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Montfort Secondary School.

2016 Montfort Secondary EMath Prelim

3

Answer all the questions.

- 1 Arrange the following in **descending** order, given that a is a negative number greater than -1 .

$$a^2, -a^3, \frac{1}{a}, \sqrt{-a}$$

Answer [1]

- 2 Calculate $\frac{-8^2 - 9 \times \sqrt{289}}{\sqrt{64} - 16 + 5}$, giving your answer to

(a) 3 decimal places,

Answer [1]

(b) 3 significant figures.

Answer [1]

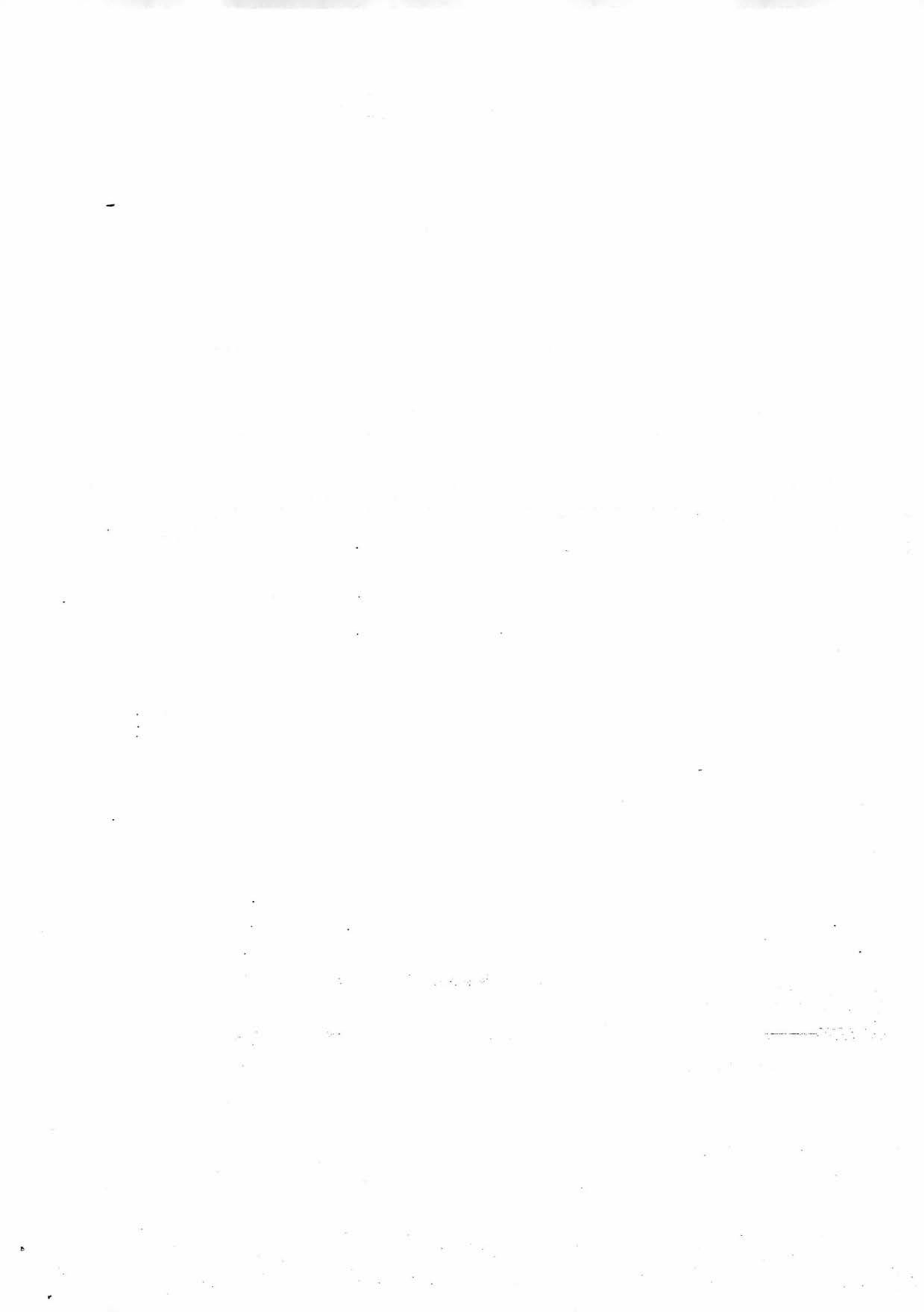
- 3 In a factory that produces sweets, 2.75×10^8 orange mint drops are produced each week. Each mint drop weighs 2 g and contains 0.75 mg of peppermint oil.

(a) Assuming that there are 52 weeks in a year, find, in **standard form**, the number of mint drops produced in a year.

Answer [1]

(b) Calculate the percentage of peppermint oil in each drop by weight.

Answer % [1]



- 4 (a) Express 3780 as a product of its prime factors, giving your answer in index notation.

Answer

[1]

- (b) Find the smallest integer n , where $n > 0$ such that $3780n$ is a perfect square.

Answer

[1]

- 5 (a) Factorise completely $(m+n)^2 - (m-n)(m+n)$.

Answer

[2]

- (b) Hence, using your result in (a), explain why $1003^2 - 997 \times 1003$ is divisible by 6.

Answer

[2]

- 6 A popular restaurant offers discounts to customers who pay \$50 per annum to become a VIP.

Bill (per meal)	Member's discount
> \$50	8% off
> \$100	10% off
> \$200	12% off
> \$300	15% off

Leslie's average bill per meal is around \$60. He dines in the restaurant once a month.

- (a) Showing your working clearly, make a recommendation whether Leslie should become a VIP.

Answer

[2]

Alan is already a VIP member. During one dining experience, \$26.50 was discounted from his bill.

- (b) Calculate the cost of the meal before the discount.

Answer

[2]

7 6 typists working 5 hours a day can type a manuscript in 16 days.

(a) How many days will 4 typists take to do the same job working 5 hours a day?

Answer [1]

(b) Find the number of typists required, in terms of p and q , to do the same job if they worked p hours a day for q days.

Answer [2]

- 8 (a) $\xi = \{\text{positive integers } x : x < 20\}$
 $A = \{\text{factors of } 18\}$
 $B = \{\text{multiples of } 3\}$

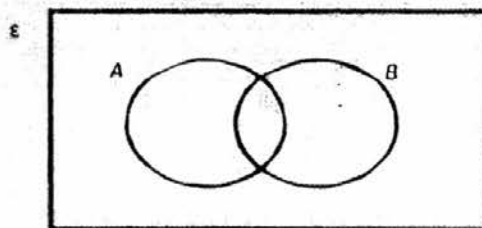
(i) List the elements in A .

