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Answer all the questions

1 (a) Calculate $\frac{19.3^2 - 13.9}{3\sqrt{9.13}}$.

Write your answer correct to 2 significant figures.

Answer (a)[1]

(b) Calculate $\left(\frac{5}{\sqrt{9}}\right)^2 - 1\frac{8}{9}$, leaving your answer in recurring decimal.

Answer (b)[1]

- 2 (a) 2 kg of apples cost \$ m and 50 g of tangerines cost n cents. How much would 750g of apples and 1.75 kg of tangerines cost, expressing your answers in dollars in terms of m and n .

Answer (a) \$.....[2]

- (b) The distance between Hougang Mall and Bowen Secondary School is 7.98 km. Benjamin Lum took 1575 sec to travel from one place to the other. Calculate his average speed expressing your answer in terms of m/min.

Answer (b)m/min[2]

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- 3 (a) Factorize fully $5 - 845y^2$.

Answer (a)[2]

- (b) Expand and simplify $\frac{1}{3}x - 4\left[-\frac{1}{2}(-x - 3) - \frac{3x}{4}\right]$.

Answer (b)[2]

- 4 (a) Using prime factorization, express 17640 as a product of prime factors.

Answer (a)[1]

- (b) Find the Highest Common Factor of 17640 and 18900.

Answer (b)[2]

- (c) Find the smallest positive integer k such that $18900k$ is a perfect square.

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Answer (c) $k = \dots\dots\dots [1]$

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- 5 (a) If each interior angle of a n -sided regular polygon is x° , find the number of sides of the polygon, n in terms of x .

Answer (a) $\dots\dots\dots [1]$

- (b) Find each interior angle of a regular octagon.

Answer (b) $\dots\dots\dots [1]$

- 6 (a) The line, l_1 cuts the x and y -axes at $(4, 0)$ and $(0, a)$ respectively. If the area of the triangle bounded by the line l_1 , the x -axis and y -axis is 6 units², find a .

Answer (a) $a = \dots\dots\dots [2]$

- (b) Find the equation of another line, l_2 parallel to the l_1 passing through the origin.

Answer (b)[2]

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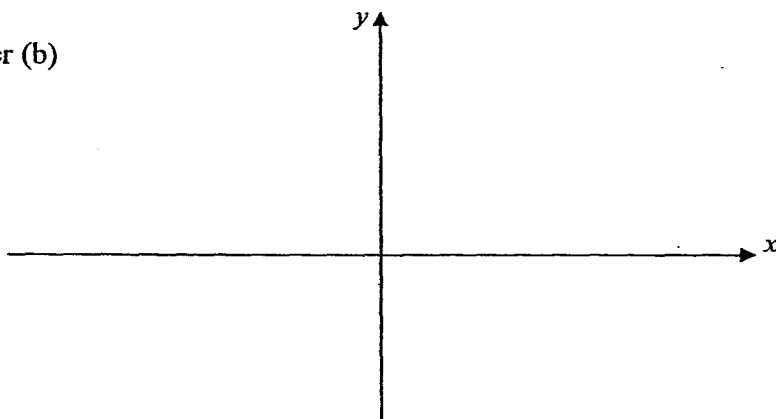
- 7 (a) Express $y = 8x - x^2 - 5$ in the form of $y = -(x - p)^2 + q$.

Answer (a)[2]

- (b) Sketch the graph of $y = 8x - x^2 - 5$ in the grid provided. [2]

(Label the x -axis, y -axis and turning points clearly)

Answer (b)



- 8 (a) Evaluate $\begin{pmatrix} 2 & 4 \\ 1 & -3 \end{pmatrix} - \frac{1}{2} \begin{pmatrix} 2 & 6 \\ 8 & 4 \end{pmatrix}$

Answer (a)[1]

- (b) Given that $\begin{pmatrix} 7 & 1 \\ 2 & 6 \end{pmatrix} - \begin{pmatrix} 2 & -y \\ x & -4 \end{pmatrix} = \begin{pmatrix} 2 & 1 \\ 1 & 3 \end{pmatrix}^2$, find the values of x and y .

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Answer (b) $x = \dots\dots\dots y = \dots\dots\dots$ [3]

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- 9 (a) Express $\frac{2}{2x^2 - x - 1} - \frac{1}{2 - 2x}$ as a single fraction.

