cos120 + 3Sin120

= 2(–0.5) + 3(0.866) ≈ 2.9

When x = 180°; y = 2Cos180 + 3Sin180

= 2(–1) + 3(0) = –2.0

When x = 300°; y = 2Cos300 + 3Sin300

= 2(0.5) + 3(–0.866) = –1.6

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When x = 360°; y = 2Cos360 + 3Sin360

= 2(1) + 3(0) = 2.0

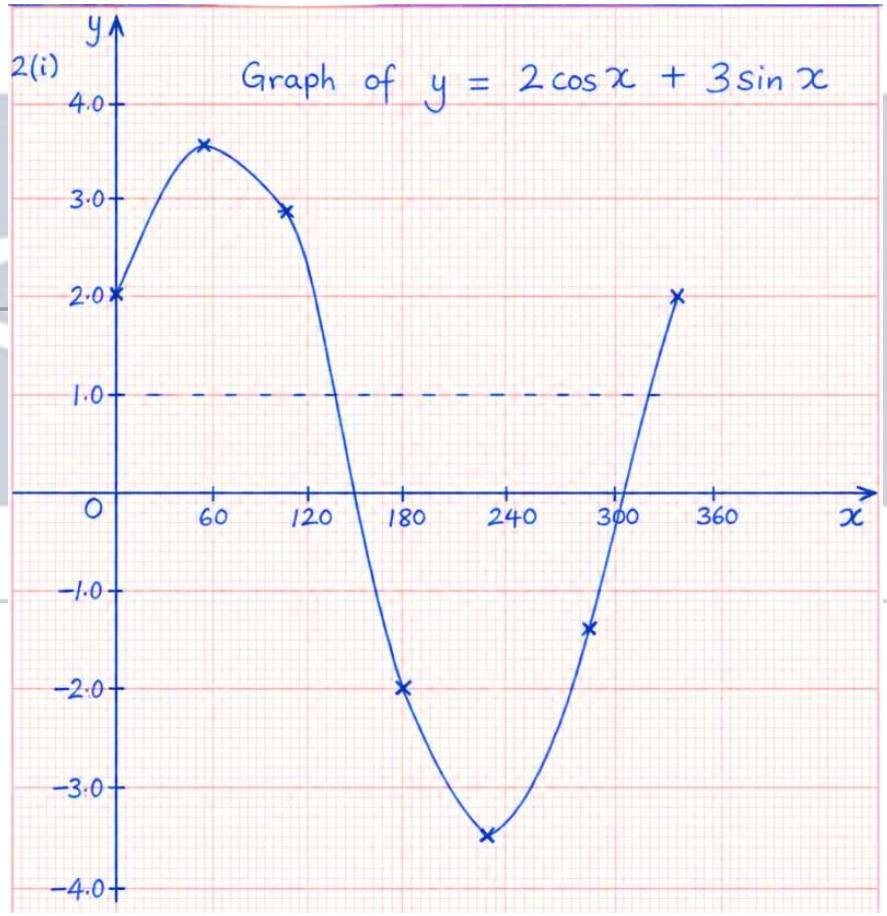
9(b) *(graph of y = 2Cosx + 3Sinx)*

9(c)

(i) From the graph: 2Cosx + 3Sinx = –1

When y = –1, from the graph, x = **162° and 312°**

(ii) When x = 342°, y = **0.9**



10(a) C.P. for the 130kg of tomatoes = ₦52,000

If 130kg = ₦52,000

⇒ 1kg = 52,000/130 × 1 = ₦400

⇒ 1kg = ₦400 (Cost Price)

Originally: half = 130/2 = 65kg

Amount for half = 52,000 ÷ 2 = ₦26,000

Selling Price for half (65kg) at 30% profit

⇒ (30/100) × 26,000 = ₦7,800

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For the 65kg; 26,000 + 7,800 = ₦33,800

Now, S.P. per kg = 33,800/65 = ₦520

For the 2nd half (65kg) at 12% reduction

⇒ ₦520 – ((12/100) × ₦520)

= ₦520 – ₦62.40

= **₦457.60**

10(b) If 5kg was thrown away, it implies that 60kg was sold at ₦457.60/kg.

⇒ Total S.P. for the 60kg = ₦457.60 × 60 = ₦27,456

⇒ Total Selling Price = ₦33,800 + ₦27,456 = ₦61,256

Total Profit made (overall) = 61,256 – 52,000 = ₦9,256.00

Hence, % Profit = 9,256/52,000 × 100 = **17.8%**

11(a) $T_3 = 1/4$, $T_6 = 1/32$

⇒ $ar^2 = 1/4$ ... (1)

and $ar^5 = 1/32$ ... (2)

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Eqn (2) ÷ Eqn (1):

$ar^5/ar^2 = (1/32) \div (1/4)$

$\Rightarrow r^3 = (1/32) \times 4 = 1/8$

Hence $r = \sqrt[3]{(1/8)} = 1/2$

Substituting r = 1/2 in equation (1), we have:

$a(1/2)^2 = 1/4$

$\Rightarrow a(1/4) = 1/4$

$\Rightarrow a/4 = 1/4$

$\Rightarrow 4a = 4$

$\therefore a = 4/4 = 1$

(i) Hence, 1st term = **1**, Common ratio = **1/2**

(ii) 7th term $(T_7) = ar^6$

$T_7 = 1(1/2)^6 = 1(1/64) =$ **1/64**

11(b) If $x = 2 \Rightarrow x - 2 = 0$

and if $x = -3 \Rightarrow x + 3 = 0$

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Combining the two equations:

$(x – 2)(x + 3) = 0$ (Expanding)

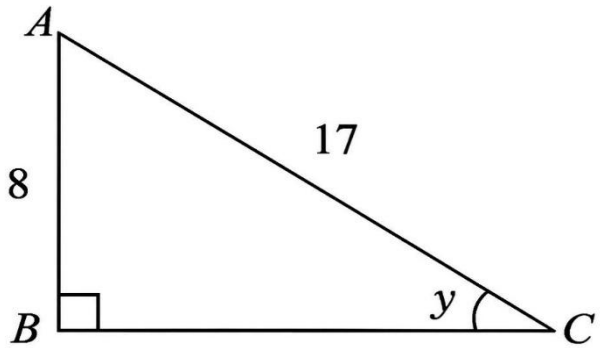
$x^2 + 3x – 2x – 6 = 0$

(Note: this continues onto the equation $ax^2 + bx + c = 0$ on the next page)

12(a) $x^2 + x – 6 = 0$

Comparing this equation with $ax^2 + bx + c = 0$ $\Rightarrow a = 1, b = 1, c = –6$

Sin y = 8/17 But Sin y = opposite/Hypotenuse



(right triangle with angle y at C, hypotenuse 17, opposite side 8, adjacent side BC)

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To find the adjacent (BC) in the Δ above, using Pythagoras theorem:

$|BC|^2 = 17^2 - 8^2$

$\Rightarrow |BC|^2 = 289 - 64 = 225$

$\therefore |BC| = \sqrt{225} = 15$

Evaluating tan y/(1 + 2 tan y):

$\Rightarrow (8/15) \div (1 + 2(8/15))$

$= (8/15) \div (1 + 16/15)$

$= (8/15) \div (15+16)/15$

$= (8/15) \times (15/31)$

$= \mathbf{8/31}$

12(b) Total Amount shared = ₦300,000.00

Otobo, Ada, Adeola

Otobo received ₦60,000.00

⇒ 300,000 – 60,000 = ₦240,000.00

⇒ Ada and Adeola shared ₦240,000.00

For Ada = 5/12 × 240,000 = ₦100,000

⇒ Adeola received 240,000 – 100,000 = ₦140,000.00

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Sharing ratio:

Otobo : Ada : Adeola

60,000 : 100,000 : 140,000

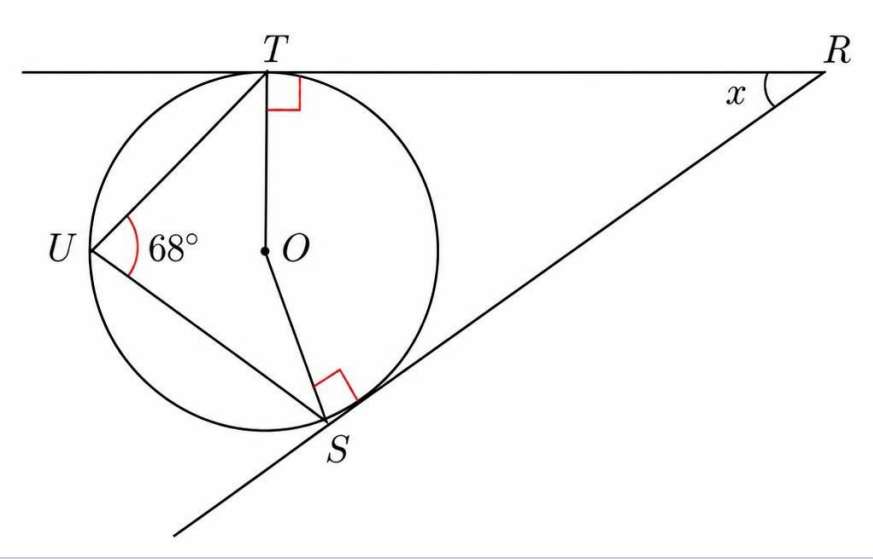
60/300 : 100/300 : 140/300

1/5 : 1/3 : 7/15

3 : 5 : 7 (out of 15)

Hence, the ratio = **3 : 5 : 7**

13(a) *circle with centre O, lines RS and RT tangent to the circle, points T, U, S on circle, ∠TUS = 68°, ∠SRT = x°)*



∠TOS = 2(68°) — ∠ at Centre = 2∠ at Circumference

⇒ ∠TOS = 136°

Consider quadrilateral TRSO:

∠RTO + ∠TOS + ∠OSR + ∠TRS = 360°

90° + 136° + 90° + x = 360°

⇒ x + 316° = 360°

⇒ x = 360 – 316

∴ x = **44°**

13(b) Let the capacities of Tanks A and B be x and y respectively.

$\Rightarrow x = y + 600$ ... (1)

or $x - y = 600$ ... (1b)

Pumping out 100 litres of diesel from each tank:

$\Rightarrow$ x becomes $(x - 100)$ and y becomes $(y - 100)$

Implying that:

$x - 100 = 3(y - 100)$ ... (2)

$\Rightarrow x - 100 = 3y - 300$

$\Rightarrow x - 3y = -300 + 100$

$\Rightarrow x - 3y = -200$ ... (2b)

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Comparing equations (1b) and (2b):

$x - y = 600$

$x - 3y = -200$

Subtracting:

$x - x - y - (-3y) = 600 - (-200)$

$\Rightarrow -y + 3y = 600 + 200$

2y = 800

∴ y = 800/2 = 400

⇒ y = 400 litres

To find the value of x, from equation (1):

x = y + 600 (Put y = 400)

⇒ x = 400 + 600

∴ x = 1000 litres

Hence, the Capacity of Tank A = **1000 Litres**

and the Capacity of Tank B = **400 Litres**

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ANSWERS TO WASSCE JUNE 2020 GENERAL MATHEMATICS 2 ESSAY (THEORY)

1.(a) A′ = {1, 3, 5, 7, 9}

B′ = {1, 2, 4, 5, 7, 8, 10}

C′ = {4, 5, 7, 8, 9, 10}

A′ ∩ B′ ∩ C′ = {5, 7}

(b) Total cost for 5 persons = $18.50 × 5 = $92.50

Amount saved = $92.50 − $80 = $12.50

Amount saved by each person = $12.50 ÷ 5 = $2.50

Alternative: price per person = $80 ÷ 5 = $16.00, so amount saved = $18.50 − $16.00 = $2.50

2.

(a)(i) P^(3/2) = rk/Q − mS

P^(3/2) + mS = rk/Q

Q(P^(3/2) + mS) = rk

Q = rk / (P^(3/2) + mS)

(ii) Q = (10 × 4) / (3^(3/2) + 15(0.2)) = 40 / (5.196152 + 3) = 4.88

(b) x + 2y = 5x − 10y

4x = 12y

x = 3y

x/y = 3/1

x : y = 3 : 1

3.

(a) SEE DIAGRAM

Let ∠CBD = ∠CDB = a.

a + a + 108° = 180°, so a = 36°

∠BDE = 90°

∠CDE = 90° + 36° = 126°

(b) sin x = √3/2 and cos x = 1/2

$(\cos^2 x - \sin x)/(\sin^2 x + \cos x) = ((1/2)^2 - \sqrt{3}/2) / ((\sqrt{3}/2)^2 + 1/2)$

$= (1 - 2\sqrt{3})/5$

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4.

(a) $r/l = 2/5$, so $l = 5r/2$

Total surface area $= \pi r^2 + \pi rl$

$224\pi = \pi r(r + 5r/2)$

$7r^2 = 448$

$r = 8$ cm

$l = (5 \times 8)/2 = 20$ cm

(b) $h = \sqrt{(20^2 - 8^2)} = 18.33$ cm

$V = \frac{1}{3} \times 22/7 \times 8 \times 8 \times 18.33 = 1229\ cm^3$

5.

