



ZHONGHUA SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2023
SECONDARY 2 EXPRESS

CANDIDATE NAME	CLASS	INDEX NUMBER

MATHEMATICS

4052

29 September 2023

2 hours

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number in the spaces at the top of this page.
 Write in dark blue or black pen.
 You may use an HB pencil for any diagrams or graphs.
 Do not use paper clips, glue or correction fluid.

Answer **all** the questions.

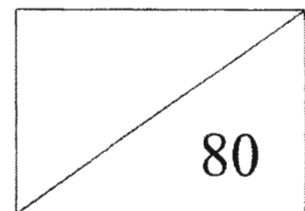
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degree, unless a different level of accuracy is specified in the question.

The use of an approved scientific calculator is expected, where appropriate.

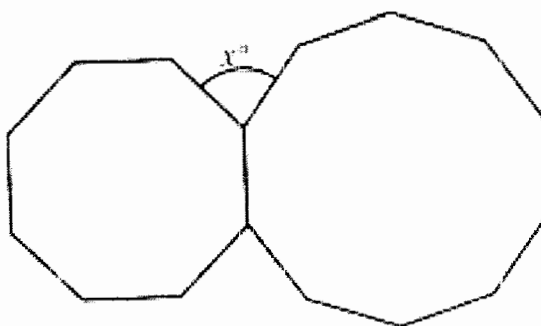
You are reminded of the need for clear presentation in your answers.

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is **80**.



- 1 The diagram below shows a regular octagon and a regular decagon.



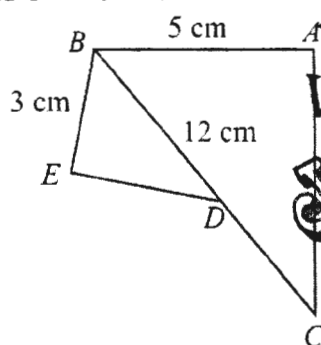
Find the value of x .

Answer $x =$ _____ [2]

- 2 Expand and simplify $3(8-5q)^2$.

Answer _____ [2]

- 3 In the diagram, triangle ABC is similar to triangle EBD .
 $AB = 5$ cm, $BC = 12$ cm and $BE = 3$ cm.



Find the length of DC .

Answer _____ cm [2]

- 4 A map is drawn to a scale of 1 : 20 000.
- (a) The distance between a pineapple plantation and a rubber plantation on the map is 15 cm. Calculate the actual distance, in kilometres, between the two plantations.

Answer _____ km [1]

- (b) The area of the pineapple plantation is 20 km^2 .
Calculate the area, in square centimetres, of the pineapple plantation on the map.

Answer _____ cm^2 [2]

- 5 A bag contains 7 red marbles, 5 green marbles and 4 blue marbles.
(a) If a marble is drawn at random from the bag, find the probability that it is a green marble.

Answer _____ [1]

- (b) When x more blue marbles are added to the bag, the probability of drawing a blue marble becomes $\frac{1}{3}$.
Form an equation in x to find the value of x .

Answer _____ [2]

6 (a) Solve the inequality $\frac{2x+3}{5} \geq \frac{4-x}{2}$.

Answer _____ [2]

(b) Hence, write down the smallest prime number which satisfies $\frac{2x+3}{5} \geq \frac{4-x}{2}$.

Answer _____ [1]

7 It is given that $\sqrt{\frac{T}{g+5}} = \frac{p}{4}$.

(a) Evaluate p when $T = 392$ and $g = 3$.

Answer $p =$ _____ [1]

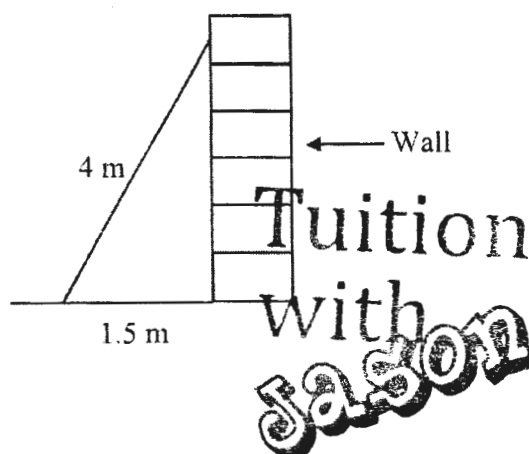
(b) Express g in terms of T and p .