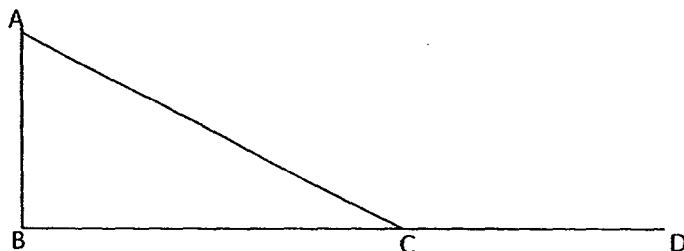
Answer (a) $\dots\dots\dots$ [2]

- (b) Given $\frac{2\sqrt{a^2 + b}}{3} = b - c$, make a the subject of the formula.

Answer (b)[2]

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- 10 In the figure, $\angle ABC = 90^\circ$, $AB = 5$ cm and the area of $\triangle ABC = 30$ cm². Find



- (a) Find the length of AC ,

Answer (a)cm[2]

- (b) Write down as a fraction, the value of

- (i) $\tan \angle BAC$,

Answer (b) (i).....[1]

- (ii) $\sin \angle BCA$,

Answer (b) (ii).....[1]

- (iii) $\cos \angle ACD$.

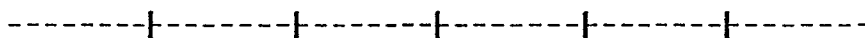
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Answer (b) (iii).....[1]

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- 11 Solve the inequality $\frac{3}{2}x - \frac{9}{4} \leq 3\frac{3}{4}x - \frac{9}{2} < -2\frac{1}{4} + 3x$ and show your solution on the number line in the answer space.

Answer



- 12 (a) Solve the equations $2y = 3x + 5$,
 $2x - 4y = 8$.

[4]

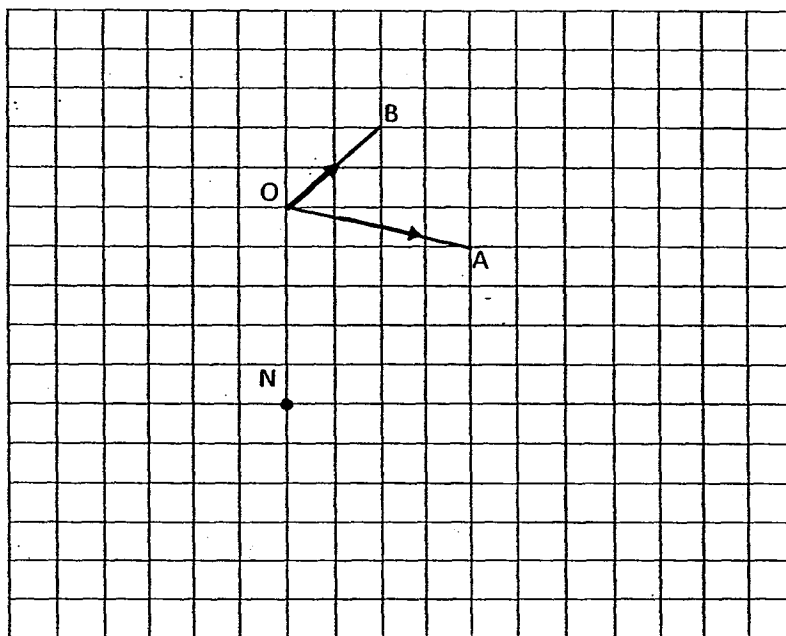
Answer (a) $x = \dots\dots\dots, y = \dots\dots\dots$ [2]

(b) Solve $\frac{6^{3k-1}}{8} = \frac{27}{36^k}$.

Answer (b) $k = \dots\dots\dots$ [2]For
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use13 (a) In the diagram given below, $\overrightarrow{OA} = x$ and $\overrightarrow{OB} = y$.(i) Mark and label clearly on the diagram, the vector $\overrightarrow{OM}$ such that

$$\overrightarrow{OM} = 2x + \frac{3}{4}y.$$

[1]

(ii) Express $\overrightarrow{ON}$ in the form $cx + dy$, where c and d are constants.Answer (a)(ii) $\dots\dots\dots$ [1](b) Given that $\overrightarrow{BC} = \begin{pmatrix} -2 \\ -3 \end{pmatrix}$ and $\overrightarrow{CD} = \begin{pmatrix} 5 \\ h \end{pmatrix}$,(i) find the value of h if $\overrightarrow{BC}$ is parallel to $\overrightarrow{CD}$,Answer (b) (i) $h = \dots\dots\dots$ [1](ii) find $|\overrightarrow{CD}|$, giving your answer correct to 1 decimal place.