Answer [1]

(ii) Find $n(A \cap B)$

Answer [1]

(b) Shade the Venn Diagram below to represent the set $(A \cap B)'$.



[1]

- 9 $ABCD$ is a quadrilateral such that ABC forms an equilateral triangle and angle ADC is 20° lesser than angle ABC . The exterior angle of triangle ACD at C is 50° more than angle ABC .

(a) Calculate the angle CAD .

Answer [2]

(b) What is the name of the quadrilateral?

Answer [1]

- 10 (a) Factorise completely $6u^4 - u^3 - u^2$.

Answer [2]

(b) Simplify $\frac{6u^4 - u^3 - u^2}{u(4u^2 - 1)(3u + 1)}$

Answer [2]

- 11 A typical rice dumpling in the shape of tetrahedron has a height of 6 cm and weighs 189 g. During the Duanwu Festival, **similar** dumplings of assorted sizes were made and sold.

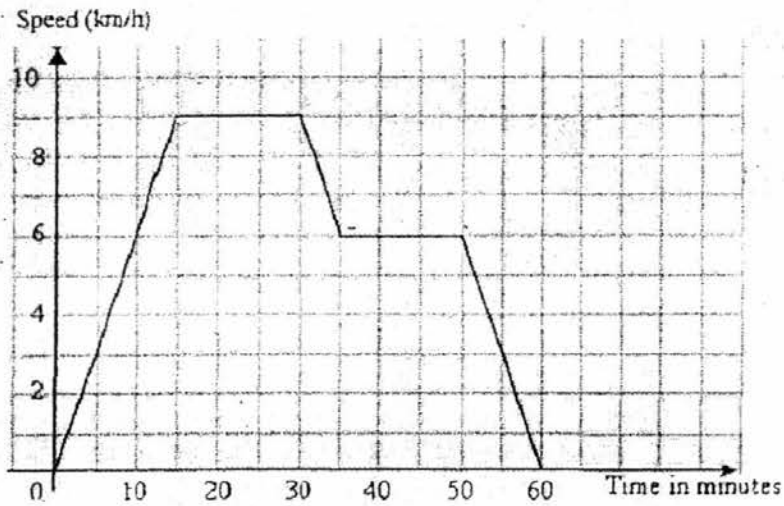
- (a) The smallest version of the dumpling has a height of 4 cm. Calculate the weight of the smallest dumpling.

Answer g [2]

- (b) The biggest version of the dumpling weighs 448 g. Express the surface area of the smallest dumpling to that of the biggest dumpling in the form $1 : n$.

Answer [2]

- 12 The speed-time graph of a particle is shown in the diagram below.



- (a) Find the acceleration, in km/h, of the particle during the first 15 minutes of the motion.

Answer km/h [1]

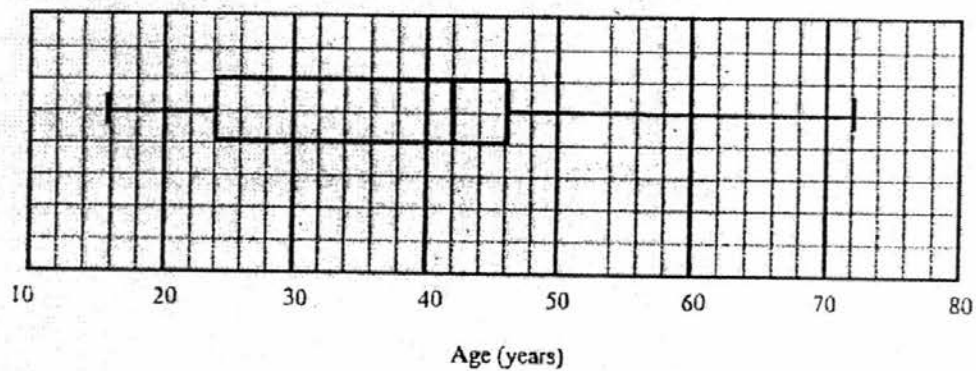
- (b) Find the duration at which the particle is travelling at constant speed.

Answer mins [1]

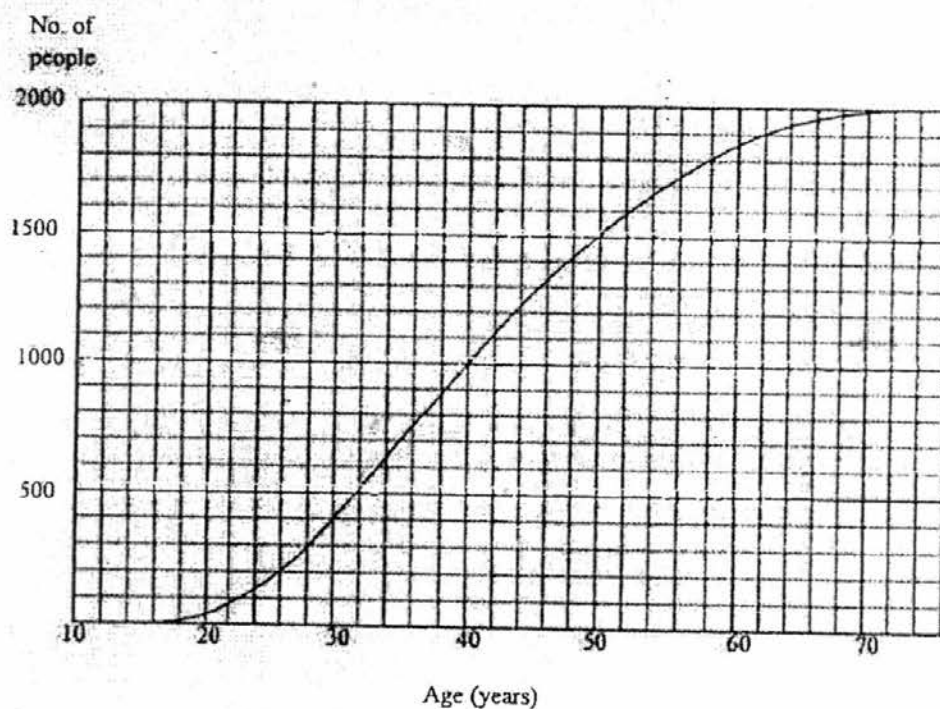
- (c) Calculate the average speed, in km/h, of the particle during the last 25 minutes.

Answer km/h [2]

- 13 The box plot shows the ages of the audience at concert X held at the Star Theatre.



The cumulative curve shows the ages of the audience at concert Y held at the Resort World Theatre.



- (a) Find the interquartile range for concert X .

Answer years

[1]

- (b) Write down the lower quartile for concert Y .

