EXP

PUNGGOL SECONDARY SCHOOL
SECONDARY 2
EXPRESS
END-OF-YEAR EXAMINATION

QUESTION & ANSWER BOOKLET

NAME

CLASS

INDEX NUMBER

Mathematics **4048**

Paper 1

6 October 2021

1 hour 15 minutes

READ THESE INSTRUCTIONS FIRST

Write your class, register number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, 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.
The use of an approved scientific calculator is expected, where appropriate.
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.

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 50.

For Examiner's use
/50

Parent's Signature

This paper consists of **11** printed pages and **1** blank page.

Setter(s) :	Vetter :
Mdm Tng Say Ping	Mdm Ho Wei Ling, Ms Jillian Khong

Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

1 If $3x = 2y$, write down $y^2 : x^2$.

Answer ..... [2]

---

2 **(a)** Solve $2-5x \leq \frac{2}{3}(3x-9)$.

Answer ..... [2]

(b) Represent the solution on a number line. [1]

---

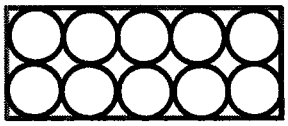
3 n is a positive integer.
Show that, for all values of n, $(4n+1)^2-(4n-1)^2$ is a multiple of 4.

Answer .....

..... [3]

---

4 The diagram shows the plan view (top view) of a box that contains ten spherical crystal balls with radius 2 cm. The box is in the shape of a cuboid and the crystal balls just fit into the box. Calculate the volume of empty space in the box.



Answer ..... cm^3 [3]

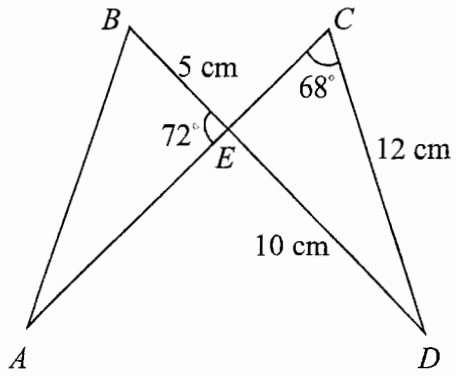
---

5 A regular polygon has n sides. The size of each interior angle is three times the size of each exterior angle. Find the value of n.

Answer $n =$ ..... [3]

---

6 In the diagram, the line AC intersects the line BD at E. $DE = 10$ cm, $BE = 5$ cm and $CD = 12$ cm. ΔABE is congruent to ΔDCE.



Find

(a) $\angle ABE$,

Answer $\angle ABE =$ .....° [1]

(b) $\angle EDC$,

Answer $\angle EDC =$.....° [1]

(c) the length of AC.

Answer $AC =$ ..... cm [1]

---

7 **(a)** Express 744 as a product of its prime factors.

Answer ..... [1]

(b) Given that $720 = 2^4 \times 3^2 \times 5$, find the highest common factor of both 744 and 720, leaving your answer as a product of prime factors.

Answer ..... [1]

(c) Find the smallest whole number that is divisible by both 720 and 744, leaving your answer as a product of prime factors.

Answer ..... [1]

---

8 **(a)** Solve the following equation $16x^2 - 9 = 0$.

Answer $x =$ ..... , ... [3]

(b) Explain why $16x^2 + 9 = 0$ has no real solutions.

Answer ..... [1]

---

9 A distance of 1.6 km is represented by 4 cm on a map.

(a) Find the map scale in the form of 1 : r.

Answer 1 : ..... [1]

(b) The distance between a park and a community club on the map is 3.8 cm. Find the actual distance in metres.

Answer ..... m [2]

(c) The actual area of a park is 320000 m^2. Find the area on the map in cm^2.

