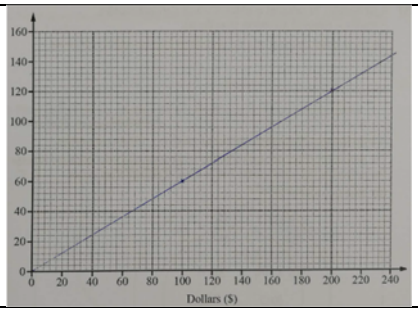
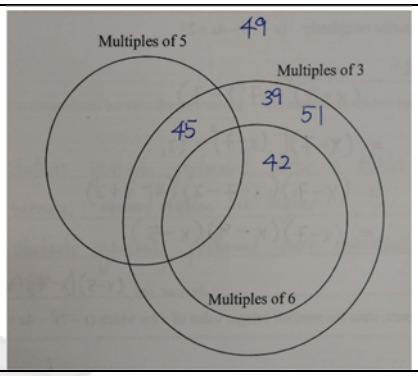
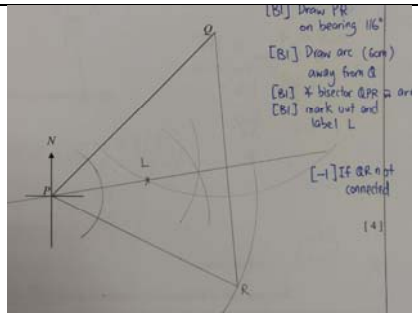
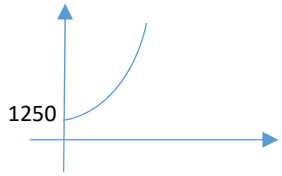
Sec 4 Mathematics Paper 1 - Prelims 2018

Qn No.		Solutions	Marks	Remarks
1		-5.25	B1	o.e. $-5\frac{1}{4}$
				Total : 1 mark
2		$2 \leq \frac{f}{7} < 6$	B1	o.e. $14 \leq \frac{f}{7} < 42$
				Total : 1 mark
3		5:2 = 22.5: 9 31.5	M1 A1	Find the max. amt of red paint needed
				Total : 2 marks
4		$\frac{21y-7}{14} - \frac{4y+10}{14} + \frac{14}{14}$ $= \frac{17y-3}{14}$	M1 A1	Combine fraction (All terms with common denominator)
				Total : 2 marks
5	a	1.49×10^8	B1	
	b	116	B1	
				Total : 2 marks
6		21, 23, 26, 27, 28	B1 B1	26 in the middle position seen
				Total : 2 marks
7		$\left(\frac{4}{6}\right)^3$ 1.60	M1 A1	Find Vol ratio Reject 1.6
				Total : 2 marks
8		Basic angle = 46.30 133.7	M1 A1	Find basic angle Accept 2.33 soi
				Total : 2 marks
9	a		B1	
	b	132	B1	DM from graph (up to $220)
				Total: 2 marks
10	a	$\begin{pmatrix} 20 & 6 & 4 \\ 25 & 0 & 5 \end{pmatrix}$	B1	
	b	$\begin{pmatrix} 58 \\ 65 \end{pmatrix}$	B1	
	c	7	√B1	Reject negative
				Total : 3 marks
11	a	$2^2 \times 3^3 \times 5$	B1	Accept $2 \times 2 \times 3 \times 3 \times 3 \times 5$
	b	54, 60	B1, B1	
				Total: 3 marks

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Qn No.		Solutions	Marks	Remarks
12	a	$\frac{x}{20}$	B1	
	b	$\frac{x+10}{30} = 2\left(\frac{x}{20}\right)$ $x = 5$	M1 A1	Form equation
				Total : 3 marks
13	a	$\frac{x^4}{16y^{12}}$	B1	
	b	$2^p \times 2^{-1} \times 3^p = 1$ $6^p = 4$	M1 A1	$2^{p-1} = 2p \div 2$
				Total : 3 marks
14	a	32	B1	
	b		B1 B1	45 and 49 39, 42 and 51
				Total : 3 marks
15		$\frac{3+1.4}{2} = 2.2$ 0.5(1.4+2.2) 1.2 × 2.5 5.4	M1 M1 A1	Find the parallel side Area of trapezium × 2.5
				Total : 3 marks
16	a	$(x-7)^3 - 4(x-7)$ $=(x-7)[(x-7)^2 - 4]$ $=(x-5)(x-7)(x-9)$	 M1 M1 A1	 Factorise $(x-7)$ Apply diff of 2 sq
	b	6	√B1	
				Total : 4 marks
17	a	25%	B1	
	b	78.5	B1	
	c	Students *performed better* in Maths because higher median/mean marks. Students performed *more consistently* for Maths because of smaller range.	B1 B1	
				Total : 4 marks

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Qn No.		Solutions	Marks	Remarks
18	a	I disagree because $\frac{360}{55} = 6.545 \neq$ *whole number*/integer	B1	Each ext. angle not a whole number.
	b	144 Angle CAD= 180 – 144 – 60 = 156 n = 360/24 = 15	M1 M1 A1	each int. angle of decagon each in.t angle of n-sided polygon
				Total : 4 marks
19			B1 B1 B1 B1	Draw PR on bearing 116° ±1° Construction ΔPQR Draw arc 6 cm away from Q ($\pm$ 1mm) Angle bisector QPR with arc Mark out L
				Total : 4 marks
20	a	$1490.60	B1	cao
	b	% change = $\frac{their\ (a) - 1250}{1250} \times 100\%$ = 19.3	M1 A1	 Accept 19.2, 19.3
	c	4.5%	B1	
	d		B1 B1	Shape Vertical intercept
				Total : 6 marks
21	a	−0.5	B1	o.e
	b	(4, 4)	B1	
	c	2	√B1	
	d	(6, 3) Sub in (6,3) to find y-intercept $y = 2x - 9$	M1 M1 A1	Find the point the line cuts $y - 3 = 2(x - 6)$ o.e.
				Total: 6 marks
22	a	$\begin{pmatrix} -4 \\ 5 \end{pmatrix}$	B1	
	b	$(2k)^2 + (-k)^2 = 180$ $k = \pm 6$	M1 A1	Use magnitude
	c(i)	$\begin{pmatrix} -7 \\ -1 \end{pmatrix}$	B1	
	c(ii)	(−2, −5)	B1 B1	
				Total : 6 marks

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Qn No.		Solutions	Marks	Remarks
23	a	$A = \pi a^2 + 2\pi ab$ $2\pi ab = A - \pi a^2$ $b = \frac{A-\pi a^2}{2\pi a}$	M1 A1	Isolate $2\pi ab$
	b(i)	$\pi(5)^2 h = \frac{2}{3}\pi r^3$ $r^3 = \frac{75h}{2}$ $r = \sqrt[3]{\frac{75h}{2}}$	B1 M1 A1	Equate the 2 volumes Isolate r^3
	b(ii)	90	B1	
				Total : 6 marks
24	a	Small pipe: $\frac{1}{120}$ Big pipe: $\frac{1}{80}$ 30 mins	B1 B1	Find rate of tank filled in one min. for at least one pipe
	b(i)	$(30 - d)^2 + 27.5^2 = 30^2$ $(30 - d)^2 = 143.75$ $d = 18.0$	M1 M1 A1	Form equation Solve equation
	b(ii)	42.0	√B1	60 – their b(i)
				Total: 6 marks

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TANJONG KATONG SECONDARY SCHOOL
Preliminary Examination 2018
Secondary 4

CANDIDATE NAME			
CLASS		INDEX NUMBER	

MATHEMATICS 4048/01

Paper 1 **Thu 16 August 2018**

2 hours

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
You are expected to use a scientific calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 80.

For Examiner's Use

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Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone $= \pi rl$

Curved surface area of a sphere $= 4\pi r^2$

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

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

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

Arc length $= r\theta$, where θ is in radians

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

Trigonometry

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

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

Statistics

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

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

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Answer **all** the questions.

1 Solve the equation $6 - \frac{4}{3}x = 13$.

Answer $x =$ ..... [1]

2 Nurul works part-time in a supermarket.
In one week, Nurul works f hours at the supermarket.
Write down an inequality for the statement below.

Nurul must work at least 2 hours and less than 6 hours in a day.

Answer ..... [1]

3 Purple paint is made by mixing red paint and blue paint in the ratio 5 : 2.
Irene has 30 litres of red paint and 9 litres of blue paint.

What is the maximum amount of purple paint she can make?

Answer ..... litres [2]

4 Simplify $\frac{3y-1}{2} - \frac{2y+5}{7} + 1$.

Answer ..... [2]

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5 **(a)** The distance between the Sun and Earth is approximately 149 million km. Convert this number to standard form.