Answer years [1]

- (c) Find the total number of audience in concert X given that 480 of them are at least 46 years old.

Answer [1]

- (d) A person is picked from the audience from concert Y .
What is the probability that the person is less than 30 years old?

Answer [1]

- (e) The following statement compares the ages of the audience for the two concerts.
Write whether you agree or disagree and provide a reason for your decision.

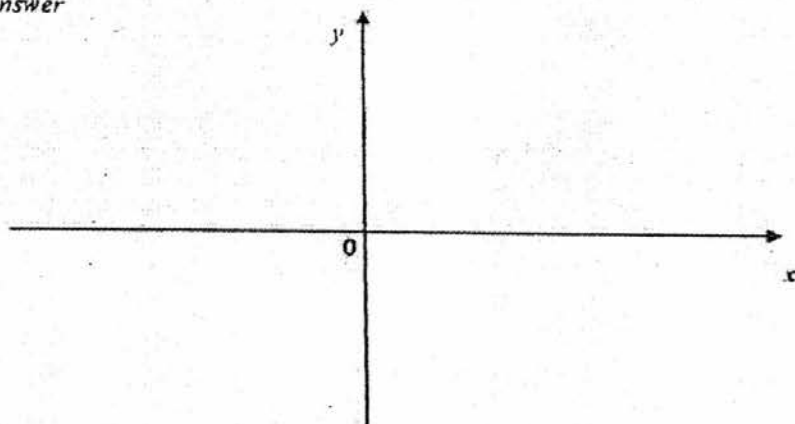
On average, the audience in concert Y is younger.

Answer because

[1]

- 14 (a) Sketch the graph of $y = (x+3)(x-1)$.

Answer



[2]

- (b) Write down the equation of the line of symmetry of the graph of $y = -3(x+3)(x-1)$.

Answer [1]

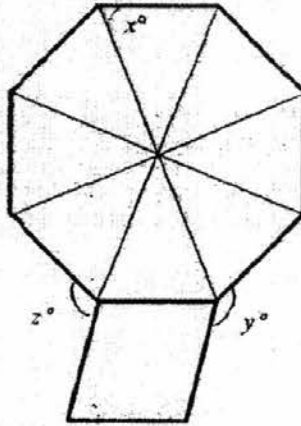
- 15 (a) Express $x^2 - 5x - 7$ in the form $(x-a)^2 + b$.

Answer [1]

- (b) Hence solve the equation $x^2 - 5x - 7 = 1$, giving your answers correct to two decimal places.

Answer $x = \dots\dots\dots$ and $\dots\dots\dots$ [2]

- 16 The diagram shows a regular octagon with a rhombus attached to one of the sides.



- (a) Find the value of x .

Answer $x = \dots\dots\dots$ [2]

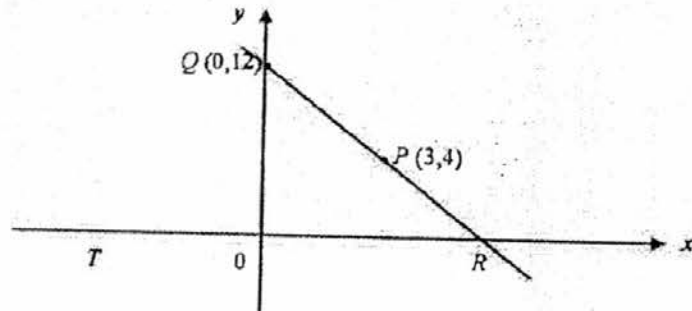
- (b) Calculate the sum of the angles z and y in the diagram.

Answer $\dots\dots\dots^\circ$ [2]

- 17 In the equation $\frac{3x}{4} + \frac{6x-5}{5} = k$, where k is a constant, the solution is twice the value of k . Find the value of k .

Answer $k = \dots\dots\dots$ [3]

- 18 The diagram shows a sketch of a straight line passing through $P(3,4)$ and $Q(0,12)$. R and T are points on the x -axis.



- (a) Find the equation of the straight line.

Answer [1]

- (b) The line cuts the x -axis at the point R . What are the coordinates of R ?

Answer R (.....) [1]

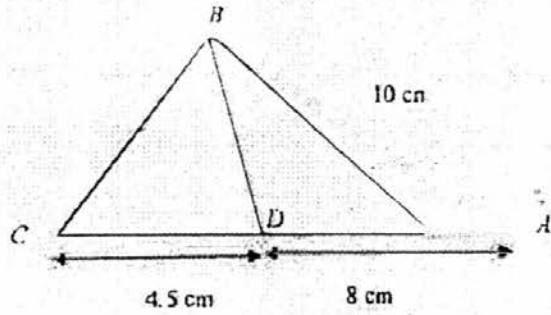
- (c) A point S lies on the straight line such that its distance from the x -axis is twice its distance from the y -axis. Find a pair of possible coordinates for S .

Answer S (.....) [2]

- (d) Find the value of $\sin \angle POT$.

Answer $\sin \angle QRT =$ [1]

- 19 (a) Prove that triangle ABD is similar to triangle ACB .



Answer

.....

.....

.....

.....

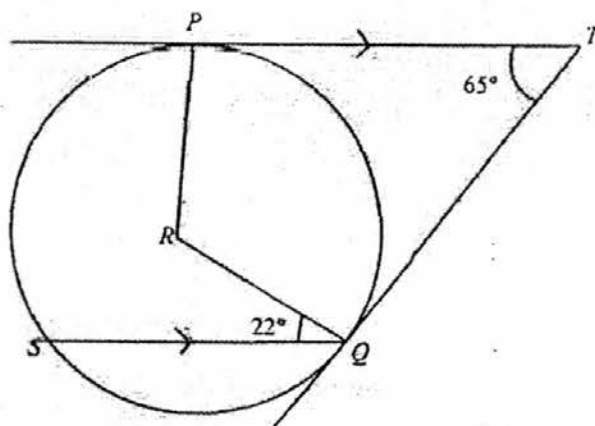
.....

[2]

- (b) Given that $\sin \angle ABC = k$, find $\sin \angle ABD$ in terms of k

Answer $\sin \angle ABD =$ [3]

- 20 In the diagram, T is a tangent to the circle at P and Q . S is a point on the circle such that SQ is parallel to PT . R is a point in the circle such that angle RQS is 22° . Angle PTQ is 65° .



- (a) Show that R is not the centre of the circle.

Answer

.....

.....

.....

.....

[2]

- (b) Find angle PSQ .

Answer $\angle PSQ = \dots\dots\dots^\circ$ [2]

- 21 The diagram shows a scale drawing of two islands P and Q using a scale of 1 cm to represent 5 km.



