

Mathematical Formulae

Compound interest

$$\text{Total amount} = P \left(1 + \frac{r}{100} \right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3} \pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3} \pi r^3$$

$$\text{Area of triangle} = \frac{1}{2} ab \sin C$$

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2} r^2 \theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f} \right)^2}$$

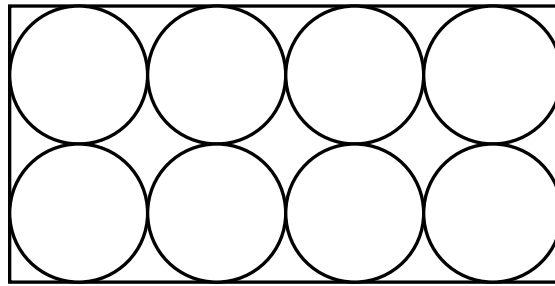
- 1 (a) It is given that $\mathcal{E} = \{x : x \text{ is an integer and } 20 \leq x \leq 100\}$,
 $A = \{x : x \text{ divided by } 12 \text{ leaves a remainder of } 4\}$,
 $B = \{x : x \text{ divided by } 14 \text{ leaves a remainder of } 6\}$.
- (i) List the members of A and B . [2]
- (ii) Find $n(A \cap B)$. [1]
- (b) The sets C , D and E satisfy the following three conditions:
 $D \subset C$, $D \cap E = \emptyset$, $C \cup E = C$.
- Represent these sets on a Venn diagram. [3]
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- 2 An ice cream factory produces boxes of ice cream in four flavours and delivers them to three different stores. The table below shows the number of boxes of ice cream supplied in each delivery and the cost price per box together with the number of deliveries made to each store in June.

Flavours of Ice cream		Number of boxes in each delivery				Number of deliveries in June
		Vanilla	Strawberry	Chocolate	Durian	
Name of stores	Fairprice	30	40	50	30	12
	Carrefour	20	30	60	50	20
	Giant	30	60	60	40	17
Cost price per box		\$3.30	\$3.10	\$3.20	\$3.50	

- (a) Write down two matrices such that the elements of their product, under matrix multiplication, will give the cost of ice cream delivered to each store per delivery. Find the product of these two matrices. [3]
- (b) Write down two matrices such that the elements of their product, under matrix multiplication, will give the total number of boxes of each flavour delivered in June. Find this product. Hence, or otherwise, write down the total number of boxes of ice cream supplied by the factory to these three stores. [4]

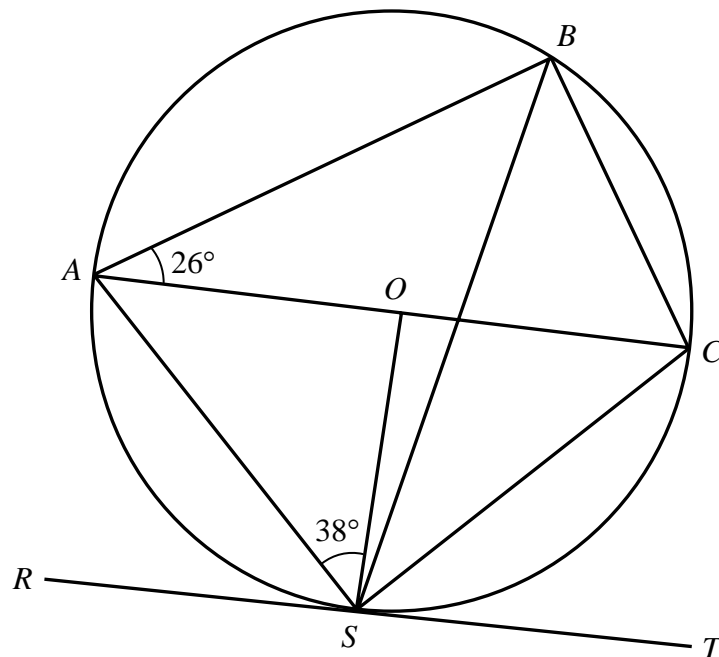
- 3 [The value of π is 3.142 correct to three decimal places.]



8 spheres, each of radius 2.5 cm, are packed in a closed rectangular wooden box. The spheres touch one another and the sides of the box. The diagram shows the view of the box and the spheres from above before the box is covered.