Answer ..... cm^2 [2]

10 Express each of the following as a single fraction in its simplest form.

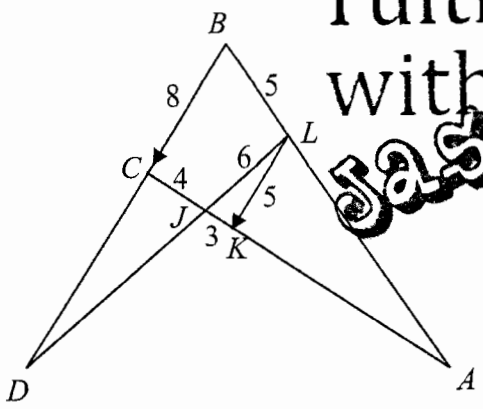
(a) $\dfrac{7}{2x+10}+\dfrac{2-x}{x+5}$

Answer ..... [2]

(b) $\dfrac{5x-2}{10x^2+7x-12}-\dfrac{6}{3+2x}$

Answer ..... [3]

11 In the diagram below, BD is parallel to LK.
$LK = BL = 5$ cm, $BC = 8$ cm, $JL = 6$ cm, $JK = 3$ cm and $CJ = 4$ cm.
ΔABC is similar to ΔALK and ΔCJD is similar to ΔKJL.



Find

(a) JD,

Answer ..... cm [2]

(b) AC.

Answer ..... cm [3]

12 **(a)** y is inversely proportional to $\sqrt{x}$.
It is known that $y = 2.5$ when $x = 0.81$.

(i) Write the equation connecting x and y.

Answer ..... [1]

(ii) Find the value of x when $y = 4.5$.

Answer $x =$ ..... [2]

(b) A moving object travels s metres in t seconds. It is given that s is directly proportional to t^2. If the object travels 75 metres when $t = Q$ seconds, find the new value of s when $t = 4Q$ seconds.

Answer $s =$ ..... [2]

13 Factorise each of the following completely.

(a) $9x^2 - 24x + 16$

Answer ..... [2]

(b) $-2a^2 + 13a - 15$

Answer ..... [2]

(c) $15ap - 8bq + 6bp - 20aq$

Answer ..... [2]

---------- End of Paper ----------

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1 Solve the simultaneous equations.

$$5x - 6y = -8$$
$$2x + y = 7$$

Answer $x = \ldots\ldots, y = \ldots\ldots$ [3]

2 It is given that $x + y = 8$ and $xy = 4$.
Find the value of $\frac{1}{x^2} + \frac{1}{y^2}$.

Answer ..... [3]

---

3 It is given that $y = \frac{x+2}{3-2x}$.
Express x in terms of y.

Answer $x =$ ..... [3]

---

4 The following are the records of plant heights in a farm.

Stem	Leaf
1	0 1 2 2 2 5 8 8 9
2	2 4 6 7 7 9
3	1 1 3 4 6
4	
5	8

Key : 1 | 0 means 10 mm

(a) Find the mean height.

Answer ..... mm [2]

(b) Find the median height.

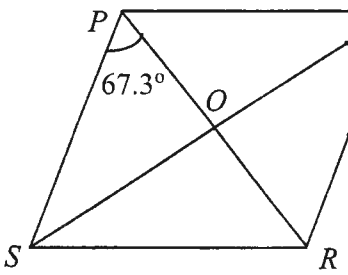
Answer ..... mm [1]

(c) Explain why the mean may not be the best representation of the average plant height.

Answer .....

..... [1]

5 The diagram shows a rhombus $PQRS$.



The diagonals PR and QS intersect at point O.
It is given that $\angle OPS = 67.3°$ and $QS = 24$ cm.

(a) Find $\angle PSQ$.

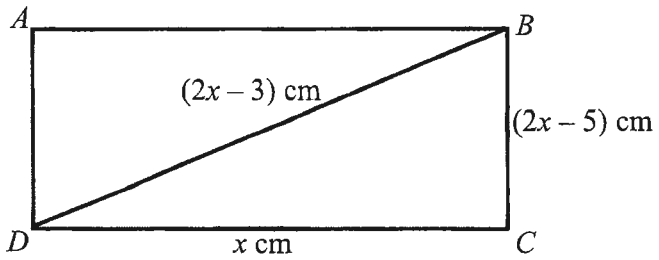
Answer $\angle PSQ =$ ..... ° [1]

(b) Show that $PS = 13.0$ cm, correct to 3 significant figures. [2]

(c) Find the area of ΔPOS.