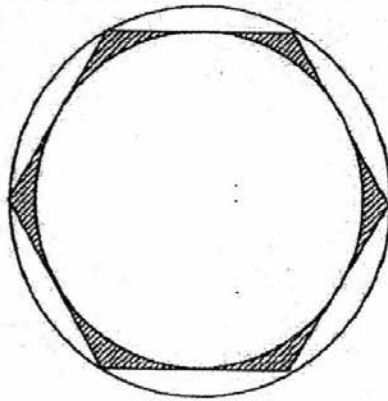
- (a) A boat B lies on a bearing of 145° from P and is equidistant from P and Q . By showing your construction clearly, mark and label B on the diagram. [2]
- (b) Measure and write down the bearing of B from Q .

Answer $^\circ$ [1]

- (c) The boat B sails towards island Q at an average speed of 12 km/h.
Calculate the travelling time, giving your answer in hours and minutes, to the nearest minute.

Answerh.....min [3]

- 22 The diagram shows a regular hexagon whose side is 2 m. An inner circle is drawn in the hexagon touching all its six sides. An outer circle is drawn passing through the all six vertices of the hexagon.



- (a) Write down the radius of the outer circle.

Answerm [1]

- (b) Find the radius of the inner circle.

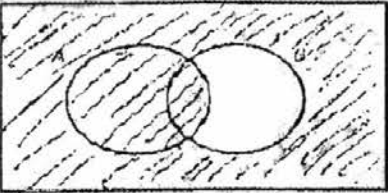
Answerm [2]

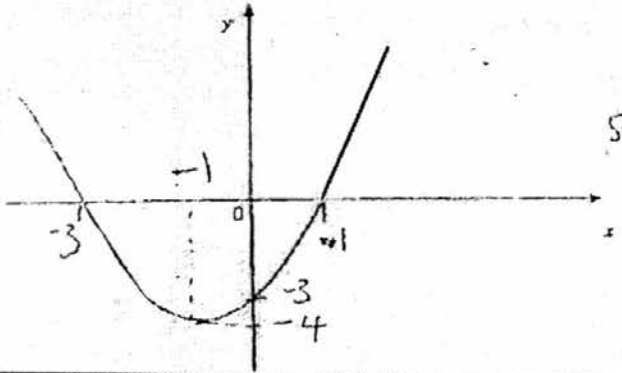
- (c) Calculate the area of the shaded region.

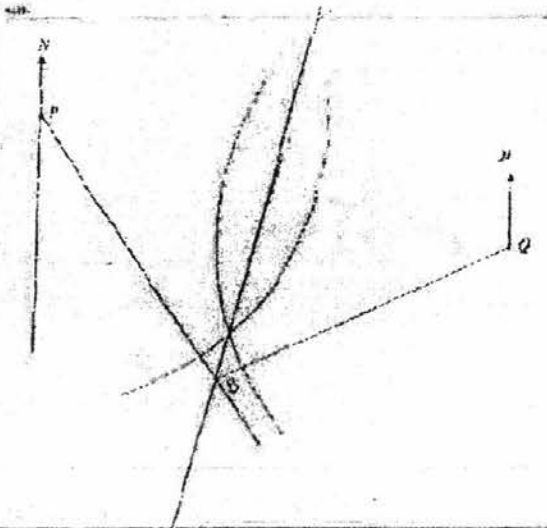
Answerm² [3]

End of paper

Montfort Sec. Prelim 2018 P1 – Answer Key

Q. No.	Part	Answer	Mark	Notes
2.	a)	-18.152	B1	
	b)	-18.2	B1	
3.	a)	1.43×10^{10}	B1	
	b)	0.0375%	A1	Accept $\frac{3}{80}$ %
4.	a)	$2^2 \times 3^3 \times 7$	B1	
	b)	105	B1	Do not accept $3 \times 5 \times 7$
5.	a)	$(m+n)(m+n-m+n)$ $= 2n(m+n)$	M1 A1	Give 1 mark if all expanded correctly.
	b)	$1003^2 - 987 \times 1003$ $= (1000+3) - (1000-3)(1000+3)$ $= 6(1000+3)$ Since 6 is a factor, expression is divisible by 6.	M1 A1	No marks if part (a) is incorrect.
6.	a)	savings = \$57.60 > \$50 He should become a VIP.	M1 A1	
	b)	$\frac{12}{100} \times x = 2650$ $x = \$220.83$	M1 A1	Do not accept 220.80 or $220\frac{5}{6}$ or 221.
7.	a)	24	B1	
	b)	480 typists : 1 hour : 1 day $\frac{480}{pu} : p \text{ hours} : q \text{ days}$	M1 A1	
8.	a) i)	1, 2, 3, 6, 9, 18	B1	
	ii)	2	B1	
	b)	ξ 	B1	
9.	a)	$CAD = 110^\circ - 40^\circ$ $= 70^\circ$	M1 A1	$\frac{180^\circ - 40^\circ}{2}$ not accepted
	b)	Kite	B1	
10.	a)	$u^2(6u^2 - u - 1)$ $= u^2(3u+1)(2u-1)$	M1 A1	$-u^2(-6u^2 + u + 1)$ accepted $u^2(-3u-1)(1-2u)$ not accepted
	b)	$\frac{u^2(3u+1)(2u-1)}{u(2u+1)(3u+1)(2u-1)}$ $= \frac{u}{2u+1}$	M1 A1	
11.	a)	$\frac{w}{189} = \left(\frac{4}{6}\right)^3$ $w = 56$	M1 A1	
	b)	$56 : 448 = 1 : 8$ height $\rightarrow 1 : 2$ area $\rightarrow 1 : 4$	M1 A1	
12.	a)	36 km/h	B1	
	b)	30 mins	B1	