(a) $P(2) = m/(170 + m) = 0.15$

$m = 0.15(170 + m)$

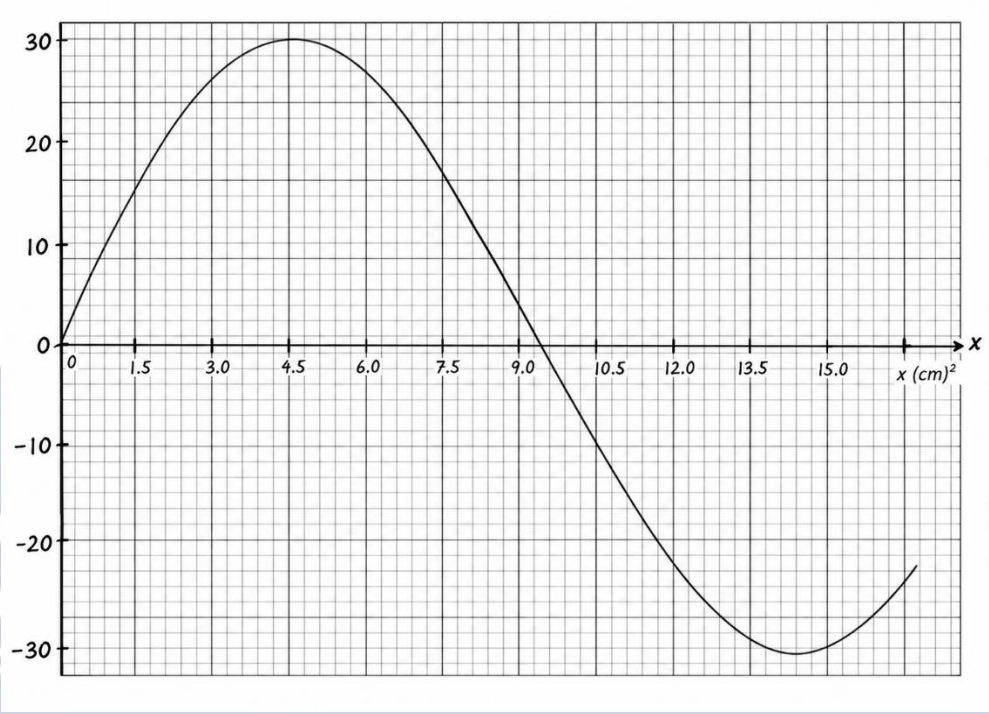
$m = 25.5 + 0.15m$

$0.85m = 25.5$

$m = 30$

(b) Number of times $= 170 + 30 = 200$

(c) P(even number) $= (30 + 45 + 40)/200 = 115/200 = 23/40$ (accept 0.575)



6.

(a)

x	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°
y	0.00	1.5	2.6	3.0	2.6	1.5	0.0	−1.5	−2.6	−3.0	−2.6

(b) SEE DIAGRAM

(c)(i) 3 sin 2x + 2 = 0, so 3 sin 2x = −2

Draw the line y = −2 and read off the graph.

Solution set = {x : x = 112° ± 1.5°}

(ii) (3/2) sin 2x = 0.25, so 3 sin 2x = 0.5

Draw the line y = 0.5 and read off the graph.

Solution set = {x : x = 4.5° ± 1.5°, 84.5° ± 1.5°}

7.

(a) SEE DIAGRAM

$l^2 = 48^2 + 14^2 = 2500$, so l = 50 m

Curved surface area of cone = $\pi rl = 22/7 \times 50 \times 14 = 2200\ m^2$

Surface area of hemisphere = $2\pi r^2 = 2 \times 22/7 \times 14 \times 14 = 1232\ m^2$

Surface area of structure = 2200 + 1232 = 3432 m^2 = 3430 m^2 (3 s.f.)

(b) Let x be Sesay's age and y be Musah's age.

x + y = 100 …(1)

y − 5 = 2(x − 5), so 2x − y = 5 …(2)

Adding (1) and (2): 3x = 105, so x = 35

Sesay's age = 35 years

Alternative: let Musah's age be m, so Sesay's age is 100 − m.

m − 5 = 2(100 − m − 5)

m − 5 = 190 − 2m

3m = 195, so m = 65

Sesay's age = 100 − 65 = 35 years

8.

(a)(i) Let x be her monthly income.

¼x + ⅓x = 7/12 x

Fraction left = x − 7/12 x = 5/12 x

Fraction spent at the mechanic workshop = ⅖ × 5x/12 = x/6

New fraction left = 5x/12 − x/6 = x/4

x/4 = 225,000

x = ₦900,000.00

(ii) Open market = ⅓ × 900,000 = ₦300,000.00

(b) 4m − 2n = a + 2d

2m − 8n = a + 8d

Subtracting: 2m + 6n = −6d

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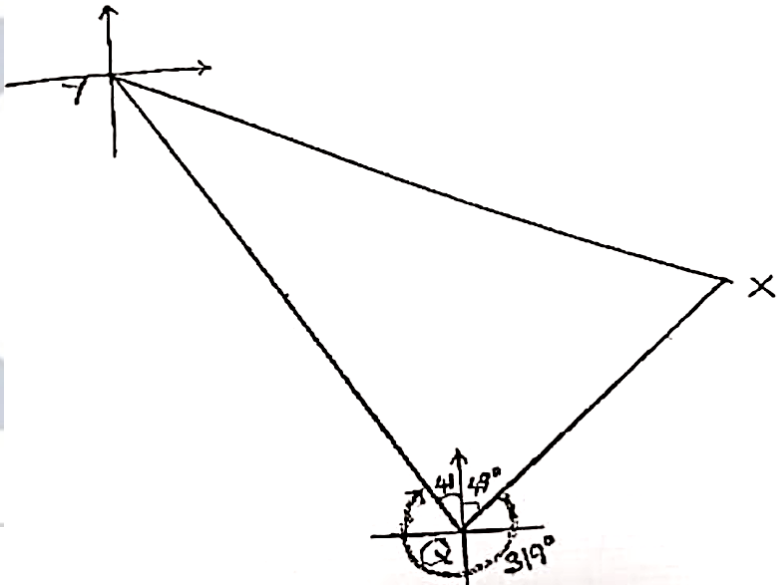
$|XY|^2 = 18^2 + 10^2$

$|XY| = \sqrt{424} = 20.5913$ km = 21 km

d = −(2m + 6n)/6

d = −(m + 3n)/3 (or equivalent)

9.((bearings 049°, 319° and 41° marked, showing the relative



positions of X and Y)

(b)(i) $|XY|^2 = |QY|^2 + |QX|^2$

$|QY| = 9 \times 2 = 18$ km

$|QX| = 5 \times 2 = 10$ km

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(ii) tan y = 10/18

y = $\tan^{-1}(10/18)$ = 29.06°

Bearing of X from Y = 180° − (41° + 29.06°) = 109.94° = 110°

(c) Average speed = 20.5913/4 = 5.147825 = 5.15 km/h

10.(a)

Marks	UCB	Frequency	Cumulative frequency
0–9	9.5	7	7
10–19	19.5	11	18
20–29	29.5	17	35
30–39	39.5	20	55
40–49	49.5	29	84
50–59	59.5	34	118
60–69	69.5	30	148
70–79	79.5	25	173
80–89	89.5	21	194
90–99	99.5	6	200

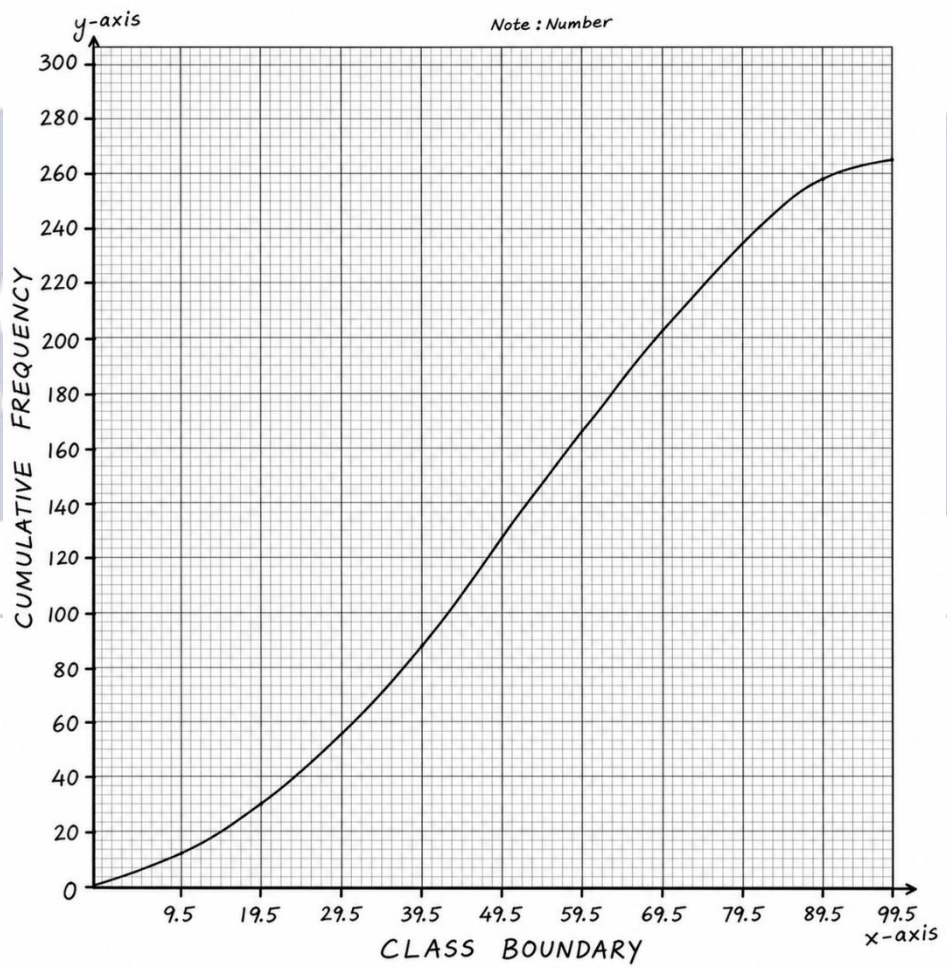
(b) SEE DIAGRAM (cumulative frequency curve, plotted with upper class boundaries)

(c)(i) 200/2 = 100th term

From the curve, median = 54.5 ± 1

(ii) 95/100 × 200 = 190

From the curve, lowest mark for distinction = 88 ± 1

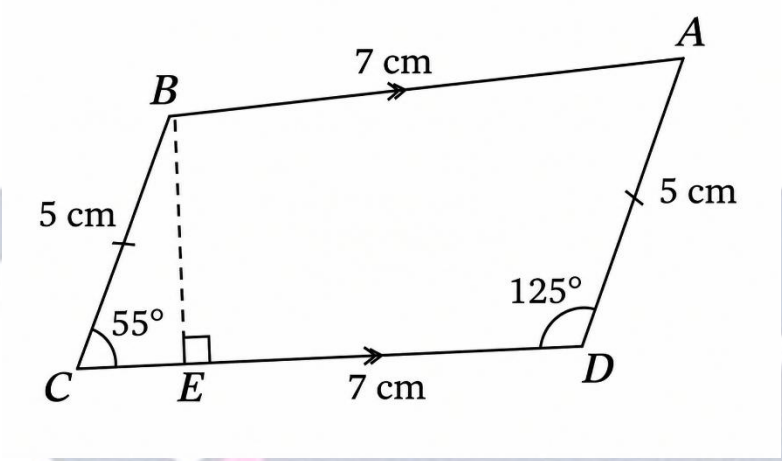


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11.(a)(i) SEE DIAGRAM

∠NPO = 180° − 50° = 130°

∠MPQ = 90°



∠MPN = 130° − 90° = 40°

∠MNP = 180° − 40° − 40° = 100°

(ii) ∠PMQ = 50° − 40° = 10°

∠POQ = 2 × 10° = 20°

(b) 8y + 4x = 24

y = −½x + 3, so gradient m = −½

y − 12 = −½(x + 8)

y − 12 = −½x − 4

y = −½x + 8 (or equivalent)

12.(a) SEE DIAGRAM

∠OCD = ∠ABC = 40°

∠CDE = 90°

∠ODE = 90° − 40° = 50°

(b (parallelogram with sides 7 cm and 5 cm, angles 125° and 55°)

(ii) ∠BCD = 180° − 125° = 55°

|BE| = 5 × sin 55° = 4.0958 cm

Area = 7 × 4.0958 = 28.69706 cm² = 28.7 cm² (1 d.p.)