- (a) Calculate the volume of the box in cm^3 . [2]
- (b) Calculate the percentage of the total volume of the box filled by the spheres. [3]
- (c) Each sphere is removed from the box and uniformly coated with paint 0.2 cm thick around it. How many complete boxes of spheres can be painted with 1 litre of paint? [3]
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- 4 (a) If $\frac{3x-2y}{2y+3x} = \frac{5}{3}$, find the value of $\frac{y}{x}$. [2]
- (b) Given that $p = \sqrt{\frac{a}{1-q}}$, express q in terms of a and p . [2]
- (c) Express $\frac{3}{x-1} + \frac{5}{x-x^2} - \frac{x-1}{x}$ as a single fraction in its simplest form. [3]
- (d) Factorise the following completely.
- (i) $x^3 - 2x^2 + x$ [2]
- (ii) $pq - 3q - 6 + 2p$ [2]

5



In the diagram, A , B , C and S lie on the circumference of a circle with centre O . AC is a diameter of the circle. RT is a tangent to the circle at S . Given that $\angle ASO = 38^\circ$ and $\angle BAC = 26^\circ$, calculate

- (a) $\angle CST$, [2]
- (b) $\angle ABS$, [2]
- (c) $\angle BSO$, [2]
- (d) $\angle BCS$. [2]

6 Answer the whole of this question on a sheet of graph paper.

The following is a table of values for the graph of $y = x^2 + \frac{1}{x} + 1$.

x	0.2	0.5	0.8	1	1.5	2	2.5	3	4
y	6.0	a	2.9	3	3.9	5.5	b	10.3	17.3

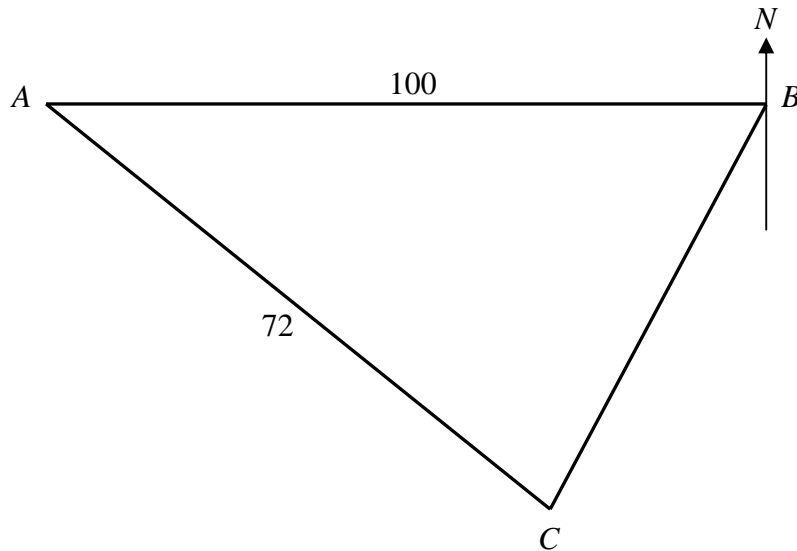
- (a) Calculate the value of a and of b , giving your answer correct to 1 decimal place. [1]
- (b) Using a scale of 4 cm to represent 1 unit on the x -axis and 1 cm to represent 1 unit on the y -axis, draw the graph of $y = x^2 + \frac{1}{x} + 1$ for $0 < x \leq 4$. [3]
- (c) Find the gradient of the curve at $x = 2.5$ by drawing a suitable tangent. [2]
- (d) By drawing a straight line on the graph, find the range of values of x for which $x^2 \leq 4 - \frac{1}{x}$. [3]
- (e) By drawing a straight line on the graph, solve the equation $x^3 - 2x^2 - 3x + 1 = 0$. [3]

- 7 (a) The car rental rates offered by two companies are shown in the table.

	Fixed Charge	Mileage Charge
ABC Carz	\$60	70 cents per km traveled
XYZ Rental	\$220	50 cents per km for every km over 300 km

- (i) Alex hires a car from ABC Carz during which he travels 435 km. Calculate the amount he has to pay. [2]
- (ii) Bruce hires a car from XYZ Rental and travels 450 km. Calculate the amount he has to pay. [2]
- (iii) The owner of ABC Carz buys a second hand car for \$30 000 and hires it out 48 times. During this period, insurance costs him \$2 000 and repairs cost \$750. He wants to make a profit of 10% from his initial outlay of \$30 000. Calculate the minimum distance, to the nearest kilometer, that the car needs to travel in total so that he can achieve this profit. [3]
- (b) The rate of exchange between Singapore dollars (\$) and Malaysia ringgits (RM) was $\$1 = 2.05\text{RM}$. John sent his car to a workshop in Malaysia for repairs. The repair cost was 315RM. In addition, he had to pay a 3% service charge. How much did John pay altogether in Singapore dollars? Give your answer correct to the nearest dollar. [2]