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Answer (b) (ii).....units [1]

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- 14 (a) Justin deposited a sum of money in Sitibank which pays 1.5% interest per annum. Calculate the amount of interest he earned if he withdrew \$16500 at the end of 66 months.

Answer (a) \$.....[2]

- (b) The cash price of an ipet mini is \$888 including Goods and Services Tax (GST), after a discount of 20%. Find the original price of the ipet mini before GST.

Answer (b)\$.[2]

- 15 The information below show the mass of 1005 packages of 1 kg flour packed by two machines A and B.

Machine A				
Mass (g)	$980 < g \leq 990$	$990 < g \leq 1000$	$1000 < g \leq 1010$	$1010 < g \leq 1020$
Frequency	125	241	542	97

Machine B
Mean = 1004.9
Standard deviation = 9.6

- (a) Find the mean and standard deviation of the mass of rice packed for Machine A.

Answer (a) Mean =[1]

S.D =[2]

- (b) If you are the owner of the flour distribution business, which machine will you buy? Give explanation for your answer.

Answer (b)

.....

.....

.....

-[2]
- 16 There are 2 pink and x yellow marbles in a box. Haniff was asked to draw 2 marbles, one after another without replacement. If the probability of drawing the same coloured marbles is $\frac{2}{5}$, find the value of x .

Answer $x = \dots\dots\dots$ [4]For
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- 17 The surface area of two similar cylinders is in the ratio of 25:9. Given that the volume of the larger cylinder is 500cm^3 , find the volume of the smaller cylinder.

Answer $\dots\dots\dots\text{cm}^3$ [2]

- 18 (a) Given that $\varepsilon = \{x \text{ is an integer: } -1 < x < 11\}$, $A = \{x: \text{prime numbers}\}$ and $B = \{x: \text{odd numbers}\}$,

- (i) list the elements in $A \cap B$,

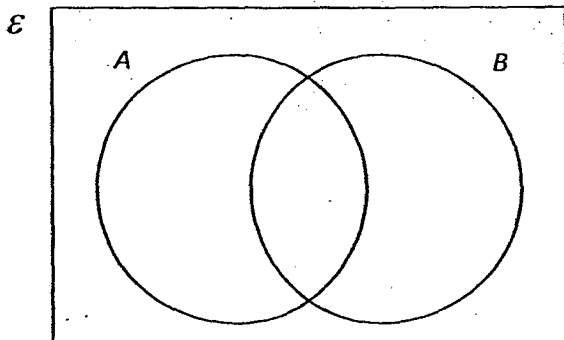
Answer (a)(i) $\dots\dots\dots$ [1]

- (ii) find $n(A \cup B')$.

Answer (b)(ii) $\dots\dots\dots$ [1]

- (b) Shade the region $(A \cap B')'$ in the diagram below.

[1]



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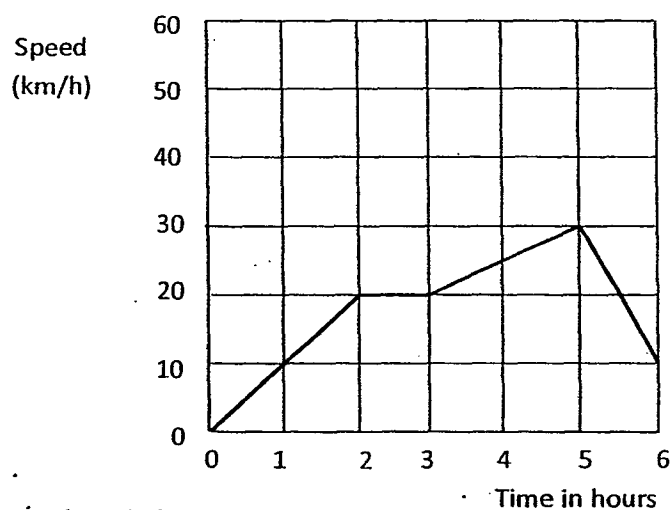
- 19 The graph shows the speed in km/h, travelled by an AMW Car at the time indicated in hours. Use the graph to calculate

- (a) the distance travelled when acceleration is at 0 ms^{-2} ,

Answer (a)km[1]

- (a) deceleration between the 5th and 6th hour.