(c) $2x^2 - 2x = 2(\frac{1}{2}(1 - \sqrt{2}))^2 - 2(\frac{1}{2}(1 - \sqrt{2}))$

$= \frac{1}{2}(1 - 2\sqrt{2} + 2) - (1 - \sqrt{2})$

$= \frac{1}{2}$

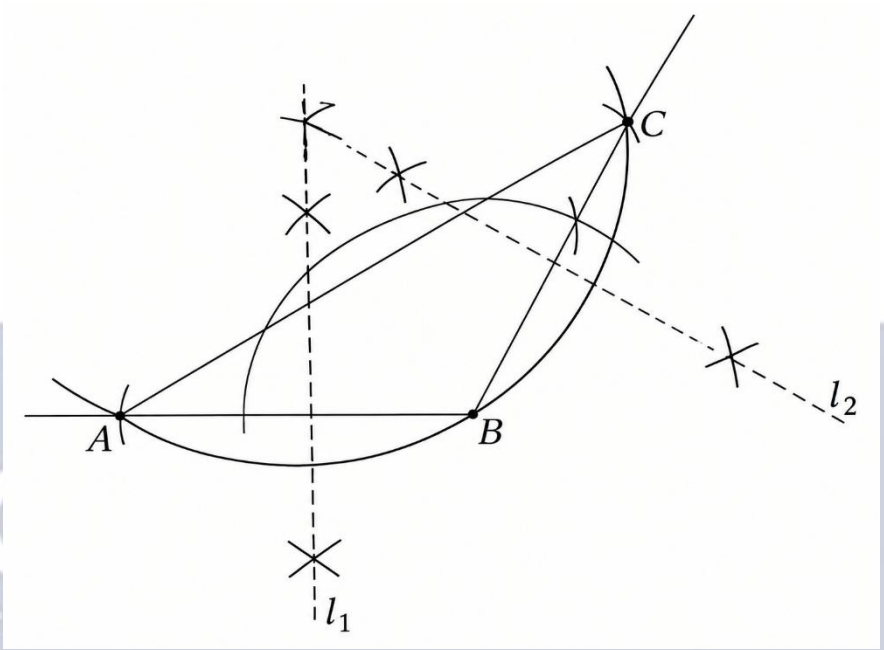
The scheme's printed middle line looks like it has a small slip.

Worked through fully: $\frac{1}{2}(3 - 2\sqrt{2}) - 1 + \sqrt{2} = 3/2 - \sqrt{2} - 1 + \sqrt{2} = \frac{1}{2}$.

---

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13.(a) (construction with arcs shown)



Marks are awarded for:

|AB| = 7.5 cm or |AC| = 13.5 cm

∠ABC = 120°

completing the triangle

the perpendicular bisectors l_1 and l_2

locating N

drawing the circle through A, B and C

(b) $4x^2 - 4\sqrt{3}x + 3 = 0$

$4x^2 - 4\sqrt{3}x = -3$

$x^2 - \sqrt{3}x = -\frac{3}{4}$

$x^2 - \sqrt{3}x + (-\sqrt{3}/2)^2 = -\frac{3}{4} + (-\sqrt{3}/2)^2$

$(x - \sqrt{3}/2)^2 = -\frac{3}{4} + \frac{3}{4}$

$(x - \sqrt{3}/2)^2 = 0$

$x - \sqrt{3}/2 = 0$

$x = \sqrt{3}/2$ (repeated)

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ANSWERS TO WASSCE JUNE 2021 GENERAL MATHEMATICS 2 ESSAY (THEORY)

1.(a) Interest = (25000 × 3 × 21)/100 = $15,750.00

Amount paid = $(25,000 + 15,750) = $40,750.00

Amount paid per year = $40,750.00/2 = $20,375.00

Marks: M1 for finding interest; A1 for $15,750.00; M1 for dividing; A1 for $20,375.00 (4 marks)

(b) Let the consecutive numbers be x and (x + 1)

3x + 2(x + 1) = 17

3x + 2x + 2 = 17

5x = 15

x = 3

Sum of the numbers = 3 + 4 = 7

Percentage = 3/7 × 100%

= 42.857%

= 42.9% (3 s.f.)

Marks: M1 for forming equation; A1 for x = 3; M1 for finding percentage; A1 for 42.9% (3 s.f.) (4 marks)

[8 marks]

2.

Time spent travelling = 3 hours 55 mins − 2 hours

= 1 hr 55 mins (accept 1 11/12 hours)

Let x be the distance from M to N and t be the time spent by car from M to N. Then,

t = x/72

Return time = 23/12 − t

23/12 − t = (x + 2)/40

23/12 − x/72 = (x + 2)/40

(138 − x)/72 = (x + 2)/40

(138 − x)/9 = (x + 2)/5

690 − 5x = 9x + 18

14x = 672

x = 48 km

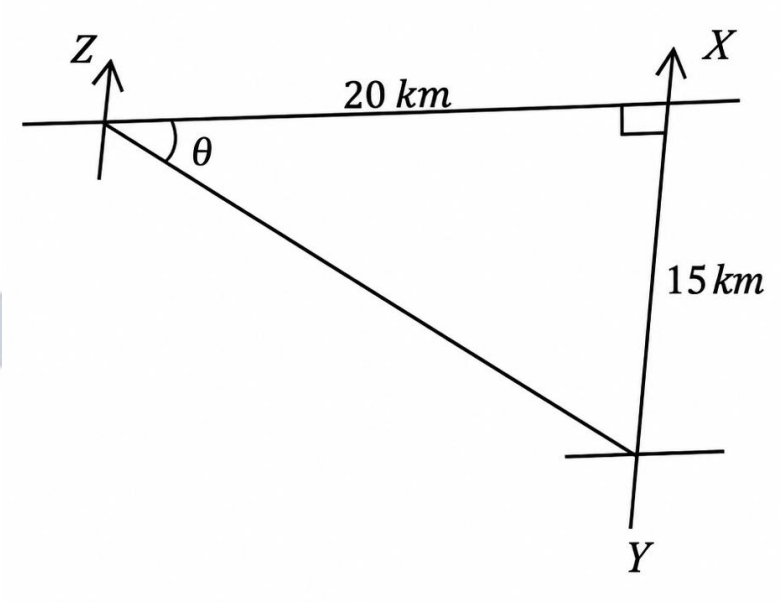
Marks: M1 for subtracting; A1 for 1 hr 55 mins (accept 1 11/12 hours); B1 for x/72; B1 for 23/12 − t; M1 for equating; M1 for clearing fractions; M1 for solving; A1 for 48 km

[8 marks]

3.

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(a)



$|YZ|^2 = 15^2 + 20^2 = 225 + 400$

$|YZ|^2 = 625$

$|YZ| = \sqrt{625}$

= 25 km

Marks: B1 (–½ ee) for diagram showing 15 km, 20 km, 90° or 270° and relative positions of X, Y and Z; M1 for use of Pythagoras; M1 for simplification; A1 for 25 km (4 marks)

(b) $\tan \theta = 15/20$

= 0.75

$\theta = \tan^{-1}(0.75)$

= 36.87°

Bearing of Y from Z = 90° + 36.87°

= 126.87°

= 127°

Marks: M1 for tan ratio or equivalent; A1 for 36.87°; M1 for adding; A1 for 127° (4 marks)

[8 marks]

4.

(a) ∠OAB = ∠OBA = 34°

∠ABD = 90°

∠OBD = ∠ABD − ∠OBA

= 90° − 34°

= 56°

Marks: B1 for 34°; M1 for subtracting; A1 for 56° (3 marks)

(b) From ΔOBC

∠BOC + ∠OBC + ∠OCB = 180°

∠BOD = 2∠OAB = 68°

68° + 90° + ∠OCB = 180°

∠OCB = 180° − 158°

= 22°

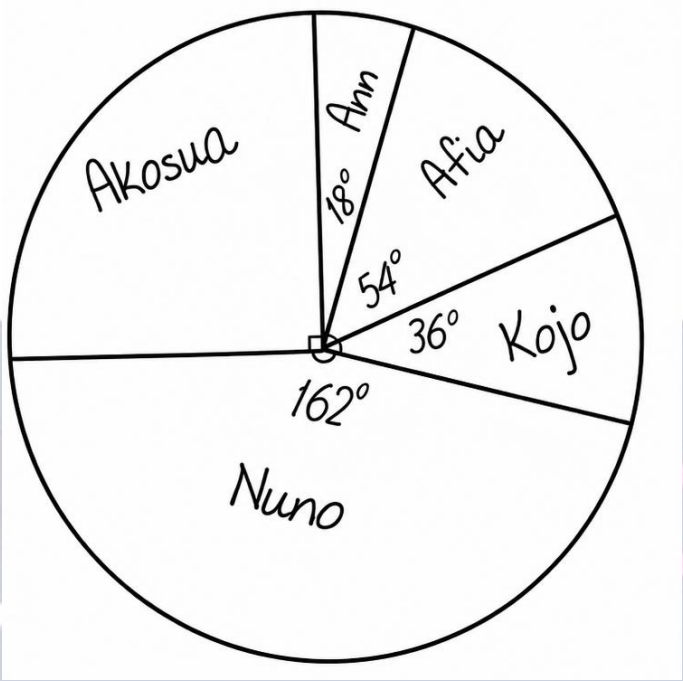
Marks: B1 for 68°; M1 for equating; A1 for correct equation; M1 for subtracting; A1 for 22° (5 marks)

[8 marks]

5.

(a)

Child's name	Percentage share (%)	Angle
Ann	5	5/100 × 360° = 18°
Afia	15	15/100 × 360° = 54°
Kojo	10	10/100 × 360° = 36°
Nuno	45	45/100 × 360° = 162°
Akosua	25	25/100 × 360° = 90°
Total	100	360°



Marks: M1 for showing at least one correct working; A2 (−1 ee) for all correct; B2 (−½ ee) for pie chart (5 marks)

(b) P(1st red) = 5/12

P(2nd red) = 4/11

Probability (two red beads) = 5/12 × 4/11

= 5/33 (accept 0.1515)

Marks: B1 for 4/11; M1 for finding probability; A1 for 5/33 (accept

0.1515) (3 marks)

[8 marks]

6.(a)(i) Let x = number of students that studied both subjects

n(U) = 80

Marks: B2 (–½ ee) for Venn diagram showing n(U) = 80, two intersecting sets properly labelled, n(B) = 60 and n(P) = 48

(ii) 60 − x + x + 48 − x = 80

x = 108 − 80

= 28

Marks: M1 for equating; M1 for solving; A1 for 28

(iii) Fraction = (60 − 28)/80 = 32/80

= 2/5

Marks: M1 for finding fraction; A1 for 2/5 (7 marks)

(b) Area of floor = 15 × 8 = 120 m²

Cost of carpeting = 120 × GHC 890

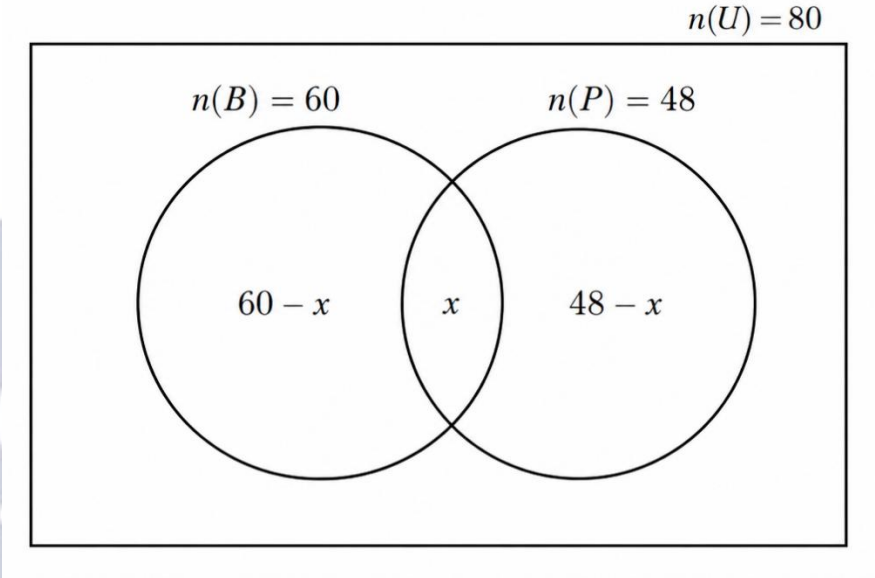
= GHC 106,800.00

Cost of painting = GHC (216,120 − 106,800)

= GHC 109,320.00

Marks: B1 for 120 m²; M1 for finding product; A1 for GHC 106,800.00; M1 for subtracting; A1 for GHC 109,320.00 (5 marks)

[12 marks]



7.(a)