8 (a)

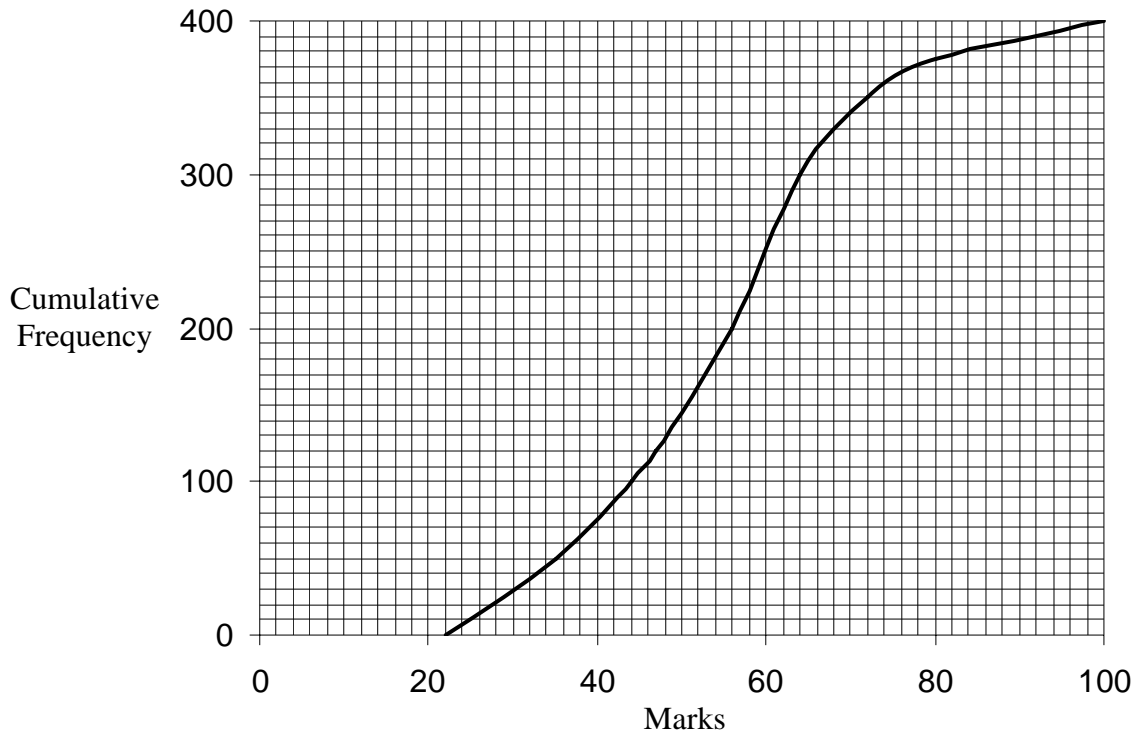


In the diagram, B is a harbour 100 km due east of a lighthouse A . C is another harbour 72 km on a bearing of 125° from A . A yacht sails along BC , leaving B at 1505 hours and reaching C at 1550 hours.

- (i) the angle BAC , [1]
- (ii) the distance BC , [2]
- (iii) the speed of the boat in km/h, [1]
- (iv) the bearing of C from B . [2]
- (b) It is given that the height of the lighthouse at A is 380 m. Calculate the greatest angle of elevation of the top of the lighthouse when viewed from the yacht as it sails along BC . [3]

- 9 Four hundred candidates took a Mathematics examination which consisted of two papers. Each paper was marked out of 100.

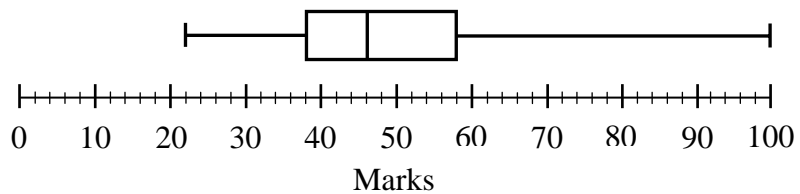
(a) The graph shows the cumulative frequency curve for the Mathematics Paper 1.