Answer (a) ..... km [1]

(b) The radius of the Sun and Earth is approximately 695 000 km and 6 000 000 m respectively.

Complete the sentence, leaving your answer to the nearest integer.
Answer (b)

The diameter of the sun is ..... times the diameter of Earth. [1]

6 5 different integers between 19 and 30 were written.
The mean is 25 and the median is 26. They have a range of 7.

Write down the five integers.

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Answer ....., ..., ..., ..., ... [2]

7 A cafe sells two sizes of cupcakes that are geometrically similar. The large cupcake is 6 cm wide at the base and the small cupcake is 4 cm wide at the base.



6 cm



4 cm

The price of a cupcake is proportional to its mass.
If the large cupcake is sold at \$5.40, what is the price of the small cupcake?

Answer \$ ..... [2]

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8 The sine of an obtuse angle in a triangle is 0.723.

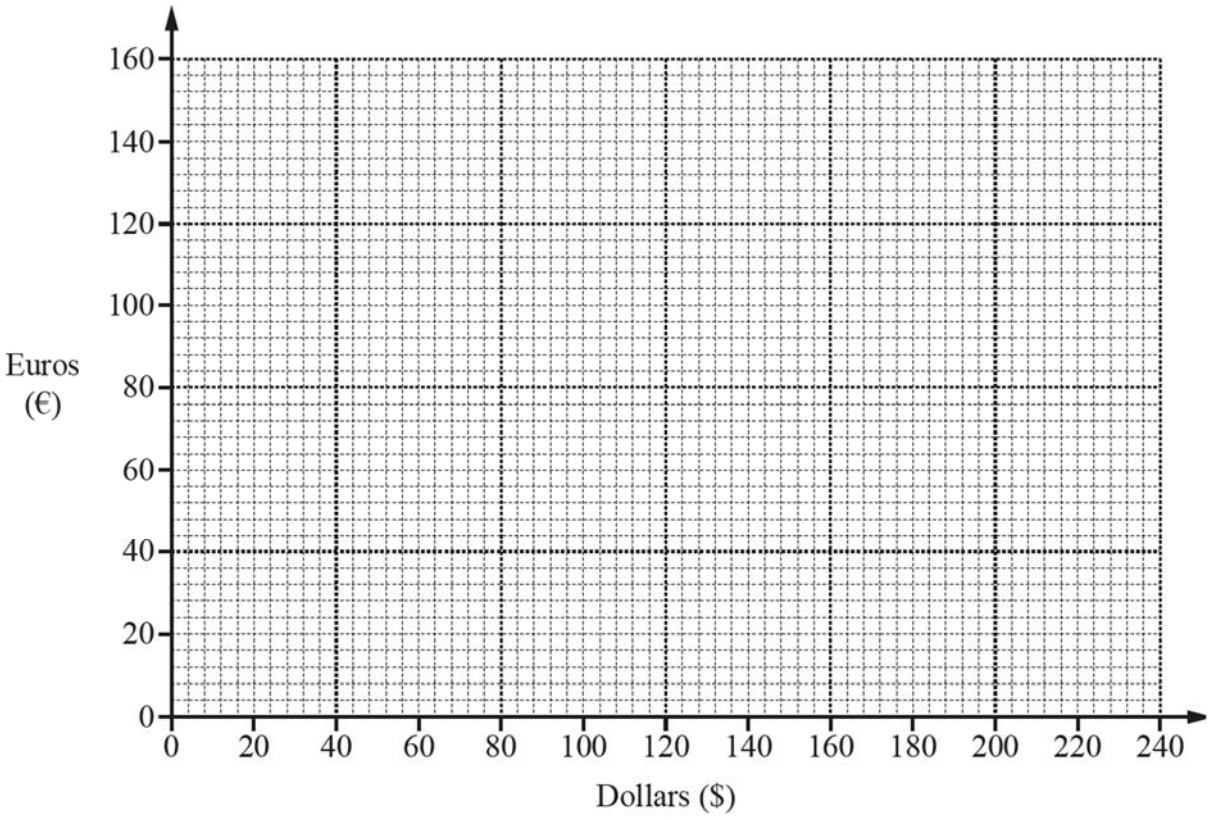
Find the angle.

Answer ..... [2]

9 The exchange rate between Euros (€) and Dollars ($) is €60 = $100.

(a) On the grid, draw a graph that represents the exchange rate.

Answer (a)



[1]

(b) Use your graph to change $220 to euros.

Answer (b) € ..... [1]

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10 The point system of a soccer league is given:

- 3 points awarded for each game won
- 1 point awarded for each game drawn
- 2 points deducted for each game lost

The points system can be represented $\mathbf{P} = \begin{pmatrix} 3 \\ 1 \\ -2 \end{pmatrix}$.

(a) In 2017, Tagore soccer club played in the league of 30 games.
It won 20, drew 6 and lost the remaining games.

In 2018, the club played in the league of 30 games.
It won 25 and lost 5 games.

Represent this information in a 2×3 matrix, **E**.

Answer (a) **E** = [1]

(b) Evaluate the matrix **T** = **EP**.

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Answer (b) **T** = [1]

(c) Find the difference between total points scored in 2017 and 2018.

Answer (c) ..... [1]

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11 **(a)** Express 540 as the product of its prime factors.

Answer (a) ..... [1]

(b) Find two numbers, both smaller than 100, that have a lowest common multiple of 540 and a highest common factor of 6.

Answer (b) ..... [2]

12 A jar contains 20 coloured marbles of which x are red marbles.
A marble is removed at random from the jar.

(a) Write down, in terms of x, the probability that the marble will be red.

Answer (a) ..... [1]

A bowl contains 30 coloured marbles of which $(x + 10)$ are red marbles.

The probability that a red marble will be taken at random from this bowl is twice the probability that a red marble will be taken at random from the jar.

(b) Find the value of x.

Answer (b) $x =$ ..... [2]

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13 **(a)** Simplify $\left(\frac{xy^{-3}}{2}\right)^4$.

Answer (a) ..... [1]

(b) Given that $2^{p-1} \times 3^p = 1$, find the value of 36^p.

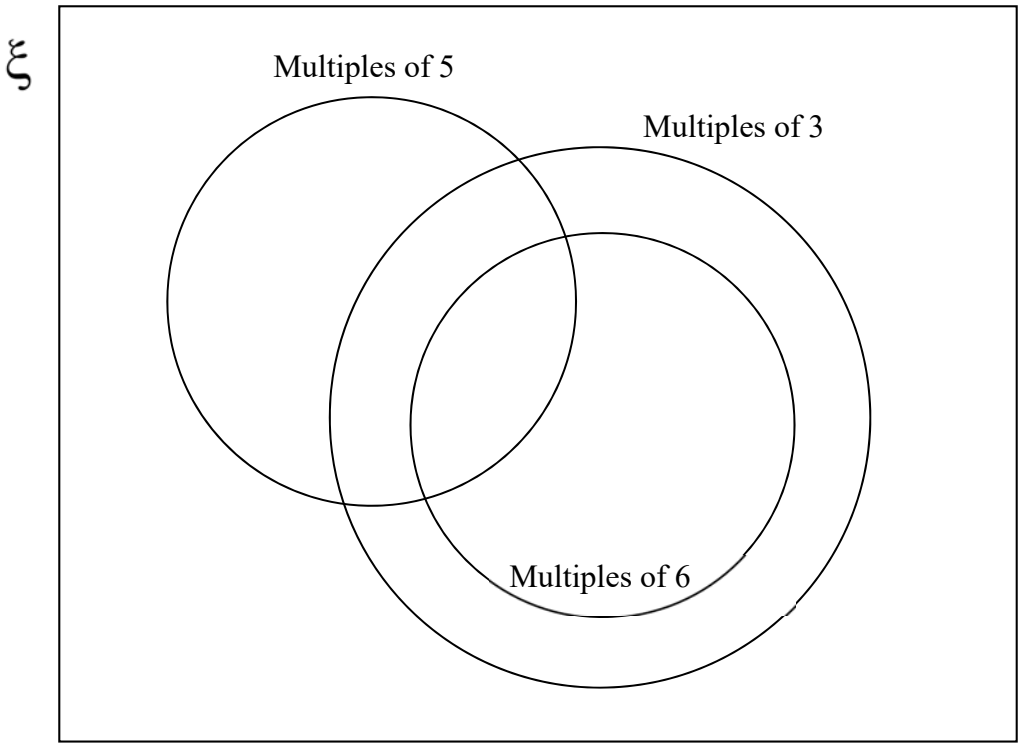
Answer (b) ..... [2]

14 **(a)** Write down the smallest whole number that leaves a remainder 2 when divided by 3, 5 and 6.