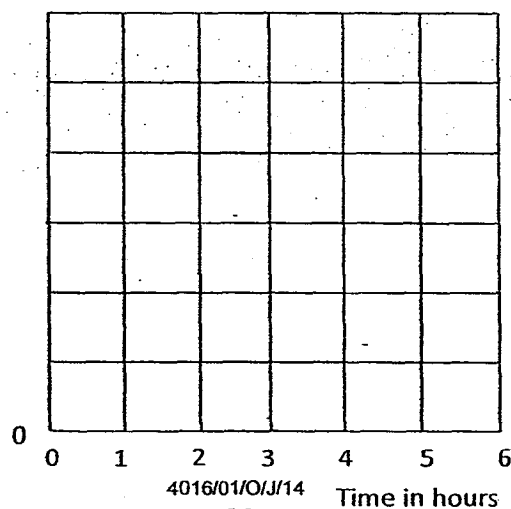
Answer (b) ms^{-2} [1]



- (b) On the grid in the answer space, sketch the distance-time graph for the same journey.

Answer (c)

Distance
(km)



[2]

- 20 The map of a new park in Punggol is drawn to a scale of 0.5 cm to 2500 m.

(a) Express the scale in the form of 1 : n .

Answer (a)[1]

(b) A pond has an actual area of 2.2 km^2 . Find the area, in square centimetres, of the pond on the map.

Answer (b) cm^2 [2]

- 21 Given that d is inversely proportional to s^2 , and $d = 18$ for a given value of s . Find d when s is doubled.

Answer[2]

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- 22 (a) Construct a triangle ABC such that $AB = 8.9$ cm, $AC = 5$ cm and $\angle BAC = 48^\circ$

Answer (a) [1]

- (b) Measure and write down $\angle BCA$.

Answer (b) $^\circ$ [1]

- (c) On the same diagram, construct and label clearly

(i) the perpendicular bisector of AB, [1]

(ii) the angle bisector of $\angle ABC$. [1]

End of Paper

Answer Key

1a	40	bii	$\frac{5}{13}$
b	0.8	iii	$-\frac{12}{13}$
2a	$\frac{3m}{8} + \frac{7n}{20}$	11	$1 \leq x < 3$
b	304 m/min	12a	$y = -4.5$ and $x = -4.25$
3a	$5(1 - 13y)(1 + 13y)$	b	$k = \frac{4}{5}$
b	$\frac{4}{3}x - 6$	13a	$a - 2b$
4a	$2^3 \times 3^2 \times 5 \times 7^2$	bi	7.5
B	1260	ii	9.01 units
C	21	14a	\$1257.50
5a	$\frac{360}{180 - x}$	b	\$1037.38
b	135°	15a	1001.5
6a	3 or -3	b	8.2
b	$y = -\frac{3}{4}x$ or $y = \frac{3}{4}x$	b	Machine A since $SD_A < SD_B$
7a	$y = -(x - 4)^2 + 11$	16	$x = 3$
8a	$\begin{pmatrix} 1 & 1 \\ -3 & -5 \end{pmatrix}$	17	108 cm^3
b	$X = -3$ and $y = 4$	18ai	$\{3, 5, 7\}$
9a	$\frac{5 + 2x}{2(2x + 1)(x - 1)}$	ii	9
b	$\pm \sqrt{\frac{3(b - c)^2}{2}} - b$	19a	20 km

a	13	b	20 km/h ⁻²
Bi	$\frac{12}{5}$	20a	1:500 000
		b	0.088
		21	4.5
		22a	100 (+/- 0.5)

Answer all the questions.

1 (a) Given that $x = \sqrt{\frac{y}{3-y}}$, find the value of y if $x = 3$. [2]

(b) (i) Factorise fully $x^3 + 2x^2 + x + 2$. [2]

(ii) Hence, simplify $\frac{4 - x^2}{x^3 + 2x^2 + x + 2}$. [2]

(c) Solve $x^4 - 2x^3 + x^2 = 0$. [2]

2 Cathryn took x minutes to assemble a computer on her own. Danny took 25 minutes more to assemble the same computer.

(a) Write down an expression in terms of x , for the fraction of assemble work completed by Cathryn in 1 minute. [1]

(b) Write down an expression in terms of x , for the fraction of assemble work completed by Danny in 1 minute. [1]

(c) If both of them worked together, it will only take them 30 minutes to complete assemble the computer.