	c)	Distance = 2km Average speed = 4.8 km.h	M1 A1	
13.	a)	22 years	B1	
	b)	32 years	B1	
	c)	1920 audience members	B1	
	d)	$\frac{1}{5}$	B1	
	e)	Agree because the median in X is 42 which is more than the median in Y, which is 40.	A1	
14.	a)		A1 A1	For correct shape For correct details i.e. intersections and turning points
	b)	$x = -1$	B1	
15.	a)	$\left(x - \frac{5}{2}\right)^2 - \left(\frac{5}{2}\right)^2 - 7$ $= \left(x - \frac{5}{2}\right)^2 - 13\frac{1}{4}$	M1 A1	
	b)	$\left(x - \frac{5}{2}\right)^2 = 1 + 13\frac{1}{4}$ $x = \pm \sqrt{14\frac{1}{4} + \frac{5}{2}}$ $x = 6.27 \text{ or } -1.27$	M1 A1	
16.	a)	$x = \frac{6 \times 180}{8 \times 2}$ $= 6.75$	A1 M1	
	b)	$z + y = (360^\circ - 135^\circ) \times 2 - 180^\circ$ $= 270^\circ$	M1 A1	
17.		$\frac{6k}{4} + \frac{12k-5}{5} = k$ $k = \frac{10}{29}$	M1 A1	
18.	a)	$y = -\frac{8}{3}x + 12$	B1	
	b)	$R\left(4\frac{1}{2}, 0\right)$	B1	
	c)	$2s = -\frac{8}{3}s + 12$ $s\left(2\frac{4}{7}, 5\frac{1}{7}\right)$	M1 A1	
	d)	$\sin \angle POT = \frac{4}{5}$	B1	
19.	a)	$\angle BAD = \angle CAB$ $\frac{AD}{CA} = \frac{10}{12.5} = \frac{4}{5}$ $\frac{AD}{AB} = \frac{8}{10} = \frac{4}{5}$	M1 A1	

	b)	$\frac{\sin \angle ABC}{12.5} = \frac{\sin \angle ACB}{10}$ $\sin \angle ABD = \frac{4}{5}k$	M1 A1	
20.	a)	$\angle RQT + 22^\circ + 65^\circ = 180^\circ$ (int. $\angle$ s, parallel lines) $\angle RQT = 93^\circ \neq 90^\circ$ $\therefore RQ$ is not perpendicular to $QT \Rightarrow RQ$ not radius R not centre	M1 A1	
	b)	$\angle$ at centre $= 360^\circ - 65^\circ - 2 \times 90^\circ$ $= 115^\circ$ $\angle$ at circumference $= \frac{115^\circ}{2} = 57.5^\circ$	M1 A1	
21.	a)		A2	
	b)	$245^\circ \pm 1^\circ$	A1	
	c)	distance = 38km time = 3 hours 10 mins	M2 A1	
22.	a)	2 m	B1	
	b)	$r = \sqrt{2^2 - 1^2}$ $= \sqrt{3}$	M1 A1	
	c)	area of hexagon = 10.39 m^2 shaded area = 0.965 m^2	M2 A1	

Answer all the questions.

- 1 (a) It is given that $A = \frac{2h^3}{m(0.5 + \sqrt{n})}$
- (i) Find A when $h = -5$, $m = \frac{3}{5}$ and $n = 18$ [1]
- (ii) Express n in terms of A , h and m . [2]
- (b) Factorise completely $12x^2 - 3y^2$. [2]
- (c) (i) Simplify $\frac{a^2 - 9b^2}{a - 3b + 2a^2 - 6ab}$. [3]
- (ii) Given that the equation $\frac{m-1}{8} = \frac{2}{m-1}$ has two solutions a and b , where $a > b$, find the value of $a - b$. [3]
-

- 2 (a) Given that $A = \begin{pmatrix} 3 & 0 \\ -1 & 2 \end{pmatrix}$ and $B = \begin{pmatrix} 4 & -3 \\ 0 & 8 \end{pmatrix}$.

Find the matrix C such that $A^2 + C = 2B$.

[2]

- (b) A western food stall at the foodcourt sells set lunches and set dinners on weekend. On a particular weekend, the number of each type of meal sold is shown in the table below.

	Set Lunch A	Set Lunch B	Set Dinner C	Set Dinner D
Saturday	55	54	60	65
Sunday	58	66	67	70

The prices of the set lunches and dinners are as follows:

	Set Lunch A	Set Lunch B	Set Dinner C	Set Dinner D
Price	\$ 8.90	\$ 10.60	\$ 9.90	\$ 12.50

- (i) Write down a 2×4 matrix, N , that represents the set meals sold on the weekend. [1]
- (ii) Write down a column matrix, P , to represent the prices of the set meals. [1]
- (iii) Evaluate NP . [2]
- (iv) State what the elements of NP represent. [1]
- (v) Mr Lee has a foodcourt discount card which gives him 10% discount. Calculate the total cost he has to pay if he orders 2 sets of Set Lunch A and 3 sets of Set Lunch B. Give your answer to the nearest dollar. [2]

3 (a) A is the point $(12, -5)$, B is the point $(7, 3)$.

(i) Write down the column vector $\overrightarrow{AB}$. [1]

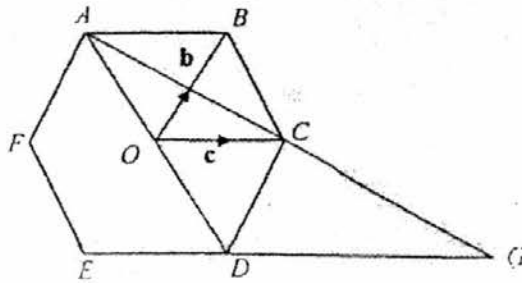
(ii) Find $|\overrightarrow{AB}|$. [2]

(iii) C is the point such that $\overrightarrow{AC} = \begin{pmatrix} m \\ 24 \end{pmatrix}$.
Find the value of m if A , B and C lie on the same straight line. [2]

(b) $ABCDEF$ is a regular hexagon, centre O .

$\overrightarrow{OB} = \mathbf{b}$ and $\overrightarrow{OC} = \mathbf{c}$.

The side ED is produced to a point G such that $ED : DG = 1 : 2$.



(i) Express, as simply as possible, in terms of $\mathbf{b}$ and/or $\mathbf{c}$.

(a) $\overrightarrow{BE}$, [1]

(b) $\overrightarrow{EG}$, [1]

(c) $\overrightarrow{DA}$, [1]

(d) $\overrightarrow{AC}$, [1]

(e) $\overrightarrow{AG}$, [1]

(ii) Hence, write down two facts about A , C and G . [2]

- 4 (a) The probabilities that John and Amy will be late for school are $\frac{1}{5}$ and $\frac{2}{7}$ respectively.
Find the probability that

- (i) both John and Amy will be late for school, [1]
(ii) only one of them will be late for school. [2]

- (b) Bag A contains four balls numbered 2, 4, 5, 8.
Bag B contains three balls numbered 3, 6, 9.
A ball is randomly drawn from each bag without replacement.
The sum of the two numbers on the balls is recorded.