Answer (a) ..... [1]

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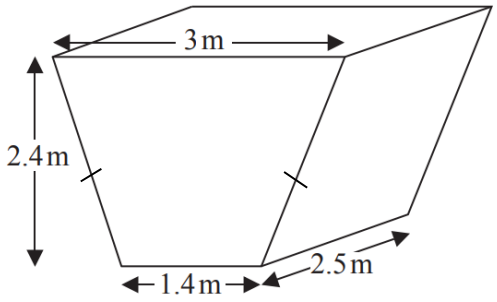
(b) Place each of the five numbers 39, 42, 45, 49 and 51 in the correct position in the Venn diagram below.



[2]

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15 The diagram shows a tank in the shape of a prism.
The cross section of the prism is an isosceles trapezium.



The tank is filled with water up to a depth of 1.2 m.

Find the volume of water.

Answer ..... m^3 [3]

16 **(a)** Factorise completely $(x - 7)^3 - 4x + 28$.

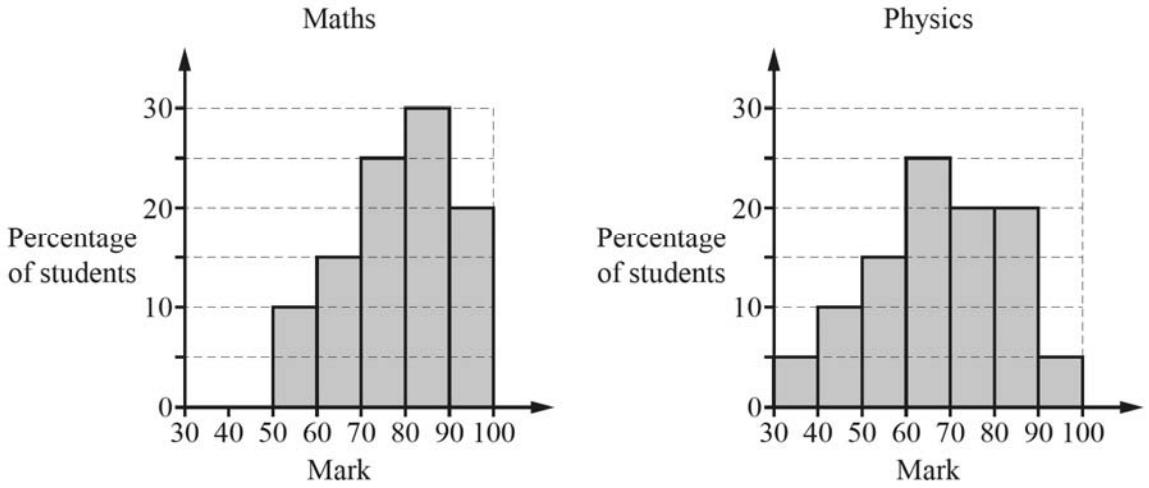
Answer (a) ..... [3]

(b) Hence, state the smallest integer value of x for which $(x - 7)^3 - 4x + 28 > 0$.

Answer (b) $x =$ ..... [1]

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17 The graphs show the distributions of the examination results, in Maths and Physics, of 20 students.



(a) What percentage of the students scored below 70 marks in Maths?

Answer (a) ..... % [1]

(b) Calculate an estimate of the mean mark for Maths.

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

(c) Make **two** comparisons between the performances of the students in the two tests.

1 .....

.....

2 .....

.....

[2]

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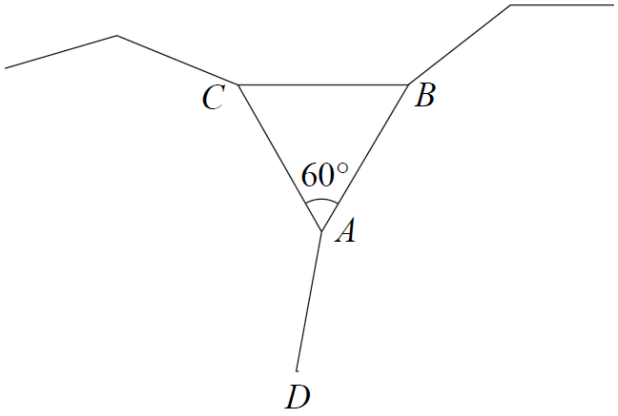
18 (a) It is possible to draw a regular polygon with an exterior angle of 50°.
Do you agree? Explain.

Answer (a) .....

..... [1]

(b) The sides of an equilateral triangle *ABC* and two regular polygons meet at *A*.
AB and *AD* are adjacent sides of a regular decagon.
AC and *AD* are adjacent sides of a regular *n*-sided polygon.

Find the value of *n*.



Answer (b) n = ... [3]

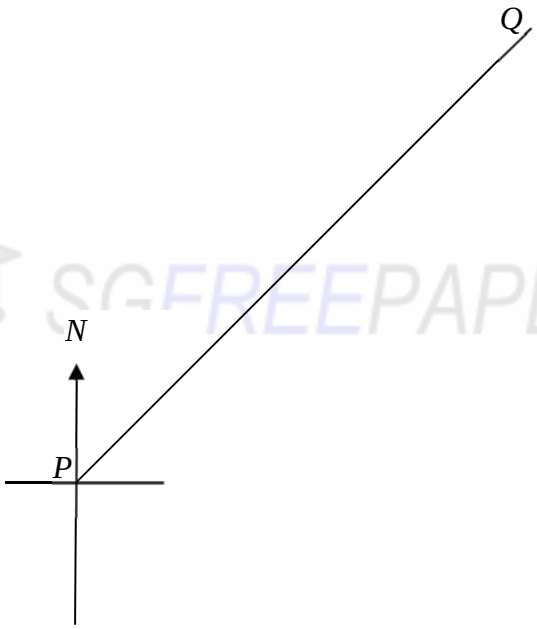
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19 A boat starts from a point *P* and sails along the sides of a triangular circuit, *PQR*.

(a) The path *PQ* has been drawn.
The scale is 1 cm to 2 km.
Construct a scale drawing to represent the triangular circuit given that *R* is 15 km from *P* on a bearing of 116°. [1]

(b) A lighthouse, L is to be located within the circuit.
It is 12 km away from *Q* and equidistant from *PQ* and *PR*.
Mark and label the lighthouse on your diagram. [3]

Answer (a) and *(b)*



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20 Ain invests some money into an account which pays a fixed rate of compound interest each year. The balance, \$*A*, of the account after *t* years is given by the formula

$$A = 1250 \times 1.045^t.$$

(a) Calculate *A* when $t = 4$.
Give your answer correct to the nearest ten cents.

Answer (a) $A =$ ..... [1]

(b) Using the answer in (a), calculate the percentage increase in Ain's savings after 4 years.

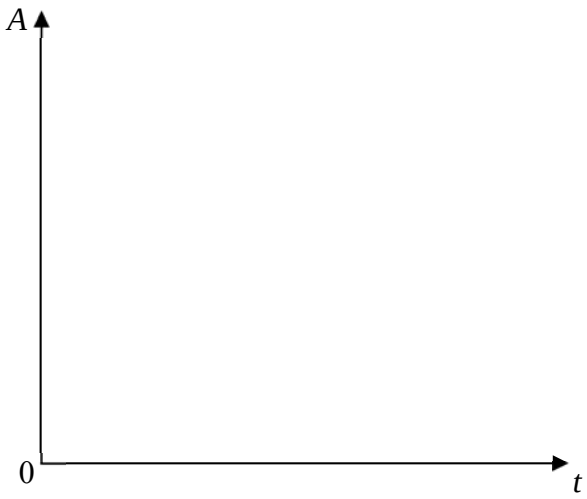
Answer (b) ..... % [2]

(c) Find the compound interest rate.

Answer (c) ..... % [1]

(d) Sketch the graph that represents the growth in Ain's account.

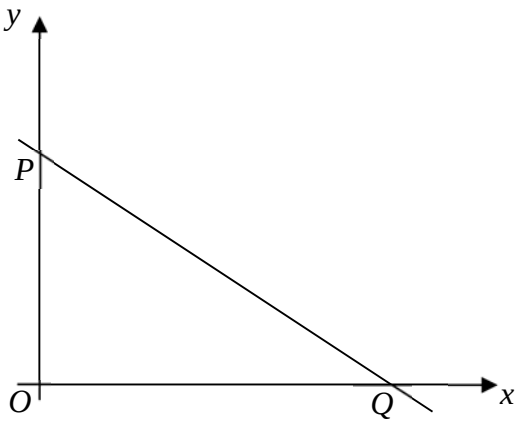
Answer (d)



[2]

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21 The equation of the line $x + 2y = 12$ cuts the y- and x-axes at P and Q.



(a) Write down the gradient of PQ.