Write down an equation in x , and show that it simplifies to

$$x^2 - 35x - 750 = 0.$$

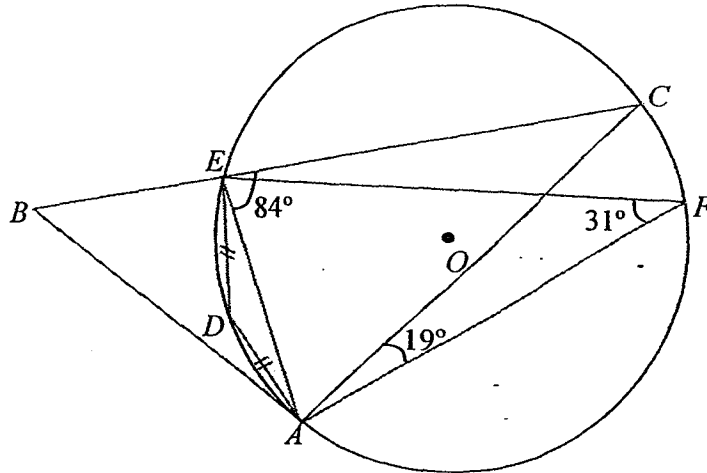
[2]

(d) Solve the equation $x^2 - 35x - 750 = 0$ to determine the time taken by Danny to complete assemble the computer on his own.

[3]

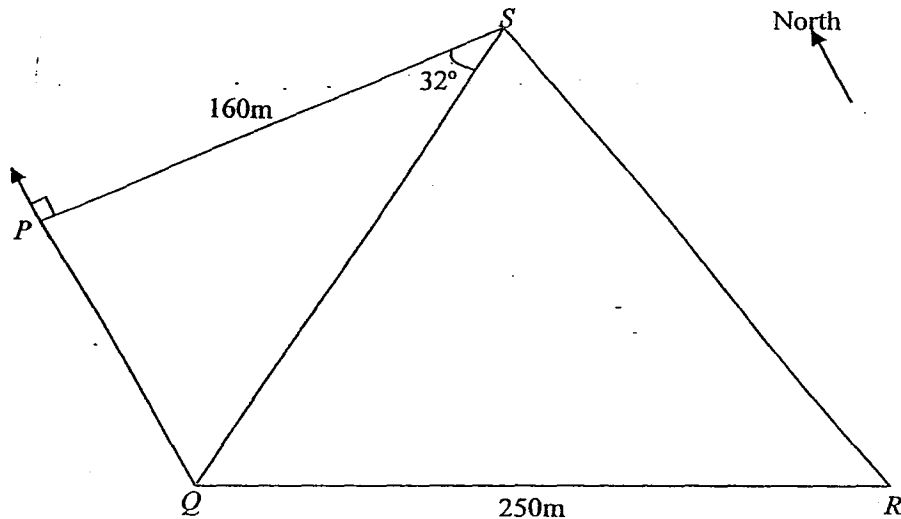
-
- 3 The cash price of a brand new car is S\$120 000.
- (a) Amos bought the car on hire purchase. He paid a deposit of 40% on the cash price and the remaining amount on a 60 monthly instalments of S\$1 365.
- (i) Find the amount of deposit paid. [1]
- (ii) Find the extra cost of buying the car on hire purchase. [2]
- (iii) Calculate the rate of simple interest (in % per year) charged on the car when it was bought on hire purchase. [2]
- (b) Belle bought an identical car. She borrowed the whole cost of the car from a legal money lending company at an interest rate of 2.5% per year compounded half-yearly for 8 years.
- Calculate the amount of interest Belle will pay. [3]
-
- 4 The points P , Q and R are the vertices of a triangle. Q is the point $(-4, 0)$, R is the point $(-7, 10)$ and the line PR has equation $x + y = 3$.
- (a) Find the coordinates of P if it lies on the x -axis. [1]
- (b) Find the equation of the line RQ . [2]
- (c) Find the area of triangle PQR . [2]
- (d) $PRQW$ is a quadrilateral such that $\overrightarrow{OW} = \begin{pmatrix} 15 \\ 4 \\ -5 \\ 2 \end{pmatrix}$.
- (i) Express as a column vector,
- (a) $\overrightarrow{QR}$, [2]
- (b) $\overrightarrow{PW}$. [2]
- (ii) Hence, write down two facts that can be deduced for QR and PW . [2]
-

- 5 In the diagram, O is the centre of the circle and points A, D, E, C and F lie on the circumference. The tangent at A meets CE produced at B and $AD = ED$. $\angle AEC = 84^\circ$, $\angle CAF = 19^\circ$ and $\angle AFE = 31^\circ$.