Answer $g =$ _____ [2]

8 Solve the equation $(2x-3)(3x+5) = 7$.

Answer $x =$ _____ or _____ [3]

- 9 A ladder of length 4 m leans against a vertical wall and the bottom of the ladder is 1.5 m from the wall.
 The safe working angle for a ladder is between 74° and 76° to the horizontal.
 Is the ladder in a safe position to use?
 Show your working to justify your decision.



Answer The ladder _____ is / is not * _____ in a safe position to use because

[3]

*Please circle accordingly

- 10 The times taken, in minutes, by 20 students to complete an assignment are recorded. The results are shown in the stem-and-leaf diagram.

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

Key: 2 | 3 means 23 minutes

- (a) (i) Find the median time.

Answer _____ minutes [1]

- ii) It was discovered that the times taken had been recorded incorrectly. The correct times taken were all 3 minutes less than those recorded. State the correct median time taken.

Answer _____ minutes [1]

- (b) Explain why the mean may not be an appropriate average to use to summarise the times taken by these students.

Answer _____

[1]

- 11 The lengths of service of 39 employees of an advertising agency are recorded in the table below.

Length of service (t years)	Number of employees
$0 < t \leq 5$	2
$5 < t \leq 10$	7
$10 < t \leq 15$	16
$15 < t \leq 20$	11
$20 < t \leq 25$	3

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- (a) Write down the modal class.

Answer _____ [1]

- (b) Calculate an estimated mean of the length of service of the 39 employees.

Answer _____ years [2]

-
- 12 The number of hours, N , required to dig a trench, is inversely proportional to the square of the number of men available, X .

It takes 6 men a total of 8 hours to dig a trench.

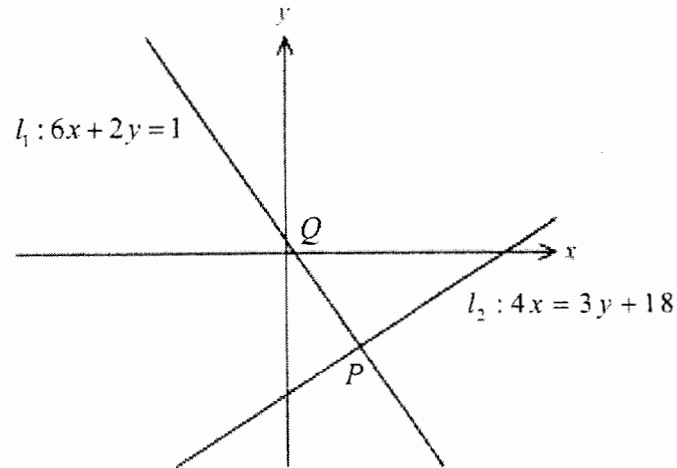
- (a) Find an equation connecting N and X .

Answer _____ [2]

- (b) When X is increased by 100%, find the percentage reduction in the value of N .

Answer _____ % [2]

- 13 The lines l_1 and l_2 are shown in the diagram below.



- (a) Line l_1 meets the x -axis at Q .
Find the coordinates of Q .

Answer (_____ , _____) [1]

- (b) Lines l_1 and l_2 intersect at P .
Find the coordinates of P .

Answer (_____ , _____) [3]

14 (a) Simplify $\frac{5a^3}{-9b^2} \times \frac{3b^3}{(-2a)^2}$.

Answer _____ [2]

(b) Express as a single fraction in its simplest form $\frac{5}{(x-3)^2} + \frac{2}{3-x}$.