Answer (a) ..... [1]

(b) A point K lies on the line and is equidistant from x- and y-axes.
Find the coordinates of K.

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

(c) **(i)** Find the gradient of the line that is perpendicular to PQ.

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

(ii) The line l is the perpendicular bisector of PQ.
Find the equation of the line l.

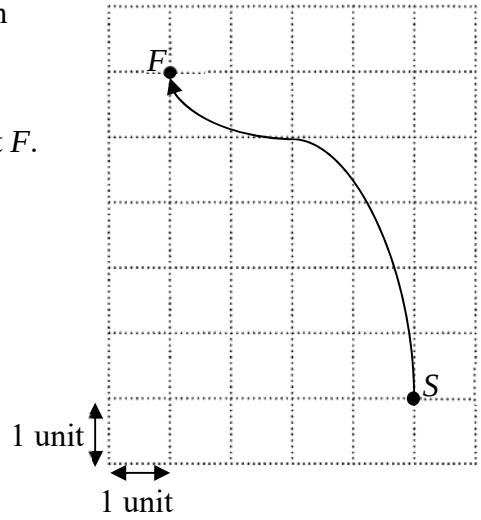
Answer (c)(ii) ..... [3]

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22 **(a)** The diagram shows the map of part of an orienteering course.

Simon runs from the start, S, to the point F.

Write $\overrightarrow{SF}$ as a column vector.



Answer (a) $\overrightarrow{SF}$ = _____ [1]

(b) $\overrightarrow{CD} = \begin{pmatrix} 2k \\ -k \end{pmatrix}$ and $|\overrightarrow{CD}| = \sqrt{180}$.
Find the possible values of k.

Answer (b) k = _____ [2]

(c) Given that A is the point (1, 2), $\overrightarrow{AB} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$ and $\overrightarrow{AC} = \begin{pmatrix} -5 \\ -4 \end{pmatrix}$, find

(i) $\overrightarrow{BC}$,

Answer (c)(i) $\overrightarrow{BC}$ = _____ [1]

(ii) the coordinates of the point P such that $ABPC$ is a parallelogram.

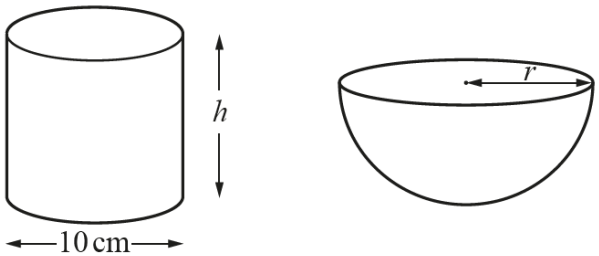
Answer (c)(ii) _____ [2]

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23 **(a)** The surface area of a solid is given by $A = \pi a(a+2b)$.
Make b the subject of the formula.

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

(b) **(i)** The diagram shows a cylinder and a hemisphere.
The cylinder has diameter 10 cm and height h cm
and the hemisphere has radius r.



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The volumes of the cylinder and hemisphere are equal.
Find r in terms of h.

Answer(b)(i) $r =$ ..... [3]

(ii) Find the smallest positive integer value of h such that r is a perfect cube.

Answer(b)(ii) $h =$ ..... [1]

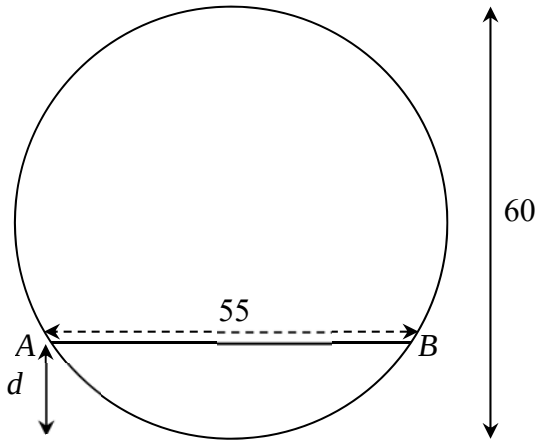
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24 **(a)** A small pipe can fill up a tank in 120 minutes.
A large pipe can fill up the same tank in 80 minutes.

Find the time taken if the tank is to be filled up by one small and two large pipes at the same time.

Answer (a) ..... mins [2]

(b) Water flows through a horizontal water pipe of diameter 60 cm.
The surface width, *AB*, of the water is 55 cm.



(i) Form an equation and calculate the depth, *d*, of the water in the pipe.

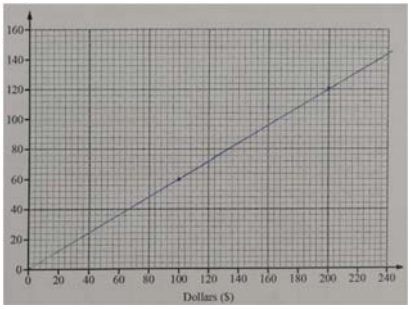
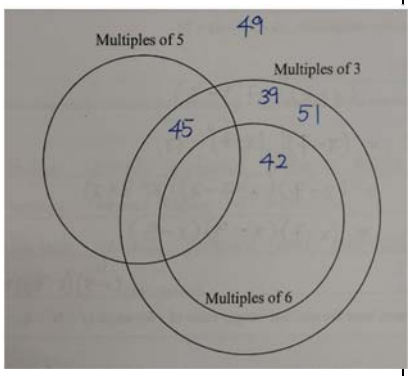
Answer (b)(i) d = ... cm [3]

(ii) Hence, state another depth of water that would give the same surface width.

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

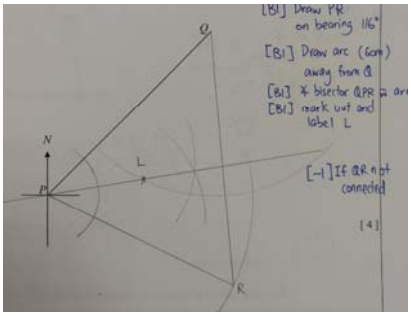
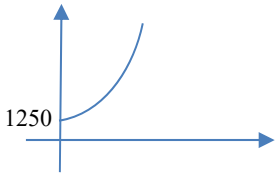
End of Paper

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Qn No.		Answers
1		−5.25
2		$2 \leq \frac{f}{7} < 6$
3		31.5
4		$\frac{17y - 3}{14}$
5	a	1.49×10^8
	b	116
6		21, 23, 26, 27, 28
7		1.60
8		133.7
9	a	
	b	132
10	a	$\begin{pmatrix} 20 & 6 & 4 \\ 25 & 0 & 5 \end{pmatrix}$
	b	$\begin{pmatrix} 58 \\ 65 \end{pmatrix}$
	c	7
11	a	$2^2 \times 3^3 \times 5$
	b	54, 60
12	a	$\frac{x}{20}$
	b	$x = 5$
13	a	$\frac{x^4}{16y^{12}}$
	b	4
14	a	32
	b	
15		5.4
16	a	$(x - 5)(x - 7)(x - 9)$
	b	6
17	a	25%
	b	78.5
	c	Students *performed better* in Maths because higher median/mean marks. Students performed *more consistently* for Maths because of smaller range.
18	a	I disagree because $\frac{360}{55} = 6.545 \neq$ *whole number*/integer
	b	15

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Qn No.		Answers
19		
20	a	$1490.60
	b	19.3
	c	4.5%
	d	
21	a	−0.5
	b	(4, 4)
	c	2
	d	$y = 2x - 9$
22	a	$\begin{pmatrix} -4 \\ 5 \end{pmatrix}$
	b	$k = \pm 6$
	c(i)	$\begin{pmatrix} -7 \\ -1 \end{pmatrix}$
	c(ii)	(−2, −5)
23	a	$b = \frac{A - \pi a^2}{2\pi a}$
	b(i)	$r = \sqrt[3]{\frac{75h}{2}}$
	b(ii)	90
24	a	30 mins
	b(i)	18.0
	b(ii)	42.0

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TANJONG KATONG SECONDARY SCHOOL
Preliminary Examination 2018
Secondary 4

CANDIDATE NAME			
CLASS		INDEX NUMBER	

MATHEMATICS 4048/02

Paper 2 **Monday 27 August 2018**

2 hours 30 minutes

Additional Materials: Writing Paper
Graph Paper

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
You are expected to use a scientific calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 100.