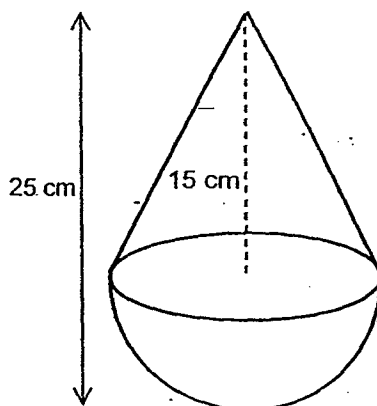
- (a) Stating your reasons clearly, find
- (i) $\angle ACE$, [1]
 - (ii) $\angle ADE$, [1]
 - (iii) reflex $\angle AOE$, [1]
 - (iv) $\angle EAF$. [2]
- (b) If AD bisects $\angle BAE$, find $\angle ABC$. [2]
- (c) Show clearly that $\triangle ACE$ is congruent to $\triangle EFA$. [2]
- (d) A point G lies on the same side of AC as F such that $\angle AGF = 100^\circ$. Determine a possible position for point G , indicating clearly whether the point G will be inside the circle, outside the circle or on the circumference of the circle. Give a clear reason. [1]

- 6 The diagram shows a field $PQRS$ with a path QS across it.
 S is due east of P and Q is due south of P .
 The bearing of R from Q is 110° , $PS = 160$ m, $QR = 250$ m and $\angle PSQ = 32^\circ$.

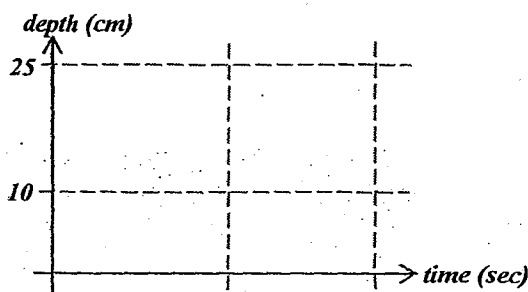


- (a) Calculate
- (i) $\angle SQR$, [1]
 - (ii) SQ , [2]
 - (iii) SR . [3]
- (b) Find the area of the field $PQRS$. [3]
- (c) A tower is located at R and a man at Q starts to walk towards S at a constant speed of 2 km/h.
 He reaches a point T along the path QS such that the angle of elevation of the top of the tower at R is at its largest.
 Find the time taken to reach point T , giving your answer in minutes. [3]

- 7 A small toy container with height 25 cm is made up of a hemisphere and a cone with a height 15 cm as shown in the diagram below. Take $\pi = 3.142$.



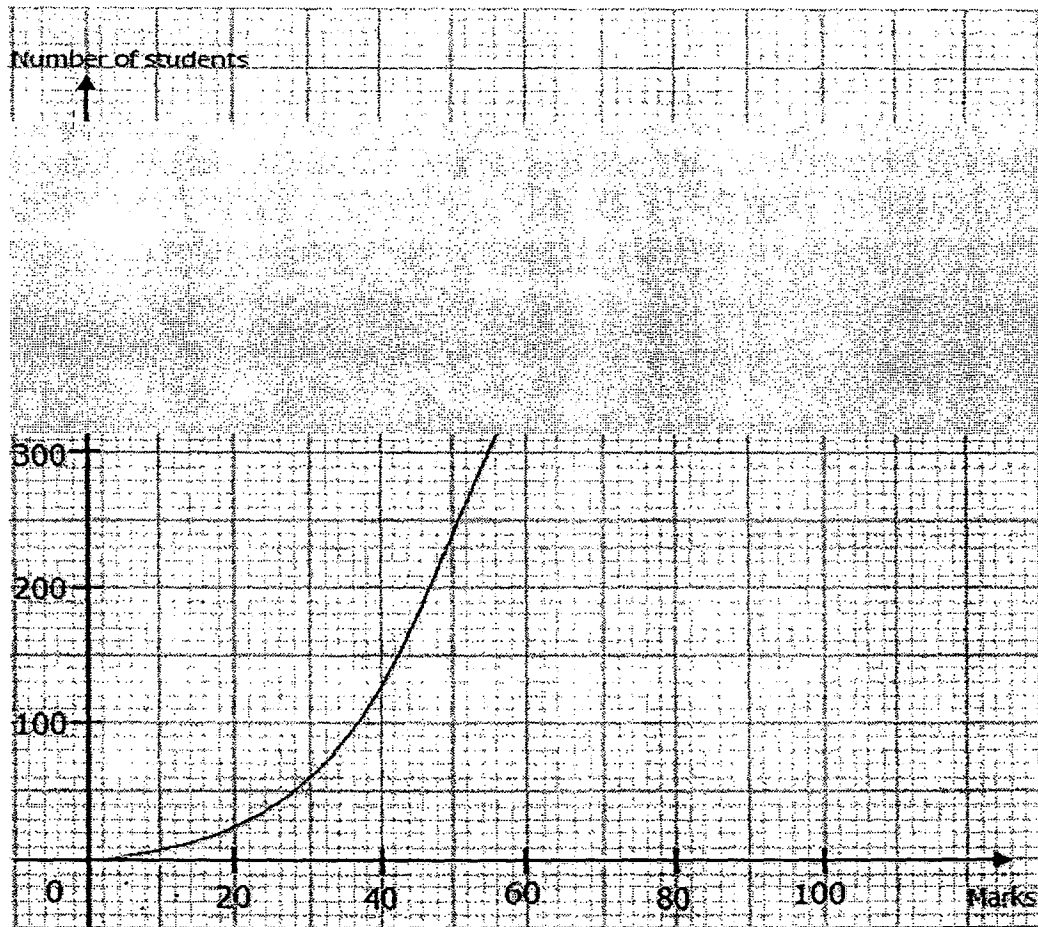
- (a) Calculate the total external surface area of the container. [3]
- (b) Given the density of air is 0.00127 g/cm^3 , find the mass of air in the container. [3]
- (c) The container is filled with water from the top at a constant rate. Draw the graph to show the relationship between the depth of the water and time as the container is being filled. [2]
(You can use the axes given below in your diagram.)