- (i) Copy and complete the possibility diagram below to represent the outcomes. [1]

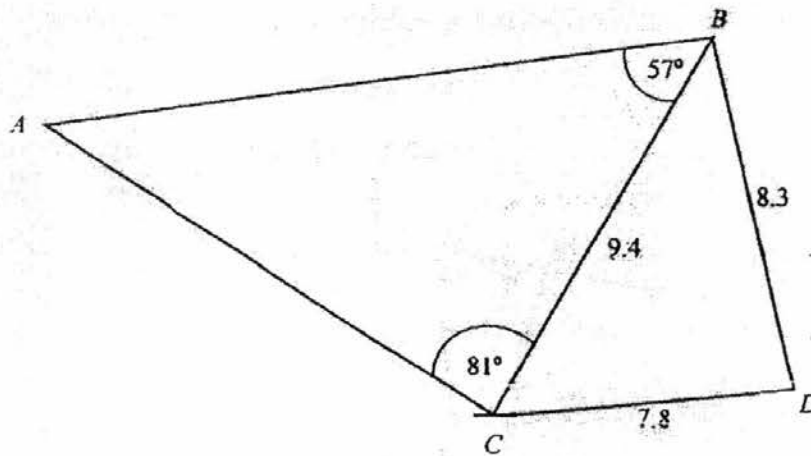
		Bag A			
Bag B	+	2	4	5	8
	3				
	6				
	9				

- (ii) Find, as a fraction in its simplest form, the probability that
- (a) the sum of the two numbers drawn is a prime number, [1]
(b) both balls drawn are even, [1]
(c) the product of the numbers drawn is less than 20. [1]
- (c) The first 5 terms of a sequence are 5, 6, 11, 20 and 33.
- (i) Write down the next term in the sequence. [1]
(ii) The n th term of the sequence is $2n^2 + An + B$.
By considering some of the numbers in the sequence and forming equations, find the value of A and B . [2]
(iii) Explain why 4708 is not a term of this sequence. [2]
-

5 The speed of a drone in still air is 15 m/s and that of the wind is x m/s.

- (a) Find an expression, in terms of x , for the speed of the drone when it travels
- (i) in the direction of the wind, [1]
 - (ii) against the direction of the wind. [1]
- (b) Find an expression for the time required for the drone to travel 80 m
- (i) in the direction of the wind, [1]
 - (ii) against the direction of the wind. [1]
- (c) The drone takes 2 mins longer to travel 80 m against the wind than it takes to travel in the direction of the wind.
- Write down an equation in x to represent this information, and show that it reduces to $3x^2 + 4x - 675 = 0$. [3]
- (d) Solve the equation $3x^2 + 4x - 675 = 0$, giving the solutions correct to 3 decimal places. [3]
- (e) Explain why one of the solutions in part (d) needs to be rejected. [1]
- (f) Hence, find the time taken to travel 80 m in the direction of the wind. Give your answer to the nearest second. [1]
-

6



Three points, A , B , C and D are four points on level ground. $BC = 9.4$ m, $BD = 8.3$ m, $CD = 7.8$ m, angle $ACB = 81^\circ$ and angle $ABC = 57^\circ$.

- (a) Calculate
- (i) AC , [2]
 - (ii) angle BCD , [3]
 - (iii) the area of triangle BCD , [2]
- (b) C is the foot of a vertical mast, CT .
The angle of depression of A when viewed from the top of the mast T is 46° .
Calculate the height of the vertical mast. [2]
- (c) An object moves from B to D .
Calculate the greatest angle of elevation of the top of the mast when viewed from the object at any point on its path BD . [3]

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

A boy stood at the top of a building.

He threw a ball vertically upwards.

The height, h metres, of the ball above the top of the building at a time t seconds after it was thrown is given by the formula

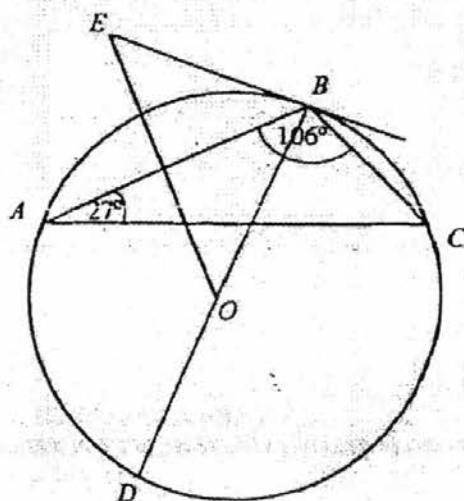
$$h = -3t^2 + 7t + 1.$$

The table below shows some values of t and the corresponding values of h .

t	0	1	2	3	4	5
h	1	5	3	-5	-19	p

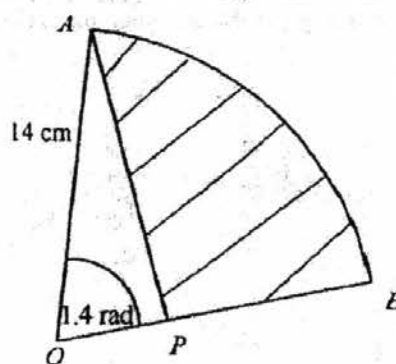
- (a) Find the value of p . [1]
- (b) Using a scale of 2 cm to 1 second, draw a horizontal t -axis for $0 \leq t \leq 5$.
Using a scale of 2 cm to 5 metres, draw a vertical h -axis for $-40 \leq h \leq 5$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (c) Use your graph to estimate
- (i) the greatest height of the ball above the top of the building. [1]
- (ii) the length of the time that the ball was more than 3 metres the top of the building. [2]
- (d) By drawing a tangent, find the gradient of the graph at $(3, -5)$ [2]
- (e) The ball hits the ground after 4 seconds after it was thrown.
Use your graph to find the height of the building. [1]

- 8 (a) In the diagram, O is the centre of circle $ABCD$. BOD is a straight line, BE is tangent to the circle. angle $ABC = 106^\circ$ and angle $BAC = 27^\circ$.



Find, giving reasons for each answer,

- | | | |
|-------|---------------|-----|
| (i) | angle ADC , | [1] |
| (ii) | angle ADB , | [2] |
| (iii) | angle ABD , | [1] |
| (iv) | angle ABE . | [1] |
- (b) In the figure, OAB is a sector of a circle with centre O and radius 14 cm. P is a point on OB such that $3OP = 2BP$ and angle $AOB = 1.4$ radians.



Find

- | | | |
|-------|-------------------------------------|-----|
| (i) | the length of the arc AB . | [1] |
| (ii) | the area of the shaded region, | [3] |
| (iii) | the perimeter of the shaded region. | [3] |

9 Here is some information about a gas cylinder.

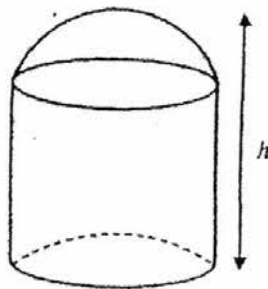
9kg BBQ Gas Bottle Dimensions, Capacity and Weight

- ♦ A 9kg gas cylinder, with POL valve, is the most common BBQ bottle size
- ♦ Diameter: 320 mm
- ♦ Height: 660 mm



Safety information the gas cylinder can be filled to a maximum of 95% of its total volume.