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Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone $= \pi r\ell$

Curved surface area of a sphere $= 4\pi r^2$

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

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

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

Arc length $= r\theta$, where θ 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

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

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

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1 **(a)** Solve the equation $\frac{2}{x^3} = -\frac{1}{32}$. [2]

(b) Simplify $\frac{8q - 12p + 2pq - 3p^2}{p^2 + 8p + 16}$. [3]

(c) Express $x^2 - 16x + 20$ in the form $(x + a)^2 + b$.
Hence, solve the equation $x^2 - 16x + 20 = 0$. [3]

(d) Given that $6x^2 - xy = 7y^2$, $x > 0$ and $y > 0$. Find the value of $\frac{12x}{y}$. [3]

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

The variables x and y are connected by the equation

$$y = 5x - 3 + \frac{1}{2x}.$$

The table below shows some values of x and the corresponding values of y correct to 2 decimal places.

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x	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7
y	7.25	2.50	0.50	0.17	0.25	a	0.83	1.21

(a) Calculate the value of a. [1]

(b) Using a scale of 2 cm to represent 0.1 unit, draw a horizontal x-axis for $0 < x \leq 0.7$. Using a scale of 2 cm to represent 1 unit, draw a vertical y-axis for $0 \leq y \leq 8$.

On your axes, plot the points given in the table and join them with a smooth curve. [3]

(c) By drawing a tangent, find the gradient of the curve at $(0.2, 0.5)$. [2]

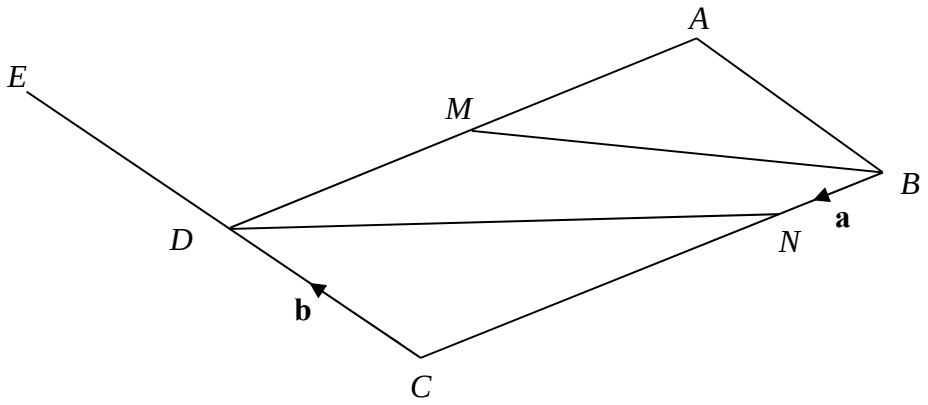
(d) Use your graph to find the solutions of $10x^2 - 8x + 1 = 0$ in the range $0 < x \leq 0.7$. [2]

(e) Write down the coordinates of the points when the line $y = 4x + 2$ intersects the curve. [2]

(f) The equation $5x - 3 + \frac{1}{2x} = kx$ has only one solution in the range $0 < x \leq 0.7$.
Explain how the value of k can be obtained from your graph. [2]

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3



ABCD is a parallelogram and *E* lies on *CD* produced such that *CD* = *DE*.
M is the midpoint of *AD*. *N* is a point on *BC* such that *BN* : *NC* = 1 : 3.
Given $\overrightarrow{BN}$ = **a** and $\overrightarrow{CD}$ = **b**,

(a) express, as simply as possible, in terms of **a** and/or **b**,

(i) $\overrightarrow{AM}$, [1]

(ii) $\overrightarrow{BM}$, [1]

(iii) $\overrightarrow{BE}$. [1]

(b) State 2 facts about *B*, *M*, and *E*. [2]

(c) Find the numerical value of

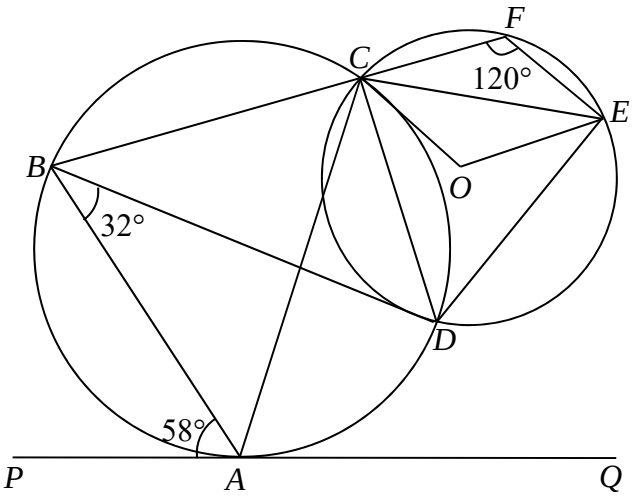
(i) $\dfrac{\text{area of } \Delta AMB}{\text{area of } \Delta DCN}$, [1]

(ii) $\dfrac{\text{area of } \Delta EDM}{\text{area of } DMBN}$. [1]

(d) Prove that triangles *EDM* and *ECB* are similar. [2]

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4 **(a)** In the diagram, PAQ is a tangent to the circle $ABCD$ at A.
O is the centre of the circle $CDEF$ and BCF is a straight line.
It is given that $\angle PAB = 58°$, $\angle ABD = 32°$ and $\angle CFE = 120°$.



(i) Find, giving reason(s) for each answer,

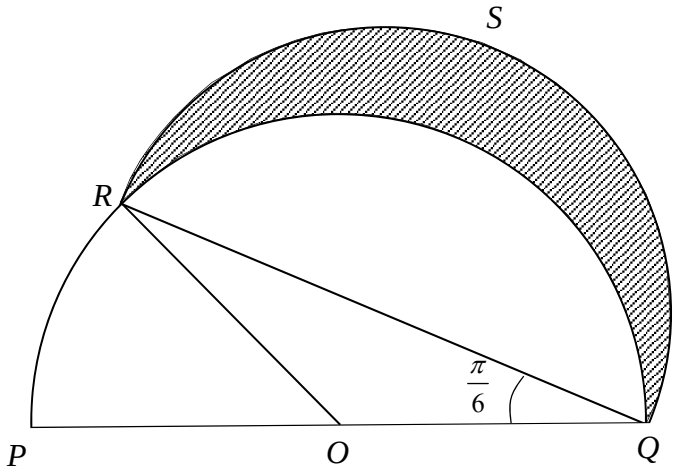
(a) angle ACD, [1]

(b) angle ACB. [1]

(ii) Given that $FC = FE$, show that triangle CDE is equilateral. [3]

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(b) The figure shows a semicircle, PRQ, with centre O and diameter PQ is 12 cm.
The chord QR makes an angle $\frac{\pi}{6}$ radian with the diameter PQ.
A second semicircle, RSQ is drawn, with QR as the diameter.



(i) Show that $QR = 6\sqrt{3}$ units. [2]

(ii) Find the perimeter of the shaded region. [3]

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5 Alex plans to cycle from point A to point C which is 56 km apart.

He travels for 50 km, at a constant speed of x km/h until he reaches the point B, where he rested momentarily. The journey from A to B took y hours.

(i) Write down an equation in x and y, to represent the time taken to cycle from A to B. [1]

Alex then continues the remaining 6 km from B to C at a constant speed which is 16 km/h slower than his speed from A to B.

(ii) Given that the total time taken for the journey from A to C is 5 hours, form another equation in x and y and show that it simplifies to

$$y = \frac{5x - 86}{x - 16}.$$ [2]

(iii) Find the value(s) of x, correct to 2 decimal places. [4]

(iv) Calculate the time taken for Alex to cycle from point A to C, if he had completed the whole journey at the slower speed.
Give your answer in hours and minutes, correct to the nearest minute. [2]

6 The first four terms in the sequence of numbers are given below.

$$P_1 = 0^2 + 4 = 4$$

$$P_2 = 1^2 + 7 = 8$$

$$P_3 = 2^2 + 10 = 14$$

$$P_4 = 3^2 + 13 = 22$$

(a) State the value of P_5 and P_6. [2]

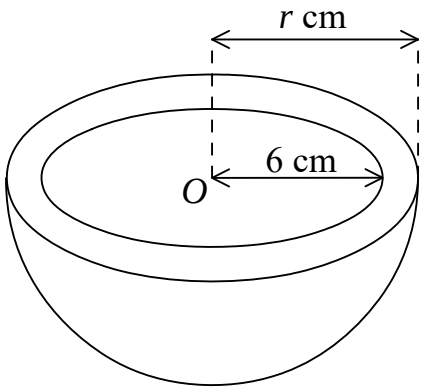
(b) The nth term of the sequence is P_n.
Find the expression of P_n in terms of n. [2]

(c) Explain why the value of P_n will never be an odd number for all values of n. [1]

(d) P_n and P_{n+1} are two consecutive terms in the sequence.
Show that $P_{n+1} - P_n$ can be expressed into $2n + 2$. [2]