- (d) A painter takes 2 seconds to paint the surface area of the toy container. If he takes 16 seconds more to paint the surface area of a similar toy container, what is the actual height of this similar toy container? [2]

8

The marks scored in a Mathematics examination by Secondary 4 students in a school are shown in the cumulative frequency curve.



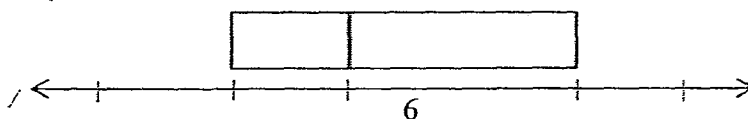
However, a portion of the graph is missing.

Given that the median is 51 marks and the interquartile range is 25 marks.

- (a) Find the total number of Secondary 4 students who sat for the Mathematics examination.

[1]

- (b) The data from the cumulative frequency curve is represented on a box-and-whisker plot diagram as shown below.



0 40 p q 100

Find

(i) p , [1]

(ii) q . [1]

- (c) Students who scored less than 40 marks are considered to have failed the Mathematics examination.
Two students are chosen at random.
Find the probability that both students passed the Mathematics examination. [2]

- (d) The data from the cumulative frequency curve is represented in a frequency table as shown below.

Marks (x)	$0 \leq x < 20$	$20 \leq x < 40$	$40 \leq x < 60$	$60 \leq x < 80$	$80 \leq x < 100$
Number of students (f)	25	m	225	125	25

(i) Find the value of m . [1]

(ii) Calculate an estimate of the standard deviation. [2]

- (e) The marks scored by the same group of students in a Science examination have the same median but a smaller standard deviation.
Describe how the cumulative frequency curve of the Science examination will differ from the cumulative frequency curve of the Mathematics examination. [1]

- 9 3 students Ace, Ben and Carter are training daily for the marathon competition. The table below shows the average running and cycling speeds of the students in their training.

Student	Running	Cycling
Ace	2.5 km/h	3 km/h
Ben	3 km/h	2.5 km/h
Carter	3.8 km/h	3 km/h

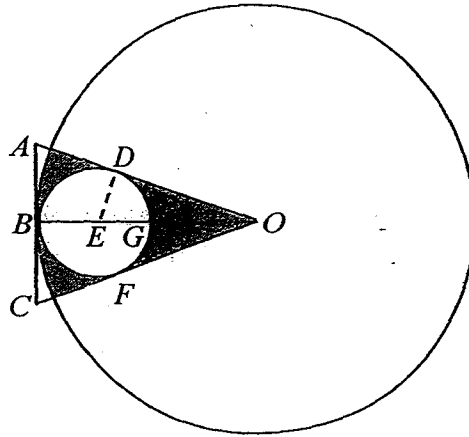
The students will run for 1 hour and cycle for 1 hour on a weekday, and run for 3 hours and cycle for 2 hours on a weekend.