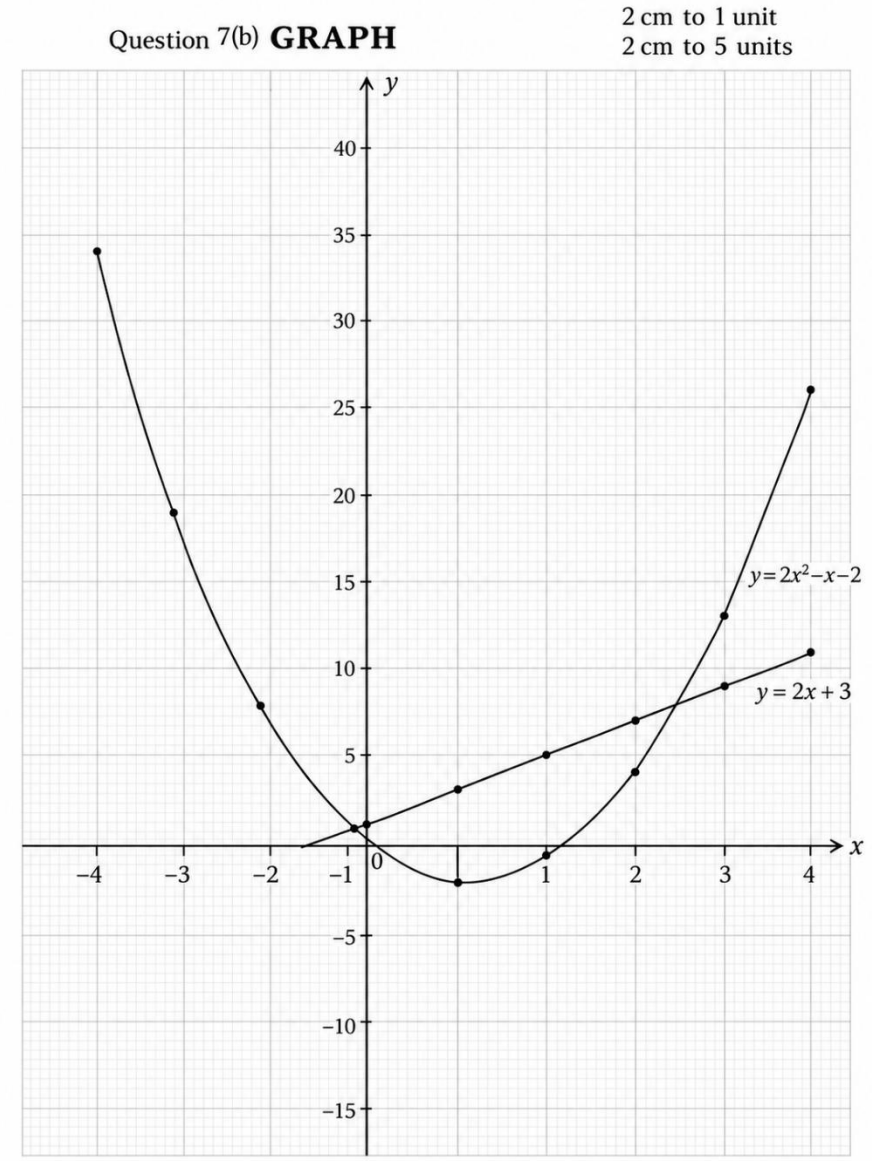
x	**−4**	**−3**	**−2**	**−1**	**0**	**1**	**2**	**3**	**4**
y	34	19	8	1	−2	−1	4	13	26

Marks: B3 (–½ ee) for table (3 marks)

(b) See the attached graph:

Marks: B3 (–½ ee) for graph (3 marks)

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(c) Straight line graph of y = 2x + 3 (drawn on the same graph)

Marks: B1 for line of y = 2x + 3 (1 mark)

(d)(i) The roots of $2x^2 - 3x - 5 = 0$ are $x = -1 \pm 0.1$ or 2.5 ± 0.1

Marks: M1 for reading; A1 for x = −1 ± 0; A1 for x = 2.5 ± 0.1

(ii) The range of values of x for which $2x^2 - x - 2 < 0$ is $(-0.7 \pm 0.1) < x < (1.3 \pm 0.1)$

Marks: M1 for reading; A1 for range (5 marks)

[12 marks]

8.(a) ½|PQ||QR| = 216

|PQ|/|QR| = 3/4

|PQ| = ¾|QR|

½ × ¾ |QR||QR| = 216

$|QR|^2 = (216 \times 4 \times 2)/3$

$|QR|^2 = 576$

|QR| = √576

= 24 cm

|PQ| = ¾ × 24 = 18 cm

$|PR| = \sqrt{(24^2 + 18^2)}$

= 30 cm

Marks: B1 for |PQ|/|QR| = 3/4; M1 for substituting; M1 for simplifying; M1 for finding square root; A1 for 24 cm; B1 for 18 cm; M1 for the use of Pythagoras theorem; A1 for 30 cm (8 marks)

(b) Let m be the number of years

47 + m = 2(17 + m)

47 + m = 34 + 2m

2m − m = 47 − 34

m = 13 years

Marks: M1 for equating; A1 for correct equation; M1 for solving; A1 for 13 years (4 marks)

[12 marks]

9.(a) Area of ΔPQR = ½ × b × 12 = 20

b = (2 × 20)/12 = 3.33 cm

|QR| = |UT| = 3.33 cm

|PQ| = √(12² + 5²)

= 13 cm

|RT| = |QU| = 12 cm

From ΔRTS

sin 50° = 12/|RS|

|RS| = 12/sin 50° = 15.6649 cm

|TS| = 12/tan 50°

= 10.069 cm

Perimeter = 13 + 3.33 + 15.6649 + 18.399

= 50.3939 cm

= 50 cm (nearest whole number)

Marks: M1 for finding area; A1 for 3.33 cm; M1 for use of Pythagoras theorem; A1 for 13 cm; M1 for sine ratio; A1 for 15.6649 cm; M1 for tan ratio or equivalent; A1 for 10.069 cm; M1 for finding perimeter; A1 for 50 cm (10 marks)

(b) Area = ½(3.33 + 18.4004) × 12

= 6(21.7304)

= 130.3824 cm²

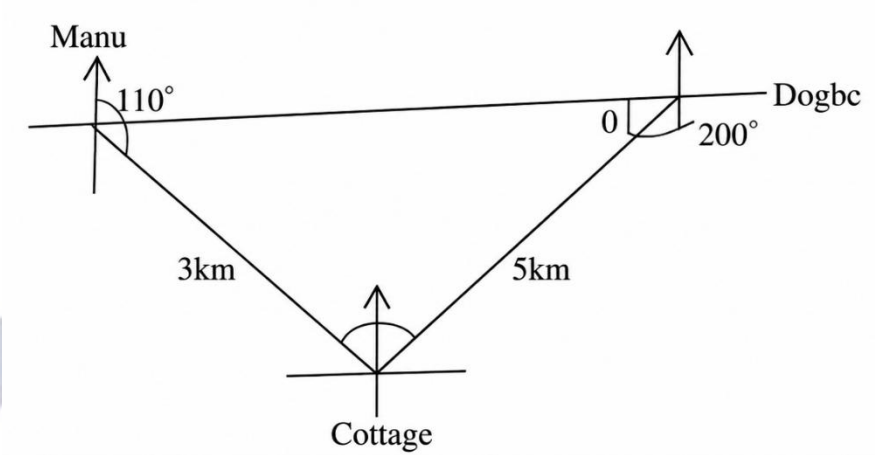
= 130 cm² (nearest whole number)

Marks: M1 for finding area; A1 for 130 cm² (2 marks)

[12 marks]

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10.(a)



Marks: B2 (−½ ee) for diagram showing 3 km, 5 km, 110° or 200° and relative positions of Dogbe's farm, Manu's farm and Cottage

(i) Distance between Manu and Dogbe's farm = $\sqrt{(3^2 + 5^2)}$

= 5.83 km

= 5.8 km (2 s.f.)

Marks: M1 for use of Pythagoras; A1 for 5.8 km

(ii) $\tan \theta = 3/5 = 0.6$

$\theta = \tan^{-1}(0.6)$

= 30.96°

Bearing = 30.96° + 200°

= 230.96°

= 231° (nearest degree)

Marks: M1 for tan ratio or equivalent; A1 for 30.96°; M1 for addition; A1 for 231° (8 marks)

(b) $x^2 + (x + 2)^2 = 10^2$

$2x^2 + 4x - 96 = 0$

$(x - 6)(x + 8) = 0$

$x = 6, x = -8$

x = 6 m (CAO)

Marks: B1 for x + 2; M1 for Pythagoras; M1 for solving; A1 for x = 6 m (4 marks)

[12 marks]

11.

x	f	fx	fx^2
4	5	20	80
5	7	35	175
6	5	30	180
7	9	63	441

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x	f	fx	fx^2
8	12	96	768
9	4	36	324
10	3	30	300
11	5	55	605
	$\Sigma f = 50$	$\Sigma fx = 365$	$\Sigma fx^2 = 2{,}873$

Marks: M1A2 (−½ ee) for fx; M1A2 (−½ ee) for fx^2; B1 for Σfx^2 = 2,873

(a) Mean ($\bar{x}$) = 365/50

= 7.30 (2 d.p.)

Marks: M1 for finding mean; A1 for 7.30 (9 marks)

(b) Standard deviation = $\sqrt{(2873/50 - (7.3)^2)}$

= $\sqrt{4.17}$

= 2.0421

= 2.04 (2 d.p.)

Marks: M1 for substituting; M1 for simplifying; A1 for 2.04 (3 marks)

[12 marks]

11. Alternative method

x	f	fx	$(x - \bar{x})$	$(x - \bar{x})^2$	$f(x - \bar{x})^2$
4	5	20	−3.3	10.89	54.45
5	7	35	−2.3	5.29	37.03
6	5	30	−1.3	1.69	8.45
7	9	63	−0.3	0.09	0.81
8	12	96	0.7	0.49	5.88
9	4	36	1.7	2.89	11.56
10	3	30	2.7	7.29	21.87
11	5	55	3.7	13.69	68.45
Total	50	365			208.5

Marks: M1A2 (−½ ee) for fx; M1A2 (−½ ee) for $f(x - \bar{x})^2$; B1 for $\Sigma f(x - \bar{x})^2$ = 208.5

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(a) Mean ($\bar{x}$) = 365/50

= 7.30 (2 d.p.)

Marks: M1 for finding mean; A1 for 7.30 (9 marks)

(b) Standard deviation = $\sqrt{(\Sigma f(x - \bar{x})^2/\Sigma f)}$

= $\sqrt{(208.5/50)}$

= $\sqrt{4.17}$

= 2.0421

= 2.04 (2 d.p.)

Marks: M1 for substituting; M1 for simplifying; A1 for 2.04 (3 marks)

[12 marks]

12.

(a)(i) $\angle PSQ = \angle QPS$

$\angle PQS = 2/8 \times 180°$

= 45°

$\angle SPQ = \angle PSQ = 3/8 \times 180°$

= 67.5°

$\angle SQR = \angle SPR = 26°$

$\angle PQR = \angle PQS + \angle SQR$

= 45° + 26°

= 71°

Marks: B1 for $\angle PQS = 45°$; B1 for $\angle SPQ = 67.5°$; M1 for adding; A1 for 71°

(ii) $\angle RPQ = \angle SPQ - \angle SPR$

= 67.5° − 26°

= 41.5°

Marks: M1 for subtracting; A1 for 41.5°

(iii) $\angle PRQ = 180° - 41.5° - 71°$

= 67.5°

Marks: M1 for finding $\angle PRQ$; A1 for 67.5° (8 marks)

(b) $\sqrt{29} = \sqrt{((7 - 5)^2 + (3 - x)^2)}$

$\sqrt{29} = \sqrt{(2^2 + (3 - x)^2)}$

$29 = 4 + (3 - x)^2$

$25 = (3 - x)^2$

$x^2 - 6x - 16 = 0$

$(x + 2)(x - 8) = 0$

$x = -2$ or 8

Marks: M1 for use of Pythagoras theorem; M1 for squaring; M1 for

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factorizing; A1 (−½ ee) for x = −2 or 8 (4 marks)

[12 marks]

13.