In this question the gas cylinder can be modelled as a cylinder with a hemisphere on top.



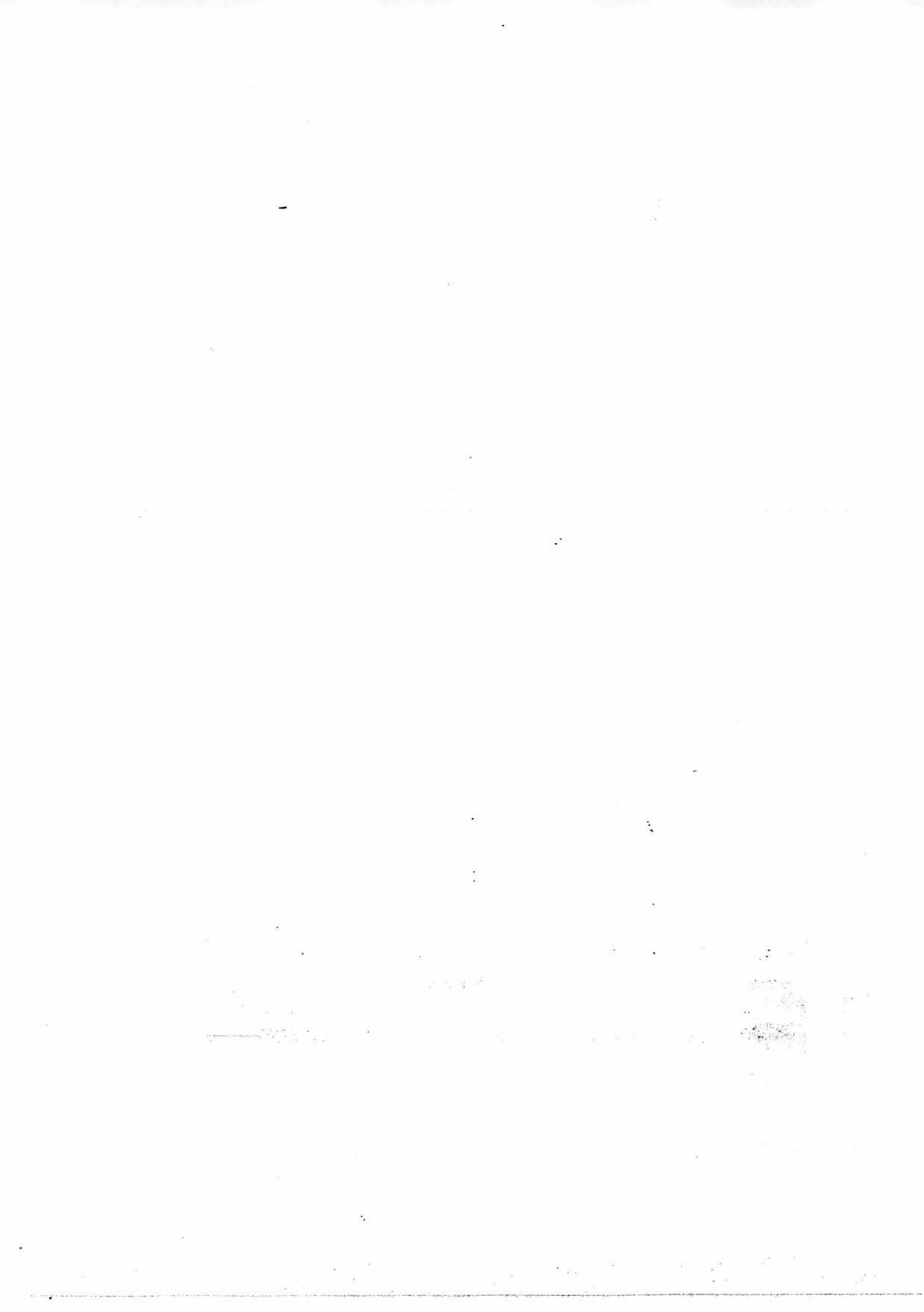
- (a) Work out the area, in square centimetres, of the base of the gas cylinder.
Give your answer in terms of π . [1]
- (b) (i) Show that the exterior surface area of the gas cylinder is $2368\pi \text{ cm}^2$. [2]
- (ii) The exterior surface of the paint of the gas cylinder needs to be painted.
The paint is supplied in tins, each of which contains enough paint to cover 0.2 m^2 .
Find the number of tins of paint required. [2]
- (c) Work out the volume, in cubic centimetres, of the gas cylinder.
Give your answer in terms of π . [2]
- (d) The gas cylinder is initially empty.
To fill up the cylinder, gas is pumped through a cylindrical pipe with the specifications given below.

Specifications of Cylindrical Pipe

- Radius: 3.2 cm
- Maximum flow speed of gas: 290 cm/s

Calculate the minimum time taken, in seconds, to fill the gas cylinder to its safe volume.

[3]