Answer ..... cm^2 [3]

6 $ABCD$ is a rectangle with $BC = (2x - 5)$ cm, $CD = x$ cm and $BD = (2x - 3)$ cm.

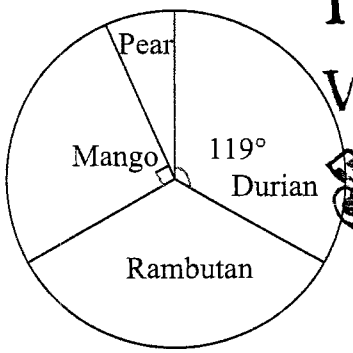


(a) Form an equation in x and show that it reduces to $x^2 - 8x + 16 = 0$. [3]

(b) Solve the equation in **part (a)** and hence find the area of the triangle ABD.

Answer ..... cm^2 [3]

7 Kentedge Primary School students were asked to state their favourite fruit in a survey. The results are represented in the pie chart below.



(a) The number of students who like mango is four times the number of students who like pear. Calculate the percentage of students who chose pear as their favourite fruit.

Answer .....% [2]

(b) There are 19 more students who chose rambutans as their favourite fruit as compared to the number of students who had indicated durian as their favourite fruit. Calculate the number of students who chose rambutans as their favourite fruit.

Answer .....students [3]

(c) Find the total number of students who participated in the above survey.

Answer .....students [2]

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

The following table shows some values of x and the corresponding values of y for the equation $y = x^2 + 2x - 5$.

x	-4	-3	-2	-1	0	1	2	3
y	3	-2	a	-6	-5	-2	3	10

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

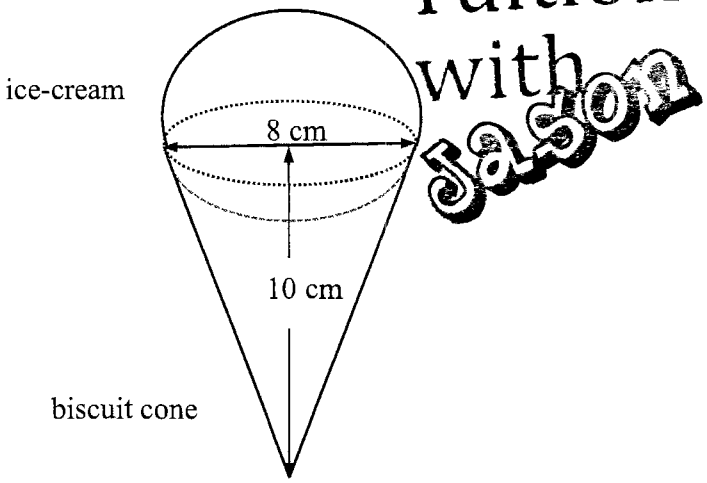
(b) Using a scale of 2 cm to represent 1 unit on the x-axis and 1 cm to represent 1 unit on the y-axis, draw and label the graph of $y = x^2 + 2x - 5$ on a sheet of graph paper for $-4 \leq x \leq 3$. [3]

(c) Write down the value(s) of x where the graph cuts the x-axis. [2]

(d) Write down the equation of the line of symmetry of the graph. [1]

(e) From your graph, state the coordinates of the minimum point. [1]

9 An ice-cream cone is modelled using a sphere and a cone as shown below. The diameter of the sphere is 8 cm and the height of the cone is 10 cm.



(a) Find the volume of the sphere.

Answer ..... cm^3 [2]

(b) Calculate the curved surface area of the biscuit cone.

Answer ..... cm^2 [3]

(c) During a school carnival, a class decides to set up an ice-cream stall to raise funds for the needy.

The class wants to make sure that they earn enough money to cover all the costs incurred in the set up of the stall as well as to earn at least 30% profit which will be donated to the needy. The class estimates that they will be able to sell at least 500 ice-cream cones at the carnival.

The cost of ice-cream, biscuit cones and the set up cost of the stall are given in the table below.