(a) Amount at end of 2nd year = 104/100 × $1000

= $1,040.00

Amount at end of 3rd year = 104/100 × $1040

= $1,081.60

Amount at end of 4th year = 104/100 × $1081.6

= $1,124.86

Marks: M1 for 104/100 × $1,000; A1 for $1,040.00; A1 for $1,081.60; M1 for 104/100 × $1081.6; A1 for $1,124.86 (5 marks)

(b) ∠ADC + ∠DCA + ∠CAD = 180°

50° + 90° + ∠CAD = 180°

∠CAD = 180° − 140°

= 40°

∠ADC + ∠ABC = 180°

50° + ∠ABC = 180°

∠ABC = 130°

∠BAC + ∠BCA + ∠ABC = 180°

But ∠BAC = ∠BCA

2∠BAC + 130° = 180°

2∠BAC = 50°

∠BAC = 25°

∠BAD = ∠CAD + ∠BAC

= 40° + 25°

= 65°

Marks: M1 for adding; A1 for ∠CAD = 40°; M1 for equating; A1 for ∠ABC = 130°; M1 for equating; A1 for ∠BAC = 25°; A1 for ∠BAD = 65° (7 marks)

[12 marks]

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ANSWERS TO WASSCE JUNE 2022 GENERAL MATHEMATICS 2 ESSAY (THEORY)

SECTION A

1.(a) Common ratio r = 9/(7 − 2x) = (5x + 17)/9

9 × 9 = (7 − 2x)(5x + 17)

81 = 35x + 119 − 10x² − 34x

10x² − x − 38 = 0

(x − 2)(10x + 19) = 0

x = 2 or x = −19/10

Since r > 0, **x = 2**

(b) Let the numbers be x and y, with x : y = 3 : 4.

x/y = 3/4, so x = (3/4)y

3x + 2y = 68

3(3/4 y) + 2y = 68

9y/4 + 2y = 68

9y + 8y = 272

17y = 272, so y = 16

x = (3/4) × 16 = 12

The smaller number is 12

2.(a) y = (pr/m − p²r)^(−3/2)

y^(−2/3) = pr/m − p²r

= (pr − p²rm)/m

m y^(−2/3) = pr − p²rm

m y^(−2/3) = r(p − p²m)

r = m y^(−2/3) / (p − p²m)

(b) r = 1(−8)^(−2/3) / (3 − 3²(1))

= (1/4) / (3 − 9)

= (1/4) / (−6)

r = −1/24

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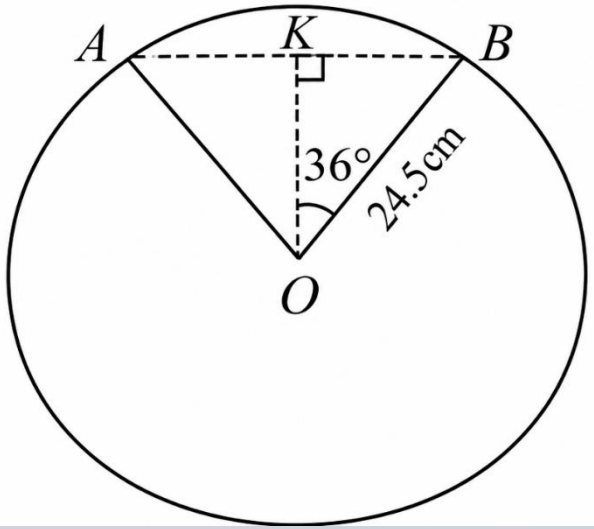
3. (circle with centre O, chord AB, perpendicular OK, angle KOB = 36°, radius 24.5 m)

From triangle OKB: sin 36° = |KB|/24.5

|KB| = 0.5878 × 24.5 = 14.4011 m

Length of arc = (72/360) × 2 × (22/7) × 24.5 = 30.8 m

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Perimeter =

2(14.4011) +

30.8 =

59.6022

Perimeter =

59.6 m

x = 35°

y = 65 − 35 = **30°**

(b) ∠ABC + [2 × 35° + 40°] + [5(35°) − 35°] + 40° = 360°

∠ABC + 110° + 140° + 40° = 360°

∠ABC + 290° = 360°

∠ABC = 70°

4.(a) **SEE DIAGRAM**

2x + 40 + 2y + 10 = 180° …(1)

2x + 2y = 130°

x + y = 65°

5x − 35 = 2(2y + 10) …(2)

5x − 35 = 4y + 20

5x − 4y = 55

5x − 4(65 − x) = 55

5x − 260 + 4x = 55

9x = 315

5.(a) (m − n)/(mn) with m = tan 30° = 1/√3 and n = tan 45° = 1

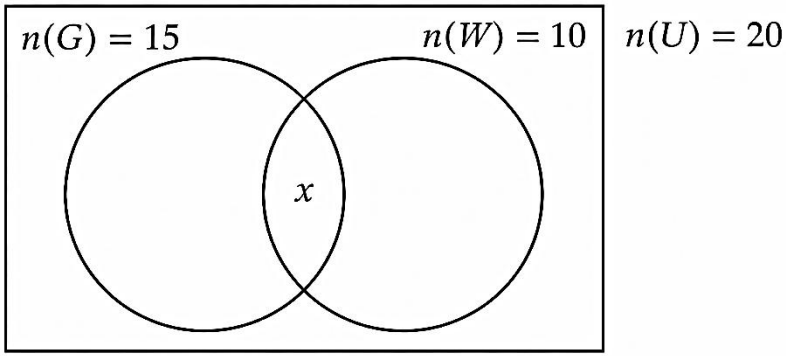
= (1/√3 − 1) / (1/√3)

= ((1 − √3)/√3) × √3

Working as printed: (√3 − 3)/√3 × (√3/√3) = (3 − 3√3)/3

= 1 − √3

(b)



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(Venn diagram with n(G) = 15, n(W) = 10, n(U) = 20 and the overlap marked x)

20 = 15 + 10 − x

x = 25 − 20 = 5

P(both) = 5/20 = **1/4 or 0.25**

SECTION B

6.(graph of $y = mx^2 + nx + r$, with points P and Q)

(a) The scales are given in the marking scheme as: x-axis, 2 cm to 1 unit (or 1 cm to 1 unit); y-axis, 2 cm to 10 units (or 1 cm to 5 units). The top of this page is cut off in the photo, so check the exact wording against your copy.

The roots from the graph: x = −4 and x = 2

(x + 4)(x − 2) = 0

$x^2 + 2x - 8 = 0$

Curve has a maximum point, so $y = 8 - 2x - x^2$

(b) **m = −1, n = −2, r = 8**

This is as the scheme shows it. Check it against your copy: the photo is slightly blurred at the values m = −1, n = −2 and r = 8.

(c) P(−5, −27), Q(3, 5)

Gradient = (5 + 27)/(3 + 5) = 32/8 = **4**

(d) Range: **{x : −2 < x < 4}**

The roots and the range in (d) don't seem to match. The photo of this section is blurred at the first lines, so check them against your copy.

7.

(a) Total cost = 180 × 250 = ₦45,000.00

Total selling price = 300y + (180 − y) × (95/100) × 250

= 300y + 42,750 − 237.5y

= 62.5y + 42,750

Profit = 62.5y + 42,750 − 45,000

7,125 = 62.5y − 2,250

9,375 = 62.5y

y = 150

(b)(i) Profit = $(33x - x^2/20) - (24x + 103)$

= $9x - x^2/20 - 103$

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(ii) Cost = 24(20) + 103 = 583.00

Selling price = 33(20) − (20)²/20 = 640

Percentage profit = ((640 − 583)/583) × 100%

= 9.78%

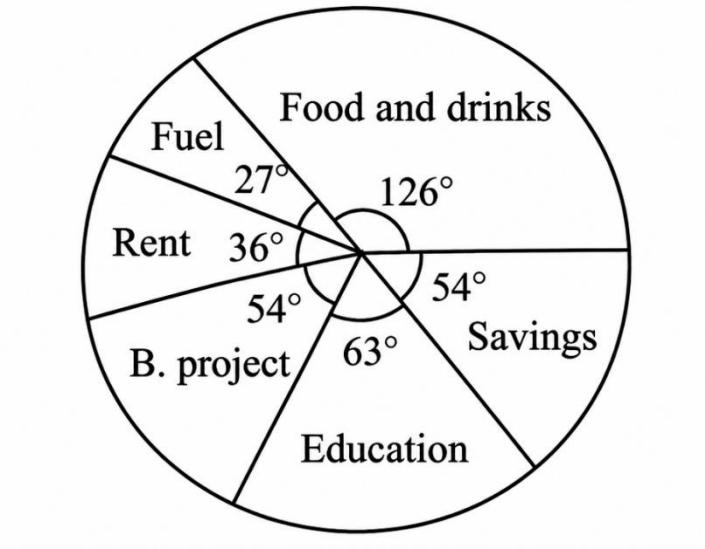
8.

(a) 35 + 7.5 + 10 + 15 + 17.5 + x = 100

85 + x = 100

x = 15%

(b) pie chart)



Angles: Food and drinks = (35/100) × 360° = 126°

Fuel = (7.5/100) × 360° = 27°

Rent = (10/100) × 360° = 36°

Building project = (15/100) × 360° = 54°

Education = (17.5/100) × 360° = 63°

Savings = (15/100) × 360° = 54°

(c)(i) Income tax = (12/100) × 28,800 = 3,456.00

Monthly income tax = 3,456 ÷ 12 = **288.00**

(ii) Monthly net salary = (1/12) (28,800 − 3,456) = 2,112.00

Amount saved each month = (15/100) × 2,112 = **316.80**

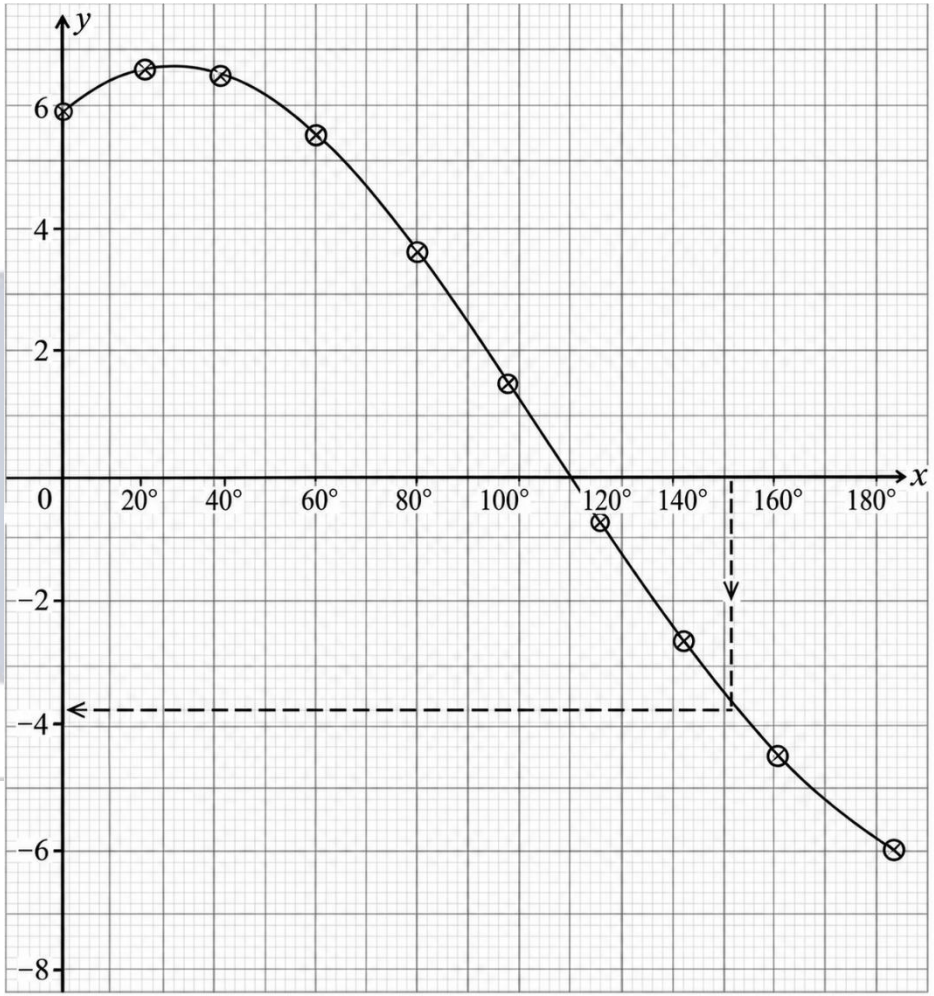
(The scheme prints the currency sign as "$" here, though the question reads ₦.)

9.

(a) Completed table:

x	**0°**	**20°**	**40°**	**60°**	**80°**	**100°**	**120°**	**140°**	**160°**	**180°**
y	7.0	7.6	7.3	6.1	4.2	1.7	−0.9	−3.4	−5.6	−7.0

(b)(graph of y = 3 sin x + 7 cos x)



(c)(i) When x = 150°, **y = −4.6 ± 0.2**

(ii) Range of x for which y > 0: **{x : 0 ≤ x < 113° ± 2°}**

10.

(a) Mean = (3×2 + 4×6 + 5×5 + 6×x + 7×6 + 8×9 + 9×8 + 10×5) / (2 + 6 + 5 + x + 6 + 9 + 8 + 5)

= (6 + 24 + 25 + 6x + 42 + 72 + 72 + 50) / (41 + x)

7 = (291 + 6x)/(41 + x)

7(41 + x) = 291 + 6x

287 + 7x = 291 + 6x

x = 4

(b) Table (with x = 4):

x	**f**	**fx^2**
3	2	18
4	6	96
5	5	125
6	4	144

x	f	fx^2
7	6	294
8	9	576
9	8	648
10	5	500
	$\Sigma f = 45$	$\Sigma fx^2 = 2401$

Standard deviation = $\sqrt{(2401/45 - 7^2)}$

= 2.087

Alternative: using $f(x - \bar{x})^2$:

x	f	$x - \bar{x}$	$f(x - \bar{x})^2$
3	2	−4	32
4	6	−3	54
5	5	−2	20
6	4	−1	4
7	6	0	0
8	9	1	9
9	8	2	32
10	5	3	45
	$\Sigma f = 45$		$\Sigma f(x - \bar{x})^2 = 196$

Standard deviation = $\sqrt{(196/45)} = \sqrt{4.355}$ = **2.087**

11.