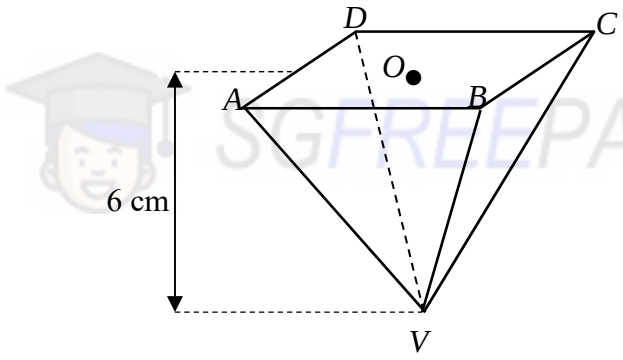
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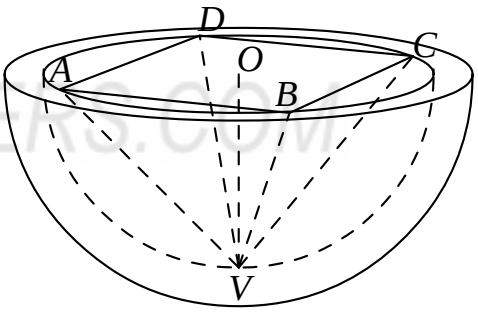
7 The diagram shows a hemispherical clay bowl with centre O.
The inner radius of the bowl is 6 cm and the outer radius is r cm



(a) Find the internal volume of the hemisphere with radius 6 cm. [2]

(b) Find the value of r if 408 cm^3 of clay is used to make the bowl. [2]





A solid pyramid with square base $ABCD$ and height OV, 6 cm, is placed in the bowl.
The points V, A, B, C and D touch the inner surface of the hemispherical bowl.

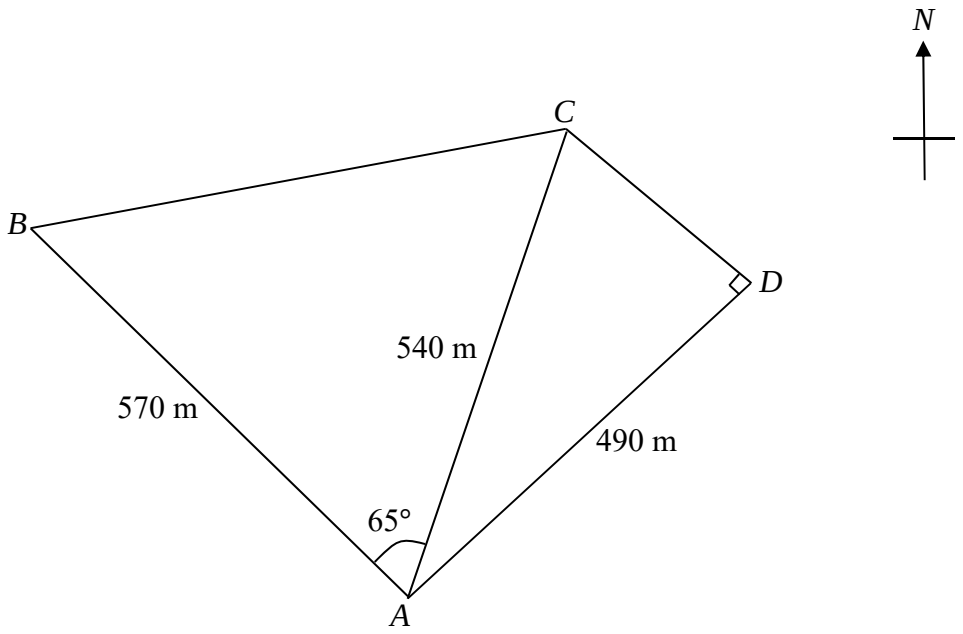
(c) Show that $AB = 6\sqrt{2}$ cm. [2]

Water is poured into the bowl to fill up the space between the pyramid and the clay bowl.
The pyramid is then removed from the bowl.

(d) Joe said that the height of the water in the bowl can be easily calculated by comparing volumes of similar solids.
Explain whether you agree or disagree with Joe. [2]

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8 The diagram shows a field $ABCD$ on horizontal ground, crossed by a path AC.
$AB = 570$ m, $AC = 540$ m and $AD = 490$ m.
$B\widehat{A}C = 65°$, $C\widehat{D}A = 90°$ and the bearing of C from B is 079°.



(a) Find

(i) BC, [3]

(ii) $B\widehat{C}A$, [2]

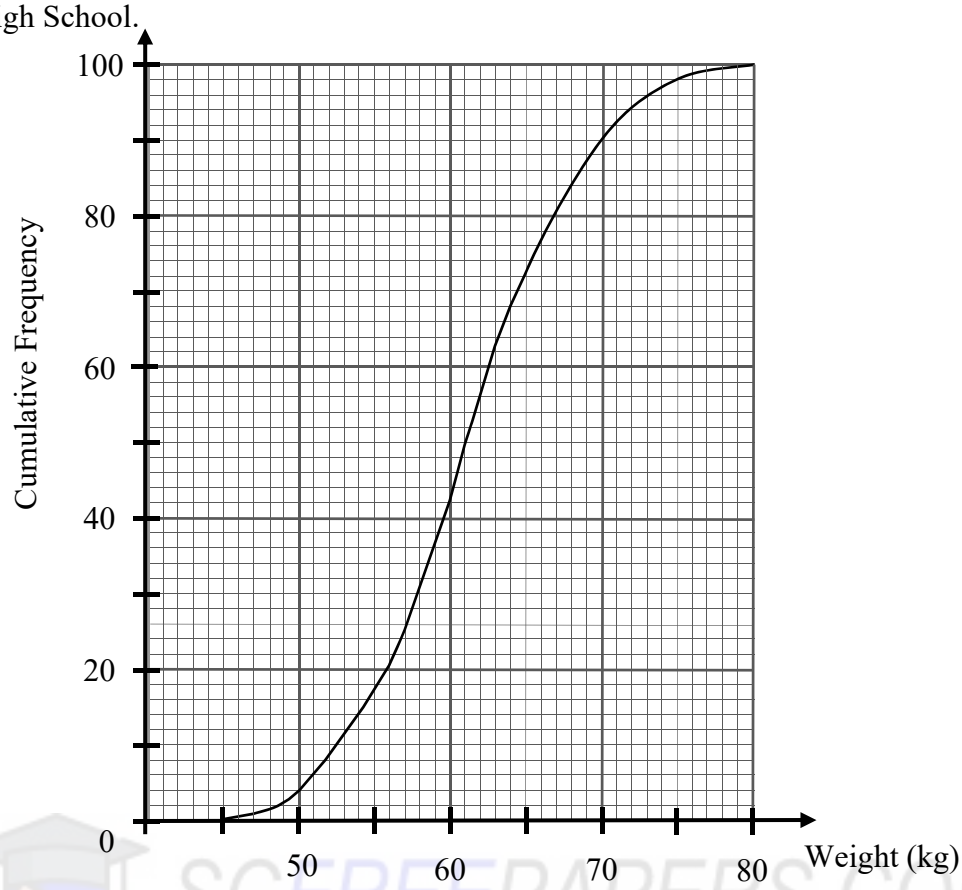
(iii) the bearing of A from C. [2]

(b) A drone is hovering vertically above point D.
The angle of depression of A from the drone is 2.6°.
Find the angle of depression of C from the drone. [4]

(c) The land is valued at \$45 000 per hectare.
Given that 1 hectare = 10 000 square metres, calculate the value of the field. [3]

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9 The cumulative frequency curve below illustrates the weights of 100 students in Senoko High School.



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(a) Use the graph to find

(i) the median weight of the students, [1]

(ii) the interquartile range. [2]

(b) The weights of 100 students in Changi High School have a higher median but a smaller interquartile range.
Describe how the cumulative frequency curve for Changi High School will differ from the curve for Senoko High School. [2]

(c) The table shows the distribution of ages for 200 students from both Senoko and Changi High School.

Age (x years)	$13 \leq x < 14$	$14 \leq x < 15$	$15 \leq x < 16$	$16 \leq x < 17$
Senoko High School	32	14	24	30
Changi High School	27	20	31	22

(i) One of the students is selected at random.
Find, as a fraction in its lowest terms, the probability that the student is
(a) a student from Changi High School who is aged 15 or more, [1]
(b) aged under 14. [1]

(ii) Two of the students are selected at random.
Find the probability that both are from Senoko High School aged under 16. [2]

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10 Peter plans to buy a new car. He must successfully obtain the Certificate of Entitlement (COE) through bidding before he can own a car. Information on the current COE prices, quota and bids received for the different category of cars are in **Table 1**.