Cost of ice-cream / 100 cm^3	\$1.20
Cost of biscuit cone / 100 cm^2 of curved surface area	\$0.75
Set up cost of the stall	\$150

Calculate a reasonable amount that the class needs to charge each customer for one ice-cream cone at the carnival.

Show working to justify your answer.

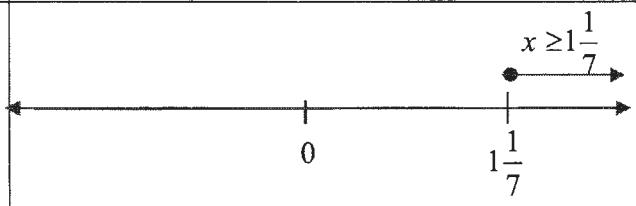
[Question continues on the next page]

Answer .....

..... [5]

---End of Paper---

2 Exp EOY Setion A Answer Scheme

1	$3x:2y$ $\frac{3}{2}=\frac{y}{x}[M1]$ $(\frac{3}{2})^2=(\frac{y}{x})^2$ $\frac{9}{4}=\frac{y^2}{x^2}[A1]$			M1 A1
2	a	$2-5x\le\frac{2}{3}(3x-9)$ $-5x-2x\le-6-2$ $-7x\le-8$ $x\ge\frac{8}{7}[M1]$ $x\ge1\frac{1}{7}[A1]$		 M1 A1
	b			B1
3		$=[(4n+1)+(4n-1)][(4n+1)-(4n-1)]$ $M1$ $=(8n)(2)$ $=16n$ $=4(4n)$ $A1$ 4 is a factor of $16n$, hence it's always a multiple of 4 for all n. [B1] Or $16n$ is divisible by 4, hence it's always a multiple of 4 for all n. $=[(4n)^2+2(4n)(1)+1^2]-[(4n)^2-2(4n)(1)+1^2]$ $=16n^2+8n+1-16n^2+8n-1$ $M1$ $=16n$ $=4(4n)$ $A1$		M1 A1 B1
4		Volume of the empty space in the box		

		$=(20\times8\times4)\ [M1]-10\times\frac{4(3.142)(2)^3}{3}[M1]$ $=640-335.1466667$ $=304.8533$ $\approx305cm^3\ [A1]$	Using calculator pie 304.8967	M1 M1 A1
5		Let x be the ext angle of the polygon, then int angle $=3x$ $x+3x=180\ [M1]$ $x=45$ $n=\frac{360}{45}\ [M1]$ $=8\quad [A1]$		 M1 M1 A1
6	a	$\angle ABE=68$		B1
	b	$\angle EDC=180-68-72$ $=40$		B1
	c	$AC=15$ cm		B1
7	a	2 | 744 2 | 372 2 | 186 3 | 93 31 | 31 | 1 $744=2^3\times3\times31\quad [B1]$		 B1
	b	$744=2^3\times3\times31$ $720=2^4\times3^2\times5$ $HCF=2^3\times3\ [B1]$		B1
	c	$744=2^3\times3\times31$ $720=2^4\times3^2\times5$ $LCM=2^4\times3^2\times5\times31\ [B1]$		B1

8	(i)	$(4x-3)(4x+3)=0$ [M1] $x=\frac{3}{4}$ or $x=-\frac{3}{4}$ [A2] OR $16x^2=9$ $x=\pm\sqrt{\frac{9}{16}}$ [M1] $=\pm\frac{3}{4}$ [A2]		M1 A1 A1
	(ii)	$x=\sqrt{\frac{-9}{16}}$, square root of negative numbers has no real solutions. Or $x^2=-\frac{9}{16}$ Since $x^2>0$, hence no real solutions.		B1
9	a	$4:1.6\times100000$ $1:40000$ [B1]		B1
	b	3.8×40000 [M1] $=152000\,cm$ $=1520\,m$ [A1]		M1 A1
	c	$1:40000$ $1:400\,m$ $1cm^2:160000\,m^2$ [M1] $\frac{320000}{160000}:320000$ $=2cm^2$ [A1]		M1 A1
10	a	$=\frac{7}{2(5+x)}+\frac{(2-x)}{5+x}$ $=\frac{7+2(2-x)}{2(5+x)}$ [M1] $=\frac{7+4-2x}{2(5+x)}$ $=\frac{11-2x}{2(5+x)}$ [A1] $or=\frac{11-2x}{10+2x}$		M1 A1