(a) $x = y - 7$

$42 + 38 + 57 + x + x + y + 2x - 15 + 3x - y = 360°$

$122 + 7x = 360°$

$7x = 238°$

$x = 34°$

$34 = y - 7$

$y = 41°$

(b) **SEE DIAGRAM**

$\angle XZY = \frac{1}{2}(146°) = 73°$

$\angle OZX = 34°$

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∠OZY = 73° − 34° = 39°

∠OYZ = ∠OZY = **39°**

12.

(a) P(not winning) = 1/4, so P(winning a race) = 1 − 1/4 = 3/4

Working as printed: p = 1/4 is used for losing a race, p′ = 3/4 for winning one.

(i) P(only the second) = 1/4 × 3/4 × 1/4 = 3/64 = **0.05**

(ii) P(winning all) = 3/4 × 3/4 × 3/4 = 27/64 = **0.422**

(iii) P(winning two) = (3/4 × 3/4 × 1/4) + (3/4 × 1/4 × 3/4) + (1/4 × 3/4 × 3/4)

= 9/64 + 9/64 + 9/64

= 27/64 = **0.422**

(b) 84/24 = V/1200

V = (7/2) × 1200

V = 4200 cm³

13.

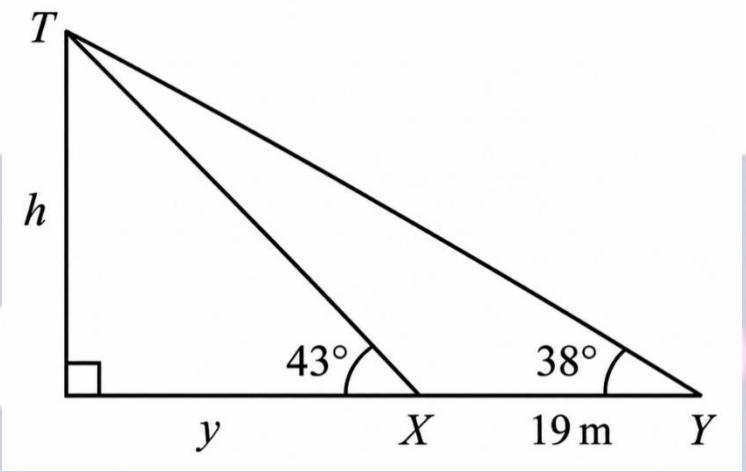
(a) 209 = 2 × (22/7) × (7/2)² + 2 × (22/7) × (7/2) × h

209 = 77 + 22h

132 = 22h

h = 6 cm

(b)



(triangle with the tree TF, points X and Y 19 m apart, angles of elevation 43° at X and 38° at Y)

Let y be the distance from the foot of the tree to X, and h the height.

tan 43° = h/y, so 0.9325y = h …(1)

tan 38° = h/(y + 19), so 0.7813(y + 19) = h …(2)

0.7813(y + 19) = 0.9325y

0.7813y + 14.8447 = 0.9325y

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14.8447 = 0.1512y

y = 98.1792

h = 0.9325 × 98.1792 = 91.55

h = 91.6 m

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ANSWERS TO WASSCE JUNE 2023 GENERAL MATHEMATICS 2 ESSAY (THEORY)

QUESTION 1

(a)

Time = distance ÷ speed

$Time_1 = 112/70$ [B1]

$Time_2 = 60/50$ [B1]

Total time = 112/70 + 60/50 [M1]

= 2.8 hours

= **2 hours 48 minutes** [A1] (4 marks)

(b)

(x + y)/(y + z) = (x/y + 1)/(1 + z/y) [M1]

= (2 + 1)/(1 + 1/3) [M1]

= 3/(4/3) [M1]

= 9/4

= **2¼ or 2.25** [A1] (4 marks)

[8 marks]

QUESTION 2

(a)

x + y = 400 ……(1) [B1 for either equation]

3x + 5y = 1700 ……(2)

2y = 500 [M1 for solving]

y = 250 [A1]

x = 150

Tickets sold to adults = **250** [A1] (4 marks)

(b)

Children = 250 − 175 = 75 [B1]

Sales = 3(75) + 5(175) [M1 for substituting]

= 225 + 875 [M1 for simplifying]

= **D1,100.00** [A1] (4 marks)

[8 marks]

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QUESTION 3

SEE DIAGRAM

From ΔPMR:

$|MP|^2 + 9^2 = 18^2$ [M1 for use of Pythagoras' theorem]

$|MP| = 9\sqrt{3}$ cm [A1] (as printed: "$|MP|^2 = 9\sqrt{3}$ cm")

Since ΔPQR is equilateral, all angles = 60°.

Area of sector AMB = $60/360 \times 22/7 \times (9\sqrt{3})^2$ [M1 for substituting]

= 127.2857 cm² [A1]

Area of ΔPQR = ½ × 18 × 9√3 [M1]

= 140.2961 cm² [A1]

Shaded region = 140.2961 − 127.2857 [M1 for subtracting]

= 13.0104

= **13.01 cm²** [A1] (−1 for omission of units, once only)

[8 marks]

QUESTION 4

SEE DIAGRAM

(a)

∠KRS = ∠KSR [B1]

2∠KSR + 80° = 180° [M1 for equation]

2∠KSR = 100°

∠KSR = **50°** [A1]

∠RQP + (50 + 41) = 180° [M1 for equation]

∠RQP = 180° − 91°

= **89°** [A1] (5 marks)

(b)

∠SRQ = 2∠KRS

= 2 × 50°

= **100°** [B1]

∠SRQ + ∠SPQ = 180° [M1 for equation]

100° + ∠SPQ = 180°

∠SPQ = 180° − 100°

= **80°** [A1] (3 marks)

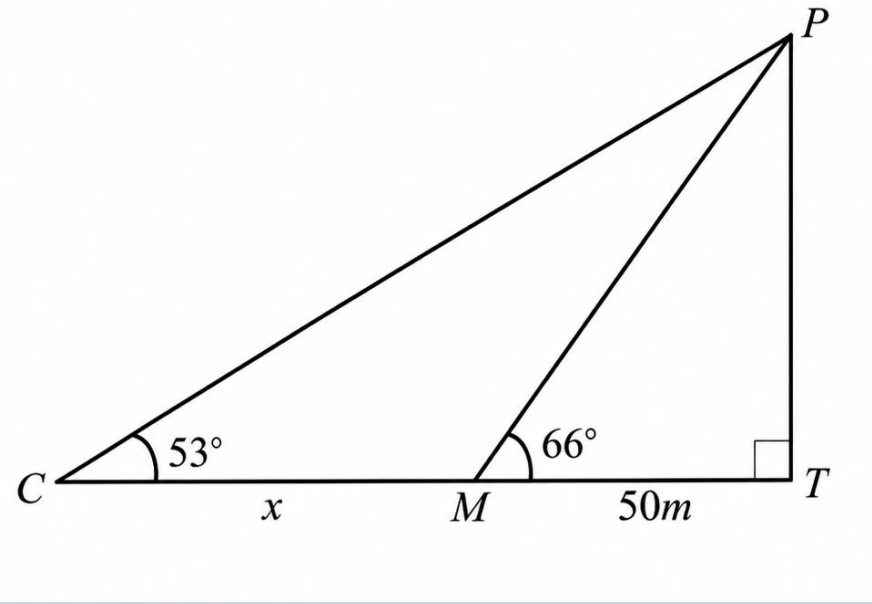
[8 marks]

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QUESTION 5

(a)



B2 (−½ ee) for diagram showing 53°, 66°, 50 m and the relative positions of C, M, P and T. (2 marks)

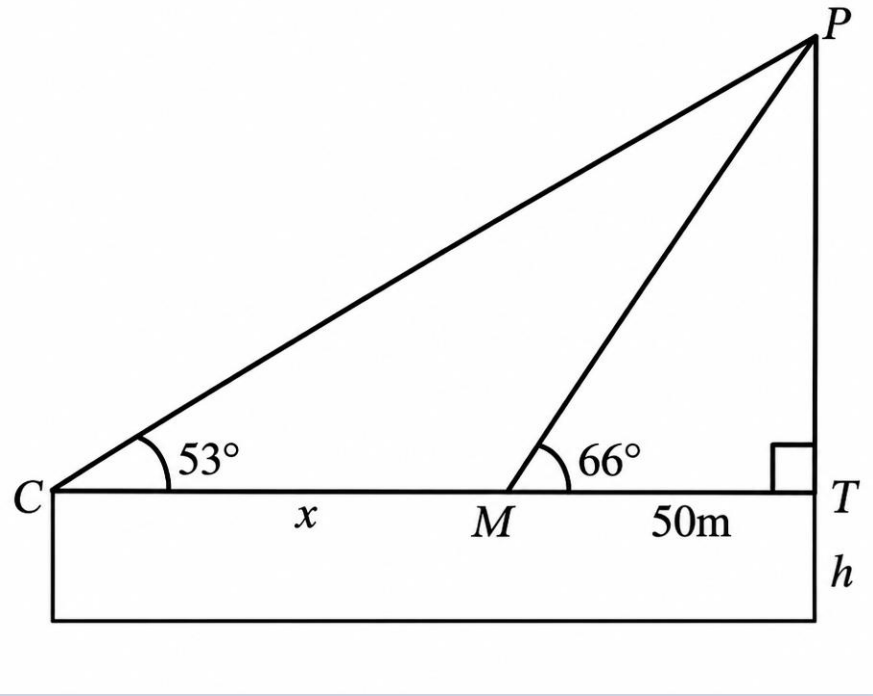
(b)(i)

tan 66° = |PT|/50 [M1 for tan ratio]

|PT| = 50 × tan 66°

= **112.3 m** [A1] (2 marks)

(a)



B2 (−½ ee) for diagram showing 53°, 66°, 50 m, the relative positions of C, M, P, T and h. (2 marks)

(b)(i)

tan 66° = |PT|/50 [M1 for tan ratio]

|PT| = 50 × (tan 66°)

Height of building = **(112.3 + h) m**, where h is the height of the boy

[A1] (2 marks)

(b)(ii)

tan 53° = 112.3/(x + 50) [M1 for tan ratio]

1.327(x + 50) = 112.3 [M1 for clearing fractions]

1.327x + 66.35 = 112.3

1.327x = 45.95 [M1 for solving]

x = 34.627

|MC| = **34.6 m** [A1] (−1 for omission of units) (4 marks)

[8 marks]

QUESTION 6

(a)

2n − 3 ≤ 37 [M1 for solving]

2n ≤ 40

n ≤ 20 [A1]

(i) M = {1, 2, 3, 4, …, 20} [B1]

(ii)(α) P(multiples of 3) = 6/20 [M1]

= **3/10 or 0.3** [A1]

(ii)(β) P(factors of 10) = 4/20 [M1]

= **1/5 or 0.2** [A1]

(7 marks)

(b)(i)

Kontor : Gapson = 3 : 2 [B1 for ratio]

Let the amount shared = x

3/5 x = 200,000 [M1 for equation]

x = **Le 333,333.33** [A1]

(ii)

Gapson's share = 333,333.33 − 200,000 [M1 for subtracting]

= **Le 133,333.33** [A1]

(5 marks) [12 marks]

6(b)

Gapson : Kontor = 3 : 2 [B1 for ratio]

Kontor's share = 2/5 x = 200,000 [M1 for equation]

2x = 200,000 × 5

Amount = (200,000 × 5)/2

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= 100,000 × 5

= **Le 500,000.00** [A1]

Gapson's share = 3/5 × 500,000 [M1]

= **Le 300,000.00** [A1] (5 marks)

(Note: as printed, the ALITER uses the ratio the opposite way round from the main method, so its answers differ.)