1.	a)	i)	-87.9	B1		
		ii)	$0.5 + \sqrt{n} = \frac{2h^3}{Am}$ $n = \left(\frac{2h^3}{Am} - 0.5 \right)^2$	M1 A1		
	b)		$12x^2 - 3y^2 = 3(4x^2 - y^2)$ $= 3(2x + y)(2x - y)$	M1 A1		
	c)	i)	$\dots = \frac{(a + 3b)(a - 3b)}{a(1 + 2a) - 3b(1 + 2a)}$ $= \dots$ $= \frac{a + 3b}{1 + 2a}$	M1 A1		
		ii)	$\dots$ $m = 5 \text{ or } -3$ $\dots$ $a - b = 8$	M2 A1		
2.	a)		$\dots = \begin{pmatrix} 8 & -6 \\ 0 & 16 \end{pmatrix} - \begin{pmatrix} 9 & 0 \\ -5 & 4 \end{pmatrix}$ $= \begin{pmatrix} -1 & -6 \\ 5 & 12 \end{pmatrix}$	M1 A1		
	b)	i)	$N = \begin{pmatrix} 55 & 54 & 60 & 65 \\ 58 & 66 & 67 & 70 \end{pmatrix}$	B1		
		ii)	$P = \begin{pmatrix} 8.9 \\ 10.6 \\ 9.9 \\ 12.5 \end{pmatrix}$	B1		
		iii)	$NP = \begin{pmatrix} 2468.4 \\ 2754.1 \end{pmatrix}$	A1 A1		
		iv)	Elements represent the sales of Set Lunch A, Set Lunch B, Set Dinner C and Set Dinner D on Saturday and Sunday respectively.	B1		
		v)	$\text{Total Cost} = 90\% \times (2 \times 8.9 + 3 \times 10.6)$ $= \$45 \text{ (nearest dollar)}$	M1 A1		
3.	a)	i)	$\overrightarrow{AB} = \begin{pmatrix} -5 \\ 8 \end{pmatrix}$	B1		
		ii)	$ \overrightarrow{AB} = \sqrt{(-5)^2 + 8^2}$ $= 9.43 \text{ units}$	M1 A1		
		iii)	$\begin{pmatrix} m \\ 24 \end{pmatrix} = k \begin{pmatrix} -5 \\ 8 \end{pmatrix}$ $m = -15$	M1 A1		
	b)	i)	a)	$\overrightarrow{BE} = -2b$	B1	
			b)	$\overrightarrow{EG} = 3c$	B1	
			c)	$\overrightarrow{DA} = 2(b - c)$	B1	
			d)	$\overrightarrow{AC} = 2c - b$	B1	
			e)	$\overrightarrow{AG} = 4c - 2b$	B1	
		ii)	$\overrightarrow{AG} = 2\overrightarrow{AC}$ $\overrightarrow{AC} \parallel \overrightarrow{AG}$ A, C and G are collinear with A as a common point. $\overrightarrow{AG}$ is twice of $\overrightarrow{AC}$ AG: AC is 2: 1 $\frac{AC}{AG} = \frac{1}{2}$ C is the midpoint of AG.	M1 A1	Must write For either one	
4.	a)	i)	$\frac{2}{35}$	B1		

	ii)	$\dots = \frac{1}{5} \times \frac{5}{7} + \frac{4}{5} \times \frac{2}{7}$ $= \frac{13}{35}$	M1 A1																									
b)	i)	<table><tr><td></td><td>1</td><td>2</td><td>4</td><td>5</td><td>8</td></tr><tr><td>Bag B</td><td>3</td><td>5</td><td>7</td><td>8</td><td>11</td></tr><tr><td></td><td>6</td><td>8</td><td>10</td><td>11</td><td>14</td></tr><tr><td></td><td>9</td><td>11</td><td>13</td><td>14</td><td>17</td></tr></table>		1	2	4	5	8	Bag B	3	5	7	8	11		6	8	10	11	14		9	11	13	14	17	B1	
	1	2	4	5	8																							
Bag B	3	5	7	8	11																							
	6	8	10	11	14																							
	9	11	13	14	17																							
	ii)	a)	$\frac{7}{12}$	B1																								
		b)	$\frac{1}{4}$	B1																								
		c)	$\frac{5}{12}$	B1																								
c)	i)	50	B1																									
	ii)	$A + B = 3$ $2A + B = -2$ $A = -5, B = 8$	M1 A1																									
	iii)	$n = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(2)(-4700)}}{2(2)}$ $= 49.7 \text{ or } -47.2 \text{ (rej.)}$ As $n = 49.7$ is not an integer, 4708 is not a term of this sequence.	M1 A1																									
5.	a)	i)	$(15 + x) \text{ m/s}$	B1																								
		ii)	$(15 - x) \text{ m/s}$	B1																								
	b)	i)	$\left(\frac{80}{15-x}\right) \text{ s}$	B1																								
		ii)	$\left(\frac{80}{15-x}\right) \text{ s}$	B1																								
	c)	$\frac{80}{15-x} - \frac{80}{15+x} = 120$ $160x = 27000 - 120x^2$ $3x^2 + 4x - 675 = 0$	M1 M1 A1																									
	d)	$x = \frac{-4 \pm \sqrt{4^2 - 4(3)(-675)}}{2(3)}$ $= 14.348$ $\text{or } -15.681$	B1 B1 B1																									
	e)	-15.861 needs to be rejected as speed cannot be negative.	B1																									
	f)	3 s	B1																									
6.	a)	i)	$\frac{AC}{\sin 57^\circ} = \frac{9.4}{\sin 42^\circ}$ $AC = 11.8 \text{ m}$	M1 A1																								
		ii)	$\cos \angle BCD = \frac{9.4^2 + 7.8^2 - 8.3^2}{2(9.4)(7.8)}$ $\angle BCD = \cos^{-1} 0.54766$ $= 56.8^\circ$	M1 M1 A1																								
		iii)	$\text{Area of } ABCD = \frac{1}{2} \times 7.8 \times 9.4 \times \sin 56.79^\circ$ $= 30.7 \text{ m}^2$	M1 A1																								
	b)	$\tan 46^\circ = \frac{TC}{11.781}$	M1																									

			height of vertical mast = 12.2 m	A1	
	c)		$\frac{1}{2} \times 8.3 \times d = 30.67$	M1	
			...		
			$\tan \angle CET = \frac{12.19}{7.3903}$	M1	
			...		
			$\angle CET = 58.8^\circ$	A1	
7.	a)		$p = -39$	B1	
	c)	i)	5.07 m	B1	
		ii)	length of time = 2 - 0.5 = 1.5 s	M1 A1	
	d)		Proper calculation Accept correctly calculated value	M1 A1	-9.5 < m < -11.5
	e)		19 m	B1	According to graph
8.	a)	i)	74°	B1	
		ii)	$\angle ACB = 47^\circ$ $\angle ADB = 47^\circ$	M1 A1	
		iii)	43°	B1	
		iv)	47°	B1	
	b)	i)	19.6 cm	B1	
		ii)	area of $\triangle AOP = 38.629 \text{ cm}^2$ Area of sector $AOB = 137.2 \text{ cm}^2$ shaded area = 98.6 cm^2	M1 M1 A1	
		iii)	$AP^2 = 14^2 + 5.6^2 - 2(14)(5.6) \cos 1.4$ $AP = 14.167 \text{ cm}$ Perimeter = 42.2 cm	M1 M1 A1	
9.	a)		$256\pi \text{ cm}^2$	B1	
	b)	i)	Area = $2\pi(16)^2 + 2\pi(16)(50) + 256\pi$ = $2368\pi \text{ cm}^2$	M1 A1	
		ii)	# of tins = $\frac{2368\pi}{2000}$ ≈ 4	M1 A1	
	c)		$\text{Vol} = \frac{2}{3}\pi(16)^3 + \pi(16)^2(50)$ = $15530\frac{2}{3}\pi \text{ cm}^3$	M1 A1	
	d)		safe vol. = $14754\frac{2}{15}\pi \text{ cm}^3$ max. rate of flow = $2969.6\pi \text{ cm}^3/\text{s}$ min. time = 4.97 s	M1 M1 A1	