	b	$=\frac{5x-2}{(2x+3)(5x-4)[M1]}-\frac{6}{2x+3}$ $=\frac{5x-2-6(5x-4)}{(2x+3)(5x-4)}$ $=\frac{5x-2-30x+24[M1]}{(2x+3)(5x-4)}$ $=\frac{22-25x}{(2x+3)(5x-4)}\ [A1]$		M1 M1 A1
11	a	$\frac{JD}{JL}=\frac{CJ}{KJ}$ $\frac{JD}{6}=\frac{4}{3}\ [M1]$ $JD=8cm\ [A1]$		M1 A1
	b	$\frac{AC}{AK}=\frac{BC}{LK}$ $\frac{4+3+AK}{AK}=\frac{8}{5}\ [M1]$ $5(7+AK)=8AK$ $35+5AK=8AK\ [M1]$ $3AK=35$ $AK=11\frac{2}{3}$ $AC=7+11\frac{2}{3}$ $=18\frac{2}{3}cm\ [A1]$ OR = 18.7 cm (3s.f)		M1 M1 A1
12	a(i)	$y=\frac{k}{\sqrt{x}}$ k is a const $2.5=\frac{k}{\sqrt{0.81}}$ $k=2.5\times0.9$ $=2.25$ $y=\frac{2.25}{\sqrt{x}}[B1]$		B1

	(ii)	$4.5=\frac{2.25}{\sqrt{x}}$ $x=(\frac{1}{2})^2$ [M1] $=\frac{1}{4}$ [A1]		M1 A1
	b	$s=kt^2$, k is a constant $75=kQ^2$ *New s* $=k(4Q)^2$ $=16kQ^2$ [M1] $=16(75)$ $=1200\,metres$ [A1]		M1 A1
13	a	$3x$ -4 $-12x$ $3x$ -4 $-12x$ $9x^2$ 16 $-24x$ $9x^2-24x+16$ $=(3x-4)^2$ [A1]		M1 A1
	b	2a -3 $3a$ $-a$ 5 $10a$ $-2a^2$ -15 $13a$ $-2a^2+13a-15$ $=(-a+5)(2a-3)$ [A1] *or* $=(5-a)(2a-3)$		M1 A1
	c	$=15ap-20aq+6bp-8bq$ $=5a(3p-4q)+2b(3p-4q)$ [M1] $=(5a+2b)(3p-4q)$ [A1]		M1 A1

Answer Scheme 2Exp EOY Section B – 50 Marks

1		$5x-6y=-8 \rightarrow eqn(1)$ $(2x+y=7)\times 6$ $12x+6y=42 \rightarrow eqn(2)$ $(1)+(2):$ $17x=-8+42$ $x=\frac{34}{17}$ $x=2$ $y=7-2(2)$ $y=3$ $x=2, y=3$	Using Elim-/ Sub-method M1 A1 A1
2		$(x+y)^2=x^2+2xy+y^2$ $(x+y)^2-2xy=x^2+y^2$ $x^2+y^2=8^2-2(4)$ $=56$ [M1] $\frac{1}{x^2}+\frac{1}{y^2}=\frac{y^2+x^2}{x^2y^2}$ [M1] $=\frac{56}{4^2}$ $=3.5$ [A1]	 M1 M1 A1
3		$y=\frac{x+2}{3-2x}$ $3y-2xy=x+2$ [M1] $3y-2=x+2xy$ $3y-2=x(1+2y)$ [M1] $x=\frac{3y-2}{1+2y}$ [A1]	 M1 M1 A1
4	a	Stem | Leaf 1 | 0 1 2 2 2 5 8 8 9 2 | 2 4 6 7 7 9 3 | 1 1 3 4 6 4 | 5 | 8	