QUESTION 7

(a)

x + y + z = 81 (printed as "x − y − z = 81")

x + (2x) + (2x + 6) = 81 [B1 for equation]

5x + 6 = 81

5x = 75 [M1 for solving]

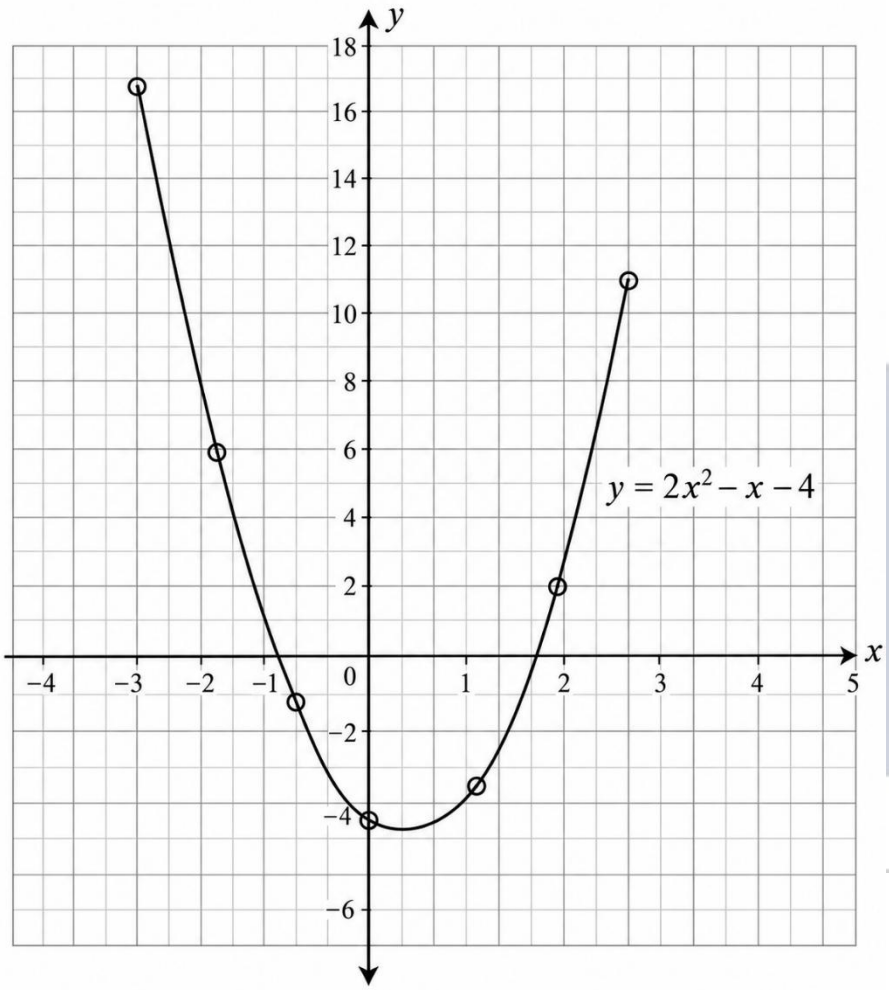
x = 15 [A1 for 15]

Numbers are **15, 30 and 36** [A1 for 30, A1 for 36] (5 marks)

(b)

Midpoint = ((3 − 5)/2, (5 + 7)/2) [M1 for finding midpoint]

= **(−1, 6)** [A1]



Gradient PQ = (5 − 7)/(3 − (−5)) [M1 for finding gradient]

= −2/8

= **−1/4** [A1]

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Gradient perpendicular to PQ = **4** [B1]

$y - 6 = 4(x - (-1))$ [M1 for finding equation of line]

$y - 6 = 4x + 4$

$y = 4x + 10$ [A1 or equivalent] (7 marks)

[12 marks]

QUESTION 8

(a) Table of values (B2, −½ ee) (2 marks)

x	**−3**	**−2**	**−1**	**0**	**1**	**2**	**3**
y	17	6	−1	−4	−3	2	11

(b) SEE DIAGRAM

Graph of $y = 2x^2 - x - 4$.

B1 for axes (−½ ee), B3 for graph (−½ ee). (4 marks)

(c)(i)

$x = -1.2 \pm 0.1, x = 1.7 \pm 0.1$

M1 for reading, A1 for the roots (−½ ee)

(ii)

$0.2 \pm 0.1 < x \leq 3 \pm 0.1$

M1 for reading, A1 for values of x

(iii)

$(0.2 \pm 0.1, -4 \pm 0.2)$

M1 for reading, A1 for minimum point of y

(6 marks) [12 marks]

QUESTION 9

(a)

Total number of trees = 4 + 6 + 4 + 5 + 6 + 2 = **27** [B1]

Median position = ((n + 1)/2)th = (27 + 1)/2 = 14th position [M1]

Median height = **5 m** [A1] (3 marks)

(b)

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x	f	fx	fx^2
3	4	12	36
4	6	24	96
5	4	20	100
6	5	30	180
7	6	42	294
8	2	16	128
	$\Sigma f = 27$	$\Sigma fx = 144$	$\Sigma fx^2 = 834$

Marks: M1 any two fx correct, A1 (−½ ee) for all correct, M1 any two fx^2 correct, A1 (−½ ee) for all correct, A1 for $\Sigma fx^2 = 834$.

(i) Mean = 144/27 [M1] = **5.3 m** [A1]

(ii)

Standard deviation = $\sqrt{(834/27 - (144/27)^2)}$ [M1 for substituting]

= $\sqrt{2.297}$

= 1.566

= **1.6 m** [A1]

(9 marks) (−1 ou/wu once only) [12 marks]

9(b)

x	f	fx	$x - \bar{x}$	$f(x - \bar{x})^2$
3	4	12	−2.33	21.7156
4	6	24	−1.33	10.6134
5	4	20	−0.33	0.4356
6	5	30	0.67	2.2445
7	6	42	1.67	16.7334
8	2	16	2.27	14.2578
	$\Sigma f = 27$	$\Sigma fx = 144$		$\Sigma f(x - \bar{x})^2 = 66.003$

(The last $x - \bar{x}$ value is printed as 2.27.)

Marks: M1 for fx (any two correct), A1 for all entries correct (−½ ee), M1 for $f(x - \bar{x})^2$ (any two correct), A1 for all entries correct (−½ ee), A1 for $\Sigma f(x - \bar{x})^2 = 66.003$.

(i) Mean = 144/27 = **5.3 m** (1 d.p.)

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(ii)

Standard deviation = $\sqrt{(\Sigma f(x - \bar{x})^2/27)} = \sqrt{(66.003/27)}$

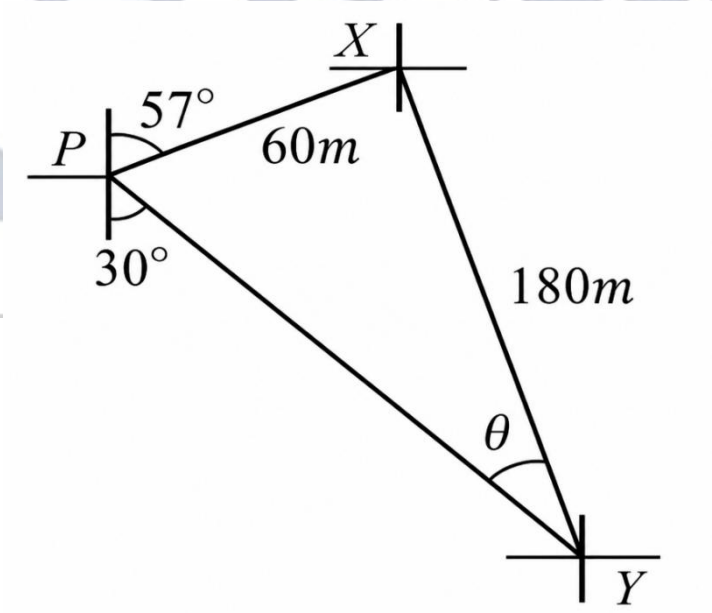
= 1.5633

= **1.6 m**

(9 marks)

QUESTION 10

(a)



(b) B2 (–½ ee) for 57°, 30°, 150°, 60 m, 180 m, and the relative positions of P, X and Y. (2 marks)

(b)(i)

sin 93°/180 = sin Y/60 [M1 for use of sine rule]

sin Y = 0.33287 [M1 for simplifying]

$Y = \sin^{-1}(0.33287)$

= **19.44°** [A1]

Bearing = 270° + 60° + 19.44° [M1 for finding bearing]

= **349°** [A1]

(5 marks)

(ii)

sin(180° − 93° − 19.44°)/|PY| = sin 93°/180

sin 67.56°/|PY| = sin 93°/180 [B1 for 67.56°]

|PY| = (180 × 0.92428)/0.998629 [M1 for use of sine rule]

= 166.3703/0.998629 [M1 for simplifying]

= 166.598 [A1]

= **167 m** [A1] (−1 ou/wu once only)

(5 marks) [12 marks]

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QUESTION 11

(a)

360/x − 360/2x = 45 [M1 for finding difference, A1 for equating to 45]

2(360) − 360 = 45(2x) [M1 for clearing fractions]

720 − 360 = 90x

90x = 360 [M1 for solving]

x = **4** [A1]

Number of sides of P = 2 × 4 = **8** [A1] (6 marks)

(b) SEE DIAGRAM

$\pi r^2/2 = 32\pi$ [M1 for equating area]

$r^2 = 64$ [M1 for solving]

r = 8 → r = **8 cm** [A1]

d = 16

Perimeter of semicircle part: $(2\pi r)/2 = (2\pi \times 8)/2 = 8\pi$ [M1 for perimeter of semi-circle, M1 for simplifying]

Circumference/Perimeter = **(8π + 16) cm** [A1] (−1 omission of unit)

(6 marks) [12 marks]

QUESTION 12

(a) ∠SOR = ∠QRO = 54° [B1 for 54°]

From ΔORQ:

2m + 54° + 54° = 180° [M1 for equation]

2m + 108° = 180°

2m = 72° [M1 for solving]

m = **36°** [A1]

n = **36°** [A1]

(5 marks)

(b) 2w + 2(w + 4) = 40 [M1 for forming equation]

4w + 8 = 40 [A1 for equating to 40]

4w = 32 [M1 solving]

w = **8 cm** [A1]

Area = (4 + 8)(8) [M1 for substituting]

= 12 × 8 [M1 for simplifying]

= **96 cm²** [A1] (−1 omission of units)

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(7 marks) [12 marks]

QUESTION 13

(a) SEE DIAGRAM

Area of sector ONM = 60/360 × 22/7 × 7² [M1 for finding area of sector]

= **25.67 cm²** [A1]

From ΔONT:

cos 60° = |OT|/7

|OT| = 7 × cos 60°

= **3.5 cm** [B1]

sin 60° = |NT|/|ON|

|NT| = 7 sin 60°

= **6.062 cm** [B1]

Area of ΔONT = ½ × 3.5 × 6.062 [M1 for area of ΔONT]

= **10.61 cm²** [A1]

Area of shaded portion = area of ONM − area of ONT [M1 for finding difference]

= 25.67 − 10.61

= 15.06 cm²

= **15.1 cm²** [A1] (−1 for omission of units)

(8 marks)

(b)

Points: (−3/4, 0) and (0, 2/7) [B1 for co-ordinates]

m = (2/7 − 0)/(0 − (−3/4))

= **8/21** [B1]

y − 0 = 8/21 (x + 3/4) [M1 for equation of line]

21y − 8x − 6 = 0 [A1, or equivalent]

(4 marks) [12 marks]

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QUESTION 1

(a)

t = kv/p [B1 for t = kv/p]

k = pt/v = (5 × 10)/20 [M1 for substituting] = 5/2 [A1 for 5/2 or equivalent]

t = 5v/(2p) [B1 for t = 5v/(2p) or equivalent] (4 Marks)

(b)

t = (5 × 50)/(2 × 2) [M1 for substituting]

= 250/4

= 62.5 minutes [A1 for 62.5 minutes (-1 ou/wu)] (2 Marks)

(c)

p = 5v/(2t)

= (5 × 40)/(2 × 20) [M1 for substituting]

= 5 pumps [A1 for 5 pumps] (2 Marks)

[8 Marks]

QUESTION 2

Time = 90 minutes = 1½ hrs [B1 for 1½ hrs]

$T_1 = (2x + 13)/67.5$ [B1 for T_1]

$T_2 = (5x - 20)/72$ [B1 for T_2]

$T_1 + T_2 = 1.5$

$(2x + 13)/67.5 + (5x - 20)/72 = 1.5$ [M1 for adding T_1 and T_2 and equating to 1.5]

$72(2x + 13) + 67.5(5x - 20) = 7290$ [M1 for clearing fractions]

$144x + 936 + 337.5x - 1350 = 7290$ [M1 for expanding]

$481.5x = 7704$ [M1 for solving]

$x = 16$ [A1 for x = 16]

[8 Marks]

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QUESTION 3

66 = 2 × 22/7 × r [M1 for equating to 66]

44r = 462

r = 21/2 m [A1 for r = 21/2 m or equivalent]

Area of floor = 22/7 × (21/2)² [M1 for finding area of the floor]

= 346.5 m² [A1 for 346.5 m²]

Area of tile = 0.4 × 0.4 [B1 for converting units]

= 0.16 m² [B1 for finding area of a tile]

Number of tiles = 346.5/0.16 [M1 for finding number of tiles]

= 2165.625

= 2166 [A1 for 2166 tiles]

[8 Marks]

QUESTION 4 — SEE DIAGRAM

(a)

∠BOD = 2t [B1 for ∠BOD = 2t]

∠BCD = 180° − t, ∠BOD = ∠BCD

2t = 180° − t° [M1 for equating to 180° − t°]

t = 60° [A1 for t = 60°] (3 Marks)

(b)