Table 1:

CAT A Cars up to 1600cc and 130bhp [View Past CAT A Results]

Quota Premium	Change	Quota	Bids Received
$25,000	⬇ $9,110	1,435	1,626

CAT B Cars above 1600cc or 130bhp [View Past CAT B Results]

Quota Premium	Change	Quota	Bids Received
$31,000	⬇ $2,900	1,288	1,637

Peter has shortlisted two cars. The specification and price details are in the **Table 2**.

Table 2:

Brand of car	**Phantom Series X**	**Sky Hawk V**
Engine capacity (cc)	1496	1598
Fuel type	Diesel (Euro V)	Petrol
Power (bph)	114	165
Fuel consumption (km/l)	23.8	17.8
CO_2 emission (g/km)	110	130
Car Price (S$) **excludes VES rebate / surcharge*	152, 888	147, 999
OMV (S$)	31, 410	26, 239
Road Tax per 6 months (S$) **excludes Special Tax if any*	372	372

(i) Peter said that he has a higher chance of obtaining COE for brand Phantom as compared to Sky Hawk. Do you agree? Explain why. [1]

A special tax is levied on diesel cars and is payable in addition to the Road Tax of the vehicle. The charge is S$0.20 per cc for 6 months.

(ii) Find the total amount of tax payable for 6 months for brand Phantom. [2]

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Car buyers can either be granted rebates or imposed surcharge based on how clean the vehicle's emissions are. Vehicle Emission Scheme (VES) is based on a vehicle's carbon dioxide (CO_2) emissions, plus emissions of other pollutants.

Table 3:

Bands	CO_2 (g/km)	HC (g/km)	CO (g/km)	NO_x (g/km)	Rebate/ surcharge(-/+) for cars ($)
A1	A1 ≤90	A1 ≤0.020	A1 ≤0.150	A1 ≤0.007	-20,000
A2	90< A2 ≤125	0.020< A2 ≤0.036	0.150< A2 ≤0.190	0.007< A2 ≤0.013	-10,000
B	125< B ≤160	0.036< B ≤0.052	0.190< B ≤0.270	0.013< B ≤0.024	0
C1	160< C1 ≤185	0.052< C1 ≤0.075	0.270< C1 ≤0.350	0.024< C1 ≤0.030	+10,000
C2	C2 >185	C2 >0.075	C2 >0.350	C2 >0.030	+20,000

(iii) Use **Tables 2** and **3** to determine the price of brand Phantom car, **including** the VES rebate / surcharge, if any. [1]

Peter decided to take a 5-year bank loan for purchase of the car.
The interest rate is at 2.78% per annum.

The Maximum Loan Amount will be dependent on the Open Market Value (OMV) of the car.

Cars with OMV exceeding $20,000 will be entitled to a maximum loan value of 60% of car price with minimum 40% down payment.

(iv) Calculate the minimum down payment Peter has to pay if he decides to buy brand Phantom. [2]

(v) Peter decides to take a 60% loan. Suggest which car Peter should buy. Justify the decision you make and show your calculations clearly. [5]

END OF PAPER

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Qn		Solutions
1	a	x = - 4
	b	$\frac{(2q-3p)}{(p+4)}$
	c	x = 14.6 or 1.37
	d	$\frac{12x}{y} = 14$
2	a	a = 0.5
	b	All points correctly plotted Graph is smooth
	c	Tangent line drawn Gradient = -11.5 (~ -7 to -14)
	d	When y = 1, x = 0.17 or 0.65 Accept 0.165~1.7 and 0.6~0.65
	e	Draw line y = 4x + 2 (0.1, 2.45)
	f	The value of k is obtained by finding the gradient of the line that passes through the origin and that cuts the curve once.
3	a(i)	$\overrightarrow{AM} = 2a$
	a(ii)	$\overrightarrow{BM} = 2a + b$
	a(iii)	$\overrightarrow{BE} = 4a + 2b$
	b	B, M and E are collinear 2BM = BE
	c(i)	$\frac{2}{3}$
	c(ii)	$\frac{2}{3}$
	d	Since ABCD is a parallelogram, Angle EDM = angle ECB (corr angles) As CD = DE, $\frac{ED}{EC} = \frac{1}{2}$ As M is midpoint AD, $\frac{DM}{CB} = \frac{1}{2}$ ∴ΔEDM is similar to ΔECB
4	a(i)a	∠ACD = 32° (∠ in same seg)
	a(i)b	∠ACB = 58° (∠ in alt seg)
	a(ii)	∠CDE = (180 – 120)° (∠ in opp seg) = 60° ∠BCD = (58+32) ° = 90° ∠FCE = (180 – 120)° ÷ 2 (isos Δ) = 30°

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Qn		Solutions
		∠DCE = (90 – 30) ° = 60° ∴ $\angle CED = 60°$ ∴ ΔCDE is equilateral
	b(i)	∠PRQ = 90° (∠ in semicircle) cos $\frac{\pi}{6} = \frac{RQ}{12}$ $\frac{\sqrt{3}}{2} = \frac{RQ}{12}$ RQ = $6\sqrt{3}$ (shown)
	b(ii)	28.89 cm
5	(i)	y = $\frac{50}{x}$
	(ii)	5 – y = $\frac{6}{x-16}$ 5 – $\frac{6}{x-16}$ = y $\frac{5x-80-6}{x-16}$ = y $\frac{5x-86}{x-16}$ = y (shown)
	(iii)	x= 18.59 or 8.60 (2dp)
	(iv)	21 h 34 mins
6	(a)	$P_5 = 4^2 + 16 = 32$ $P_6 = 5^2 + 19 = 44$
	(b)	P_n = n(n+1) + 2
	c	For all values of n, n(n+1) is an even value.
	d	P_n = n(n+1) + 2 P_{n+1} = (n+1)(n+2) + 2 P_{n+1} - P_n = (n+1)(n+2) + 2 - n(n+1) – 2 = (n+1)(n+2-n) = (n+1)(2) = 2n + 2 (shown)
7	(a)	452.389 cm^3
	(b)	r = 7.4338
	(c)	OV = OA = 6cm OA = OB $6^2 + 6^2 = AB^2$ AB = $\sqrt{72}$ = $6\sqrt{2}$
	(d)	Disagree. The volume of water in the bowl is not is a shape of a hemisphere (h ≠ r) or The volume of water and the volume of the bowl are not similar figures since h

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Qn		Solutions
		$\neq r$.
8	a(i)	BC =596.939 cm
	(ii)	BCA = 59.929°
	(iii)	199.07°
	b	$\theta = 5.6°$
	c	\$878 000 (3sf)
9	a(i)	Median = 62.5kg
	a(ii)	IQR = 65.5 – 57 = 8.5 kg
	b	The curve will shift to the right of the curve for Senoko as the median is higher. The middle 50% of the curve will be steeper than for Senoko as the IQR is smaller.
	c(i)a	$\frac{53}{200}$
	c(i)b	$\frac{59}{200}$
	c(ii)	$\frac{70}{200} \times \frac{69}{199}$ $= \frac{483}{3980}$
10	(i)	P(brand Phantom) = $\frac{1435}{1626} \times 100\% = 88.3\%$ P(brand Sky Hawk) = $\frac{1288}{1637} \times 100\% = 78.7\%$ I agree with Peter.
	(ii)	\$671.20
	(iii)	\$142 888
	(iv)	\$571 55. 20
	(v)	<u>For Phantom:</u> Interest = 0.6 x their (iii) x 2.78 x 5 = \$11 916.86 Total repayment (balance + interest) = 0.6 x their (iii) + \$11 916.86 = \$97 649.66 Monthly instalment = \$1627.50 For Sky Hawk: Interest = 0.6 x 147 999 x 2.78 x 5 = \$12 343.12 Total repayment (balance + interest) = 0.6 x 147 999 + \$12 343.12 = \$101 142.52 Monthly instalment = \$1685.71 Since the monthly instalment is lower / total repayment amount with interest is lower, brand Phantom is a better buy.