		Mean $=(1+11+12\times3+15+18\times2+19+22+24+26+27\times2$ $+29+31\times2+33+34+36+58)/20$ [$M1$] $=\frac{505}{21}$ $=24.0476\,mm$ $\approx24.0\,mm$ [$A1$]	M1 A1
	b	Median = 24 mm	B1
	c	Because there is an outlier in the distribution, so mean may not be the best representation of the average plants height.	B1
5	a	$\angle PSQ=180-90-67.3$ $=22.7$ [$B1$]	B1
	b	$QS=24$ cm, $OS=12$ cm $PS=\frac{12}{\sin 67.3}$ $=13.00759301$ $\approx13.0\,cm\,(3s.f)$ (shown)	M1 M1
	c	$PO=\frac{12}{\tan 67.3}$ $=5.019708$ [$M1$] $Area=\frac{1}{2}(SO)(PO)$ [$M1$] $=30.11825$ $\approx30.1cm^2$ [$A1$]	M1 M1 A1
6	a	By Pythagoras Theorem $(2x-3)^2=x^2+(2x-5)^2$ $4x^2-12x+9=x^2+4x^2-20x+25$ $4x^2-12x+9-x^2-4x^2+20x-25=0$ $-x^2+8x-16=0$ $x^2-8x+16=0$ (*shown*) Or $(2x)^2-2(2x)(3)+(3)^2=x^2+(2x)^2-2(2x)(5)+(5)^2$ $-x^2+8x-16=0$ $x^2-8x+16=0$ (*shown*)	M1 Expansion M1 [×(−1)] A1

	b	$x^2-8x+16=0$ $(x-4)^2=0$ [*factorisation M1*] $x=4$ [*M1*] Area of triangle *ABD* $=\frac{1}{2}(4)(8-5)$ $=6\,cm^2$ [*A1*]	 M1 M1 A1
7	a	Percentage of those who liked pear $=\frac{\frac{1}{4}\times 90}{360}\times 100\%$ [*M1*] or $=\frac{25\%}{4}$ [*M1*] $=6.25\%$ [*A1*] $=6.25\%$[*A1*]	 M1 A1
	b	Angle of sector for those who liked rambutans $=(360-90-119-\frac{90}{4})$ $=128.5$ 19 rep $(128.5-119)=9.5$ No of students chosen rambutans $=128.5\times\frac{19}{9.5}$ $=257$	 M1 M1 A1
	c	Total students took the survey $=360\times\frac{19}{9.5}$ $=720$	 M1 A1
8	a	a = –5	B1
	b	Attached. Correct scale – B1; all points correctly plotted – B1; smooth curve – B1	B3
	c	*x* intercepts = 1.45 , –3.45 ±0.05 (or ±0.1) Accept *x*-intercept = 1.4 to 1.5, –3.4 to –3.5	B1, B1
	d	$x=-1$	B1
	e	Min point (–1,–6) Accept ±0.1 for both *x*-coordinate and *y*-coordinate of the min point.	B1

9	a	$Vol = \frac{4}{3}\pi(4)^3$ [M1] $= 268.0825$ $\approx 268\ cm^3$ [A1]	M1 A1
	b	By Pythagoras Theorem $l = \sqrt{10^2 + 4^2}$ [M1] $= \sqrt{116}$ Curved S. A. $= \pi(4)(\sqrt{10^2 + 4^2})$ [M1] $= 135.3439$ $\approx 135 cm^2$ (3s.f) [A1]	M1 M1 A1
	c	<u>Ice-cream</u> Cost $= \frac{268.0825}{100} \times 1.2$ [M1] $= 3.21699$ <u>Cone</u> Cost $= \frac{135.3439}{100} \times 0.75$ [M1] $= 1.01507$ Total cost $= 500 \times (3.21699 + 1.01507) + 150$ [M1] $= \$2266.0346$ Profit $= \frac{30}{100} \times 2266.0346$ $= 679.81033$ $\frac{2266.0346 + 679.81038}{500}$ $= 5.89168$ $\approx \$6$ They should charge \$6 per cone to cover all costs and it's a convenient amount to charge.	M1 M1 M1 M1 A1

Q8 answer attached