Use the curve to estimate, as accurately as possible,

- (i) the range, [1]
- (ii) the median mark, [1]
- (iii) the interquartile range, [2]
- (iv) the pass mark, given that 70% of the candidates passed the examination. [2]

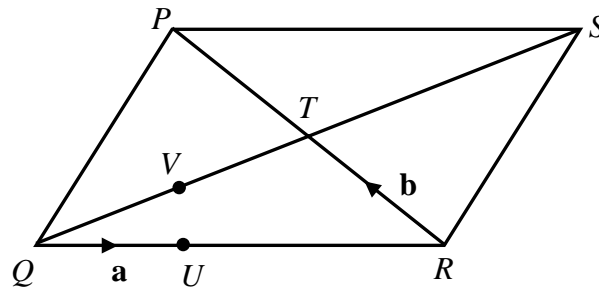
(b)



The box and whisker diagram illustrates the marks obtained for the Mathematics Paper 2 examination. Find the range. [1]

- (c) State, with a reason, which you think was the easier paper. [2]

10 (a)

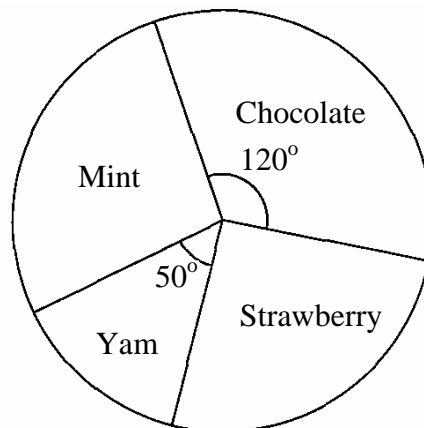


In the diagram, $PQRS$ is a parallelogram. The diagonals PR and QS intersect at T . U is a point on QR such that $QR = 3QU$. V is the midpoint of QT . $\vec{QU} = \mathbf{a}$ and $\vec{RT} = \mathbf{b}$.

Express, as simply as possible, in terms of \mathbf{a} and/or \mathbf{b} ,

- (i) \vec{QP} , [1]
- (ii) \vec{QS} . [1]
- (iii) Show that $\vec{PV} = -\frac{3}{2}(\mathbf{a} + \mathbf{b})$. [1]
- (iv) Express \vec{PU} as simply as possible, in terms of \mathbf{a} and \mathbf{b} . Hence, show that PV produced meets QR at U . [2]

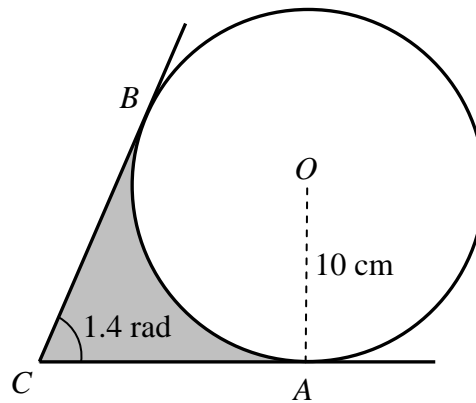
(b)



A group of children was asked to indicate their preference for one of four ice-cream flavours: Strawberry, Chocolate, Yam or Mint. The pie chart shows the result. It is given that 184 children prefer Strawberry. There were 140 more children who preferred Chocolate to Yam. Calculate

- (i) the angle of the sector which represents the number of children who prefers Strawberry, [2]
- (ii) the number of children who prefers Mint. [2]

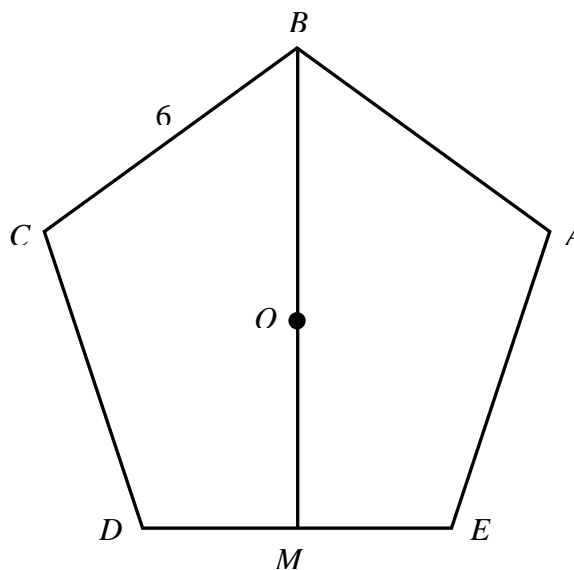
11 (a)



The points A and B lie on the circumference of a circle with centre O and radius 10 cm. The tangents at A and B meet at C and angle ACB is 1.4 radians, as shown in the diagram.