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Qn		Solutions	Marks	Remarks
1	a	$\frac{2}{x^3} = -\frac{1}{32}$ $64 = -x^3$ $x = -4$	 B1 B1	
	b	$\frac{8q - 12p + 2pq - 3p^2}{p^2 + 8p + 16}$ $= \frac{2q(4+p) - 3p(4+p)}{(p+4)^2}$ $= \frac{(2q - 3p)(4+p)}{(p+4)^2}$ $= \frac{(2q - 3p)}{(p+4)}$	 M1 M1 A1	Factorise denominator Factorise numerator
	c	$x^2 - 16x + 20 = (x-8)^2 - 44$ $(x-8)^2 - 44 = 0$ $x - 8 = \pm\sqrt{44}$ $x = 14.6$ or 1.37	B1 M1 A1	Both correct answer
	d	$6x^2 - xy = 7y^2$ $6x^2 - xy - 7y^2 = 0$ $(6x - y)(x + y) = 0$ Since $x + y > 0$, $6x = 7y$ $\frac{x}{y} = \frac{7}{6}$ $\frac{12x}{y} = 14$	 M1 M1 A1	Factorise quadratic Show ratio of $\frac{x}{y}$
			11m	
2	a	$a = 0.5$	B1	
	b	All points correctly plotted Graph is smooth	P2 G1	P1 if 1 or more point is missing / wrongly plotted
	c	Tangent line drawn Gradient = -11.5	T1 B1	Accept range from -7 to -14.6
	d	$10x^2 - 8x + 1 = 0$ $5x - 4 + \frac{1}{2x} = 0$ $5x - 3 + \frac{1}{2x} = 1$ When $y = 1$, $x = 0.17$ or 0.65	 B1 B1	
	e	Draw line $y = 4x + 2$ $(0.1, 2.45)$	L1 B1	
	f	The value of k is obtained by finding the gradient of the line that cuts the curve once.	B1 B1	"use gradient" "intersect the curve"
			12m	

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Qn		Solutions	Marks	Remarks
3	a(i)	$\overrightarrow{AM} = 2a$	B1	
	a(ii)	$\overrightarrow{BM} = 2a + b$	B1	
	a(iii)	$\overrightarrow{BE} = 4a + 2b$	B1	
	b	$\overrightarrow{BE} = 2(2a + b)$ $\overrightarrow{BE} = 2\overrightarrow{BM}$ B, M and E are collinear 2BM = BE	 B1 B1	
	c(i)	$\frac{2}{3}$	B1	
	c(ii)	$\frac{2}{3}$	B1	
	d	Since ABCD is a parallelogram, Angle EDM = angle ECB (corr angles) As CD = DE, $\frac{ED}{EC} = \frac{1}{2}$ As M is midpoint AD, $\frac{DM}{CB} = \frac{1}{2}$ ∴ΔEDM is similar to ΔECB	 B1 B1	
			9m	
4	a(i)a	∠ACD = 32° (∠ in same seg)	B1	
	a(i)b	∠ACB = 58° (∠ in alt seg)	B1	
	a(ii)	∠CDE = (180 – 120)° (∠ in opp seg) = 60° ∠BCD = (58+32) ° = 90° ∠FCE = (180 – 120)° ÷ 2 (isos Δ) = 30° ∠DCE = (90 – 30) ° = 60° ∴ $\angle CED = 60°$ ∴ ΔCDE is equilateral	B1 B1 B1	
	b(i)	∠PRQ = 90° (∠ in semicircle) $\cos\frac{\pi}{6} = \frac{RQ}{12}$ $\frac{\sqrt{3}}{2} = \frac{RQ}{12}$ RQ = $6\sqrt{3}$ (shown)	B1 B1 CAG	soi $\frac{\sqrt{3}}{2}$ seen
	b(ii)	∠ROQ = $\pi - 2(\frac{\pi}{6})$ = $\frac{2\pi}{3}$ Perimeter = $6(\frac{2\pi}{3}) + \frac{1}{2}\pi(6\sqrt{3})$ = 28.891 cm	 M1, B1 A1	Find Arc length RQ and RSQ
			10m	

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Qn		Solutions	Marks	Remarks
5	(i)	$y = \frac{50}{x}$	B1	o.e.
	(ii)	$5 - y = \frac{6}{x-16}$ $5 - \frac{6}{x-16} = y$ $\frac{5x-80-6}{x-16} = y$ $\frac{5x-86}{x-16} = y$ (shown)	B1 B1 CAG	o.e. combine fraction
	(iii)	$\frac{5x-86}{x-16} = \frac{50}{x}$ $50x - 800 = 5x^2 - 86x$ $5x^2 - 136x + 800 = 0$ $x = \frac{-(-136) \pm \sqrt{(-136)^2 - 4(5)(800)}}{2(5)}$ x= 18.59 or 8.60 (2dp)	B1 √ M1 M1 A1	Equate (i) and (ii) Remove fraction Any method to solve seen
	(iv)	Slower speed = 18.59 -16 = 2.59599 Time taken = 56 ÷ 2.59599 = 21. 57 hrs = 21 h 34 mins	 M1 A1	
			9m	
6	(a)	$P_5 = 4^2 + 16 = 32$ $P_6 = 5^2 + 19 = 44$	B1 B1	
	(b)	$P_n = (n-1)^2 + 3n + 1$ $= n^2 - 2n + 1 + 3n + 1$ $= n^2 + n + 2$ $= n(n+1) + 2$	B1, B1	$(n-1)^2$ seen & 3n + 1 seen
	c	For all values of n, n(n+1) is an even value.	B1	
	d	$P_n = n(n+1) + 2$ $P_{n+1} = (n+1)(n+2) + 2$ $P_{n+1} - P_n$ $= (n+1)(n+2) + 2 - n(n+1) - 2$ $= (n+1)(n+2-n)$ $= (n+1)(2)$ $= 2n + 2$ (shown)	 B1 B1	o.e. Leading to CAG
			7m	
7	(a)	Vol hemisphere $= \frac{1}{2}(\frac{4}{3}\pi 6^3)$ $= 144\pi$ $= 452.389$ cm^3	B1 B1	
	(b)	$\left(\frac{r}{6}\right)^3 = \frac{144\pi + 408}{144\pi}$ r = 7.4338	M1 A1	
	(c)	OV = OA = 6cm OA = OB $6^2 + 6^2 = AB^2$ $AB = \sqrt{72} = 6\sqrt{2}$	B1 B1 CAG	
	(d)	Disagree. The volume of water in the bowl is not is a shape of a hemisphere ($h \neq r$) or The volume of water and the volume of the bowl are not similar figures since $h \neq r$.	B1 B1	
			8m	

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Qn		Solutions	Marks	Remarks
8	a(i)	$BC^2 = 570^2 + 540^2 - 2(570)(540)\cos 65°$ BC =596.939 cm	M2 A1	
	(ii)	$\frac{\sin BCA}{570} = \frac{\sin 65°}{596.939}$ BCA = 59.929°	M1 A1	
	(iii)	360° – 59.929° – (180 – 79) ° = 199.07°	M1 A1	
	b	tan 2.6° = $\frac{HD}{490}$ HD = 22.2508 cm $CD^2 = 540^2 - 490^2$ CD = 226.936 cm Tan $\theta = \frac{22.2508}{226.936}$ $\theta = 5.6°$	M1 A1 B1 A1	
	c	Area of land = 0.5(490)(226.936) + 0.5(570)(540)sin65 = 195080 sq meter = 19.5 hectare Value of land = 19.5 x 45 000 = $877 860	M1 M1 A1	
			13m	
9	a(i)	Median = 62.5kg	B1	
	a(ii)	IQR = 65.5 – 57 = 8.5 kg	M1 A1	soi
	b	The curve will shift to the right of the curve for Senoko as the median is higher. The middle 50% of the curve will be steeper than for Senoko as the IQR is smaller.	B1 B1	
	c(i)a	$\frac{53}{200}$	B1	
	c(i)b	$\frac{59}{200}$	B1	
	c(ii)	$\frac{70}{200} \times \frac{69}{199}$ $= \frac{483}{3980}$	M1 A1	Accept 0.121
			9m	

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Qn		Solutions	Marks	Remarks
10	(i)	P(brand Phantom) = $\frac{1435}{1626} \times 100\% = 88.3\%$ P(brand Sky Hawk) = $\frac{1288}{1637} \times 100\% = 78.7\%$ I agree with Peter.	B1	
	(ii)	\$372 + (0.20 x 1496) = \$671.20	B1 B1	0.2 x 1496 seen
	(iii)	\$152 888 - \$10 000 = \$142 888	B1	
	(iv)	0.4 x 142 888 = \$571 55. 20	B1 B1	0.4 x their (iii)
	(v)	<u>For Phantom:</u> Interest = 0.6 x their (iii) x 2.78 x 5 = \$11 916.86 Total repayment (balance + interest) = 0.6 x their (iii) + \$11 916.86 = \$97 649.66 Monthly instalment = \$1627.50 For Sky Hawk: Interest = 0.6 x 147 999 x 2.78 x 5 = \$12 343.12 Total repayment (balance + interest) = 0.6 x 147 999 + \$12 343.12 = \$101 142.52 Monthly instalment = \$1685.71 Since the monthly instalment is lower / total repayment amount with interest is lower, brand Phantom is a better buy.	B1 B1 B1 B1 B1	Find interest Find total (balance + interest) Find interest Find total (balance + interest) Conclusion with justification.
			11m	

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