∠BOD = 2t = 120°

∠OBD = ∠ODB = 30°

60 + (y + 30°) + (y + 30°) = 180 [M1 for equation]

2y = 60

y = 30° [A1 for y = 30°] (2 Marks)

(c)

∠OBD + ∠ODB + ∠BOD = 180°

2∠ODB = 180° − ∠BOD [M1 for equation]

2∠ODB = 180° − 2t

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2∠ODB = 180° − 120

2∠ODB = 60°

∠ODB = 30°

∠ADC = ∠ADO + ∠ODB + ∠BDC

= 30° + 30° + 30° [M1 for substituting]

∠ADC = 90° [A1 for ∠ADC = 90°] (3 Marks)

ALITER:

∠ADC = y + 60°

= 30° + 60°

= 90°

[8 Marks]

QUESTION 5

Let x be number of silver marbles

Total = 3 + 4 + x = 7 + x [B1 for 7 + x or equivalent]

(x/(7 + x)) × ((x − 1)/(6 + x)) = 1/15 [M1 for the product of the two fractions; A1 for equating to 1/15]

x(x − 1)/((7 + x)(6 + x)) = 1/15 [M1 for simplifying]

$14x^2 - 28x - 42 = 0$ [A1 for correct quadratic equation]

$x^2 - 2x - 3 = 0$

(x + 1)(x − 3) = 0 [M1 for factorising, one factor correct]

x = −1, x = 3 [A1 for x = −1 and x = 3 (−½ ee)]

Number of silver marbles = 3 [A1 for concluding]

[8 Marks]

QUESTION 6

(a)

r = (4x + 3)/(x + 2) = (7x + 24)/(4x + 3) [B1 for finding common ratio]

(4x + 3)(4x + 3) = (x + 2)(7x + 24) [M1 for clearing fractions]

$16x^2 + 24x + 9 = 7x^2 + 38x + 48$ [M1 for expanding and simplifying]

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$9x^2 - 14x - 39 = 0$ [A1 for correct quadratic equation]

$(9x + 13)(x - 3) = 0$ [M1 for factorising]

$x = -13/9$ [A1], $x = 3$ [A1]

(b)

When $x = -13/9$:

$r = (4(-13/9) + 3)/(-13/9 + 2)$ [M1 for substituting]

$r = -5$ [A1 for $r = -5$]

When $x = 3$:

$r = (4(3) + 3)/(3 + 2)$ [M1 for substituting]

$= 15/5$

$r = 3$ [A1 for $r = 3$]

$\therefore r = -5$ or $r = 3$ [A1 for concluding]

QUESTION 7

(a)

$x : y = 1 : 2$

$x/y = 1/2$

$y = 2x$ [B1 for $y = 2x$]

$2 + 2x - 1 + y + 2 + 4 + 2 + y - 1 = 20$ [M1 for forming equation; A1 for correct equation]

$2x + 2y + 8 = 20$

$2x + 2(2x) + 8 = 20$ [M1 for substituting]

$6x = 12$ [M1 for solving]

$x = 2$ [A1 for $x = 2$]

$y = 2(2) = 4$ [A1 for $y = 4$] (7 Marks)

(b)

Mean = $[(5 \times 2) + 6[2(2) - 1] + 7(4 + 2) + (8 \times 4) + (9 \times 2) + 10(4 - 1)]$ / 20 [M1 for substituting; A1 for all correct substitution]

$= (10 + 18 + 42 + 32 + 18 + 30)/20$ [M1 for expanding]

$= 150/20$ [M1 for simplifying]

$= 7.5$ [A1 for 7.5] (5 Marks)

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[12 Marks]

QUESTION 8 —

(a)

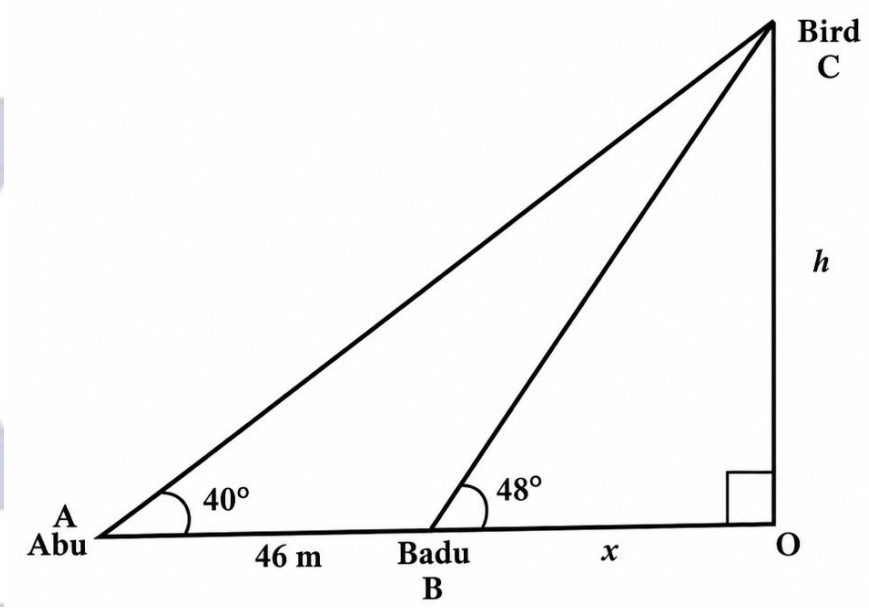


Diagram showing A, B, O, C with angles 40° and 48°, 90° at O, distance AB = 46 m. [B2 (−½ ee) for 40°, 48°, 90°, 46 m, relative positions of A, B, O and C] (2 Marks)

(b)

Let |OB| = x and |OC| = h

From ΔOBC:

tan 48 = h/x [M1 for trig ratio]

h = x tan 48

h = 1.1106x [A1 for 1.1106x]

From ΔAOC:

tan 40 = h/(46 + x) [M1 for trig ratio]

h = tan 40(46 + x)

h = 38.5986 + 0.8391x [A1 for (38.5986 + 0.8391x)]

1.1106x = 38.5986 + 0.8391x [M1 for equating heights]

0.2715x = 38.5986 [M1 for solving]

x = 142.1680 [A1 for x = 142.168]

Height of pole = 1.1106 × 142.1680 [M1 for finding height of pole]

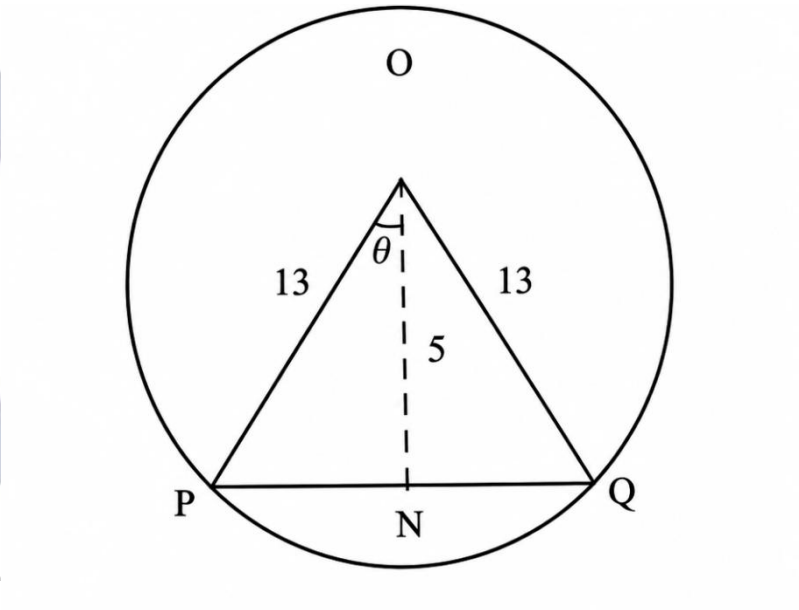
= 157.8918 [A1 for 157.891…]

= 157.9 m [A1 for 157.9 m (−1 ou/wu)]

[12 Marks]

QUESTION 9 — SEE DIAGRAM

(a)



cos θ = 5/13 [M1 for trig ratio]

θ = 67.38° [A1 for 67.38°]

∠POQ = 2 × 67.38 [M1 for multiplying by 2]

= 134.76

= 135° [A1 for 135°] (4 Marks)

(b)

Area of minor sector POQ = (134.76/360) × (22/7) × 13^2 [M1 for substituting]

= 198.82 cm^2 [A1 for 198.82 cm^2]

|PN| = √($13^2 - 5^2$)

= 12 cm [B1 for 12 cm]

Area of ΔPQO = 12 × 5 [M1 for finding area of ΔPQO]

= 60 cm^2 [A1 for 60 cm^2]

Area of minor segment = 198.82 − 60 [M1 for finding difference]

= 138.8 [A1 for 138.8]

= 139 cm^2 [A1 for 139 cm^2 (−1 ou/wu)]

(8 Marks)

[12 Marks]

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QUESTION 10

(a)(i)

Let y be total acres

Wife's share = 2/5 y

Acres left = y − 2/5 y [M1 for (y − 2/5 y) or equivalent]

= 3/5 y [A1 for 3/5 y]

Family's share = 1/3 × 3/5 y

= 1/5 y [A1 for 1/5 y]

Acres left = 3/5 y − 1/5 y

= 2/5 y [A1 for 2/5 y]

Total ratio = 3 + 5 + 2 = 10

(2/10) × (2/5) y = 8

y = (8 × 10 × 5)/(2 × 2) [M1 for finding y]

= 100 acres [A1 for 100 acres]

(ii)

Acres received by wife = 2/5 × 100

= 40 [B1 for 40 acres]

(7 Marks)

(b)

Balance = 1600 − 400

= $1200.00 [B1 for $1200.00]

Interest = 1200 × 0.25 [M1 for finding interest]

= $300.00 [A1 for $300.00]

Total Cost = 400 + 1200 + 300 [M1 for adding]

= $1,900.00 [A1 for $1,900.00 (−1 ou/wu or dp)]

(5 Marks)

[12 Marks]

QUESTION 11

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(a)

x + 2y = 7

x − y = 4

Solving simultaneously [M1 for solving]

x = 5 [A1 for x = 5]

y = 1 [A1 for y = 1]

Point of intersection is (5, 1)

Gradient of line = (1 − 0)/(5 − 0)

= 1/5 [B1 for 1/5]

Equation of line:

(y − 0)/(x − 0) = 1/5 [M1 for finding equation]

y = (1/5)x or equivalent [A1 for y = (1/5)x or equivalent]

(6 Marks)

(b)(i)

(n − 2)(180°)/360° = 4 [M1 for correct expression for ratio]

n − 2 = 8 [M1 for simplifying]

n = 10 [A1 for n = 10]

(ii)

External angle = 360°/10

= 36° [B1 for 36°]

(iii)

Sum of interior angles = (10 − 2)180° [M1 for substituting]

= 1440° [A1 for 1440° (accept 1440)]

(6 Marks)

[12 Marks]

QUESTION 12 —

(a)(i)

∠OQT = (180 − 56)/2 [M1 for finding ∠OQT]

= 62° [A1 for 62° or equivalent]

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∠TQP = 90 − 62

= 28° [B1 for ∠TQP = 28°]

(ii)

∠VQO = 180 − 56 − 109

= 15° [B1 for ∠VQO = 15°]

∠TQS = 90 − 28 − 15 [M1 for finding ∠TQS]

= 47° [A1 for ∠TQS = 47°]

∠QTS = 180 − 28 − 47 [M1 for finding ∠QTS]

= 105° [A1 for ∠QTS = 105°]

(8 Marks)

(b)

[(2n + 1)(n − 2)/((2n + 1)(n + 1))] × [(n + 1)(n − 1)/((n + 2)(n − 2))]
[M1 for two factors correct in the numerator; M1 for two factors correct in the denominator]

= (n − 1)/(n + 2) [M1 for simplifying; A1 for (n − 1)/(n + 2)]

(4 Marks)

[12 Marks]

QUESTION 13 —

(a)

∠BTQ = 44°

∠ABT = 60°

∠TBC = 180 − 60

= 120° [B1 for either 44° or 60° or 120°]

∠BTC = ∠CTQ = ½ × ∠BTQ [M1 for finding ∠BTC or ∠CTQ]

= 44/2

= 22° [A1 for 22°]

Let ∠ACT = y

y + 120 + 22 = 180 [M1 for equation]

y + 142 = 180

y = 180 − 142 [M1 for solving]

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= 38° [A1 for y = 38°]

(6 Marks)

(b)(i)

2 × (22/7) × r = 11 [M1 for equating to circumference]

44r = 77

r = 7/4 m [A1 for r = 7/4 m or equivalent]

(ii)

h = 3 + 6(7/4) [M1 for substituting]

= 3 + 21/2

= 27/2 m [A1 for 27/2 m or equivalent]

(iii)

V = (22/7) × $(7/4)^2$ × (27/2) [M1 for finding volume]

= 129.9375

= 129.94 m^3 [A1 for 129.94 m^3 (−1 ou/wu)]

(6 Marks)

[12 Marks]

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