- (i) Show that $\angle AOB = 1.742$ rad. [2]
- (ii) Find the perimeter of the shaded region. [3]
- (iii) Find the area of the shaded region. [3]

(b)



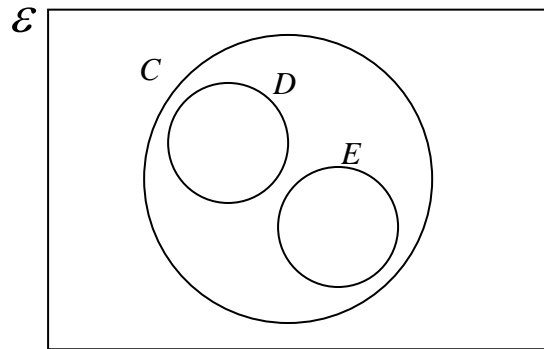
$ABCDE$ is a regular pentagon with sides 6 cm and center O . The point M is the midpoint of DE . Find BM . [4]

End of Paper

Secondary Four First Preliminary Examination 2009**Elementary Mathematics Paper 2****Answer Key**

- 1 (a) (i) $A = \{28, 40, 52, 64, 76, 88, 100\}$
 $B = \{20, 34, 48, 62, 76, 90\}$
- (ii) $n(A \cap B) = 1$

(b)



2 (a)

$$\begin{pmatrix} 30 & 40 & 50 & 30 \\ 20 & 30 & 60 & 50 \\ 30 & 60 & 60 & 40 \end{pmatrix} \begin{pmatrix} 3.30 \\ 3.10 \\ 3.20 \\ 3.50 \end{pmatrix} = \begin{pmatrix} 488 \\ 526 \\ 617 \end{pmatrix}$$

(b)

$$\begin{pmatrix} 30 & 40 & 50 & 30 \\ 20 & 30 & 60 & 50 \\ 30 & 60 & 60 & 40 \end{pmatrix} \text{ and } (12 \quad 20 \quad 17)$$

$$(12 \quad 20 \quad 17) \begin{pmatrix} 30 & 40 & 50 & 30 \\ 20 & 30 & 60 & 50 \\ 30 & 60 & 60 & 40 \end{pmatrix} = (1270 \quad 2100 \quad 2820 \quad 2040)$$

Total number of boxes supplied to the 3 stores = 8230.

- 3** (a) Vol. of box = 1000 cm^3
 (b) % of total vol. $\approx 52.4\%$ (3 SF)
 (c) No. of boxes that can be painted ≈ 7
- 4** (a) $\frac{y}{x} = -\frac{3}{8}$
 (b) $q = 1 - \frac{a}{p^2}$
 (c) $\frac{(2-x)(x-3)}{x(x-1)}$
 (d) (i) $x(x-1)^2$
 (ii) $(p-3)(q+2)$
- 5** (a) $\angle CST = 38^\circ$
 (b) $\angle ABS = 52^\circ$
 (c) $\angle BSO = 26^\circ$
 (d) $\angle BCS = 116^\circ$
- 6** (a) $a = 3.3, b = 7.7$
 (c) Gradient = 4.6
 (d) $0.25 \leq x \leq 1.9$
 (e) $x = 0.3$ or $x = 2.9$
- 7** (a) (i) Amount Alex paid = \$364.50
 (ii) Amount Bruce paid = \$295
 (b) 46958 km
 (c) Total cost in SGD = S\$158
- 8** (a) (i) $\angle BAC = 35^\circ$
 (ii) $BC = 58.2 \text{ km}$ (3SF)
 (iii) Speed of boat $\approx 77.6 \text{ km/h}$
 (iv) Bearing of C from $B \approx 224.8^\circ$
 (b) \angle of elevation $\approx 0.3^\circ$

- 9** (a) (i) 78 marks
(ii) 56 marks
(iii) 20 marks
(iv) 47 marks
(b) 78 marks
(c) Paper 1. Paper 1 has a higher MEDIAN mark.
- 10** (a) (i) $\overline{QP} = 3\mathbf{a} + 2\mathbf{b}$
(ii) $\overline{QS} = 6\mathbf{a} + 2\mathbf{b}$
(iii) $\overline{PV} = -\frac{3}{2}(\mathbf{a} + \mathbf{b})$
(iv) $\overline{PU} = -2(\mathbf{a} + \mathbf{b})$ $\overline{PV} = \frac{3}{4}\overline{PU}$
- (b) (i) \angle of sector representing Strawberry = 92°
(ii) No. of children who prefers Mint = 196
- 11** (a) (i) $\angle BOA = 1.742$ rad
(ii) Perimeter of shaded region ≈ 41.2 cm
(iii) Area of shaded region = 31.6 cm^2
- (b) $BM \approx 9.23$ cm