Given that $A = \begin{pmatrix} 2.5 & 3 \\ 3 & 2.5 \\ 3.8 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 3 \\ 1 & 2 \end{pmatrix}$,

- (i) Find AB . [2]
- (ii) Explain what the entries of the matrix product AB represent. [1]
- (iii) Use matrix multiplication to evaluate the total distance covered by each student during the training in a week. [2]

- 10 The diagram shows a circle with centre O and a smaller circle with centre E . ODA , ABC and CFO are tangents to the smaller circle at D , B and F respectively.

The radius of the smaller circle with centre E is 5cm and $OG = GB$.



- (a) Show clearly that $\triangle ODE$ is similar to $\triangle OBA$. [2]
- (b) Show that the value of $\angle DOE = 0.34$ radians. [2]
- (c) Find the perimeter of the shaded region. [3]
- (d) Find the area of the shaded region. [3]

11 Answer the whole of this question on a piece of graph paper.

The total monthly cost of producing soft toys consists of fixed factory rental cost and variable production cost.

On a particular month, Gundam Pte. Ltd. estimated net profits of y thousand dollars when x hundred toys were produced.

(net profit = total monthly sales – total monthly cost)

The corresponding values of x and y for the equation $y = -x^2 + 8x - 3$ are given in the table below.

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

- (a) Using a scale of 2 cm to represent 2 thousand dollars, draw a vertical y -axis and a scale of 2 cm to represent 1 hundred toys, draw a horizontal x -axis for $0 \leq x \leq 7$.
On your axes, plot the points given in the table and join them with a smooth curve to draw the graph of $y = -x^2 + 8x - 3$. [3]
- (b) Use your graph to estimate
- (i) the number of toys the company must produce to obtain maximum profit. [1]
 - (ii) the minimum number of toys the company must produce to ensure there is a breakeven in the month (when profit is zero). [1]
 - (iii) the monthly fixed factory rental cost (when production is zero). [1]
- (c) By drawing a tangent, find the gradient of the curve at $x = 3$. [2]
- (d) You make a decision to discontinue the production of toys should the gradient of the graph becomes negative. Explain your answer. [1]
- (e) A straight line is drawn to determine the number of toys the company must produce to ensure a profit of \$4 000 for a particular month.
Hence, write down an equation in the form of $ax^2 + bx + c = 0$ which is satisfied by these values. [1]

Answers

- 1(a) $y = 2.7$ (b)(i) $(x^2 + 1)(x + 2)$ (ii) $\frac{2-x}{x^2+1}$
 (c) $x = 0$ or 1
- 2 (a) $\frac{1}{x}$ (b) $\frac{1}{x+25}$ (c) $30\left(\frac{1}{x} + \frac{1}{x+25}\right) = 1$
 (d) $x = 50$ or -15 (na)
 time = 75 minutes
- 3(a)(i) \$48000 (ii) \$9900 (iii) 2.75%
 (b) \$26 386.75
- 4(a) $(3, 0)$ (b) $3y = -10x - 40$ (c) 35
 (d)(i)(a) $\begin{pmatrix} -3 \\ 10 \end{pmatrix}$ (b) $\begin{pmatrix} \frac{3}{4} \\ -\frac{5}{2} \end{pmatrix}$
- (ii) QR and PW are parallel lines.
 QR is a scalar multiple of PW such that $4PW = QR$
- 5(a)(i) 31° (ii) 149° (iii) 298°
 (iv) 84°
 (b) 53° (c) AAS test
 (d) G lies outside the circle since angle $AGF = 115^\circ$ if it lies on the circumference of the circle.
- 6(a)(i) 52° (ii) 189m (iii) 200m
 (c) 26600m^2 (d) 4.62 minutes
- 7(a) 1190cm^2 (b) 4.66g (d) 75cm
- 8(a) 500 (b)(i) 51 (ii) 65
 (c) $\frac{561}{998}$ (d)(i) 100 (ii) 18.4
 (e) The curve is steeper.
- 9(a) $\begin{pmatrix} 5.5 & 13.5 \\ 5.5 & 14 \\ 6.8 & 17.4 \end{pmatrix}$ (c) $\begin{pmatrix} 54.5 \\ 55.5 \\ 68.8 \end{pmatrix}$
 (b) AB represents the total distance covered by each student on a weekday and a weekend respectively.
- 10(a) AAA test (c) 85.0cm (d) 57.5cm^2
- 11(b)(i) 400 toys (ii) 35 ± 5 (iii) \$3000
 (c) Accept $1.8 - 2.5$
 (d) Negative gradient indicates the net profit is decreasing with increased production.
 (e) $x^2 - 8x + 7 = 0$