Answer _____ [3]

-
- 15 (a) Factorise fully $2xy - 6y + 15 - 5x$.

Answer _____ [2]

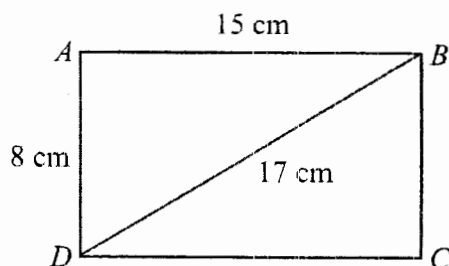
- (b) (i) Factorise fully $72y^2 - 8x^2$.

Answer _____ [2]

- (ii) Hence, simplify $\frac{72y^2 - 8x^2}{36y^2 - 24xy + 4x^2}$.

Answer _____ [3]

- 16 In the diagram, $ABCD$ is a quadrilateral and triangle ABD is congruent to triangle CDB .
 $AB = 15$ cm, $AD = 8$ cm and $BD = 17$ cm.



Determine if quadrilateral $ABCD$ is a rectangle.
 Justify your decision with clear working.

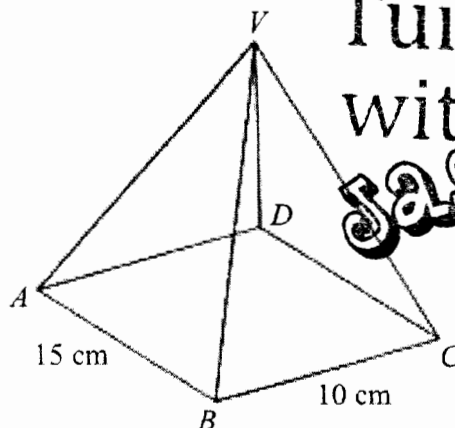
Answer

Quadrilateral $ABCD$ _____ is / is not * _____ a rectangle because _____

[3]

*Please circle accordingly

- 17 The diagram shows a candle in the shape of a rectangular pyramid $VABCD$.
 $AB = 15$ cm, $BC = 10$ cm and its volume is 600 cm³.



- (a) Find the height of the candle.

Answer _____ cm [2]

The candle is melted and reshaped into a solid sphere of radius r cm.

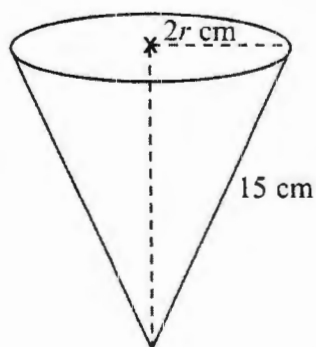
- (b) Show that $r = 5.232$, when corrected to 4 significant figures.

Answer [1]

- (c) The spherical candle is cut into two equal hemispheres.
 Find the total surface area of the two hemispheres.

Answer _____ cm² [2]

- 18 The diagram shows a solid cone.
The slant height of the cone is 15 cm and its base radius is $2r$ cm.



- (a) If the total surface area of the cone is 16π cm², form an equation in x and show that it reduces to

$$2r^2 + 15r - 8 = 0.$$

Answer

[2]

- (b) Solve the equation in part (a) to find the radius of the cone.

Answer _____ cm [2]

(c) Using the answer in part (b), find the volume of the cone.

Answer _____ cm^3 [3]

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- 19 The variables x and y are connected by the equation $y = 2x^2 - 8x - 24$.
Some corresponding values of x and y are given in the table below.

x	-2.5	-1	0	1	3	4	5	6
y	p	-14	-24	-30	-30	-24	-14	0

- (a) Find the value of p .

Answer $p =$ _____ [1]

- (b) On the grid on the opposite page, draw the graph of $y = 2x^2 - 8x - 24$ for $-2.5 \leq x \leq 6$. [3]

- (c) Write down the equation of the line of symmetry of the graph.

Answer _____ [1]

- (d) Use your graph in part (b) to find

- (i) the coordinates of the minimum point of the graph,

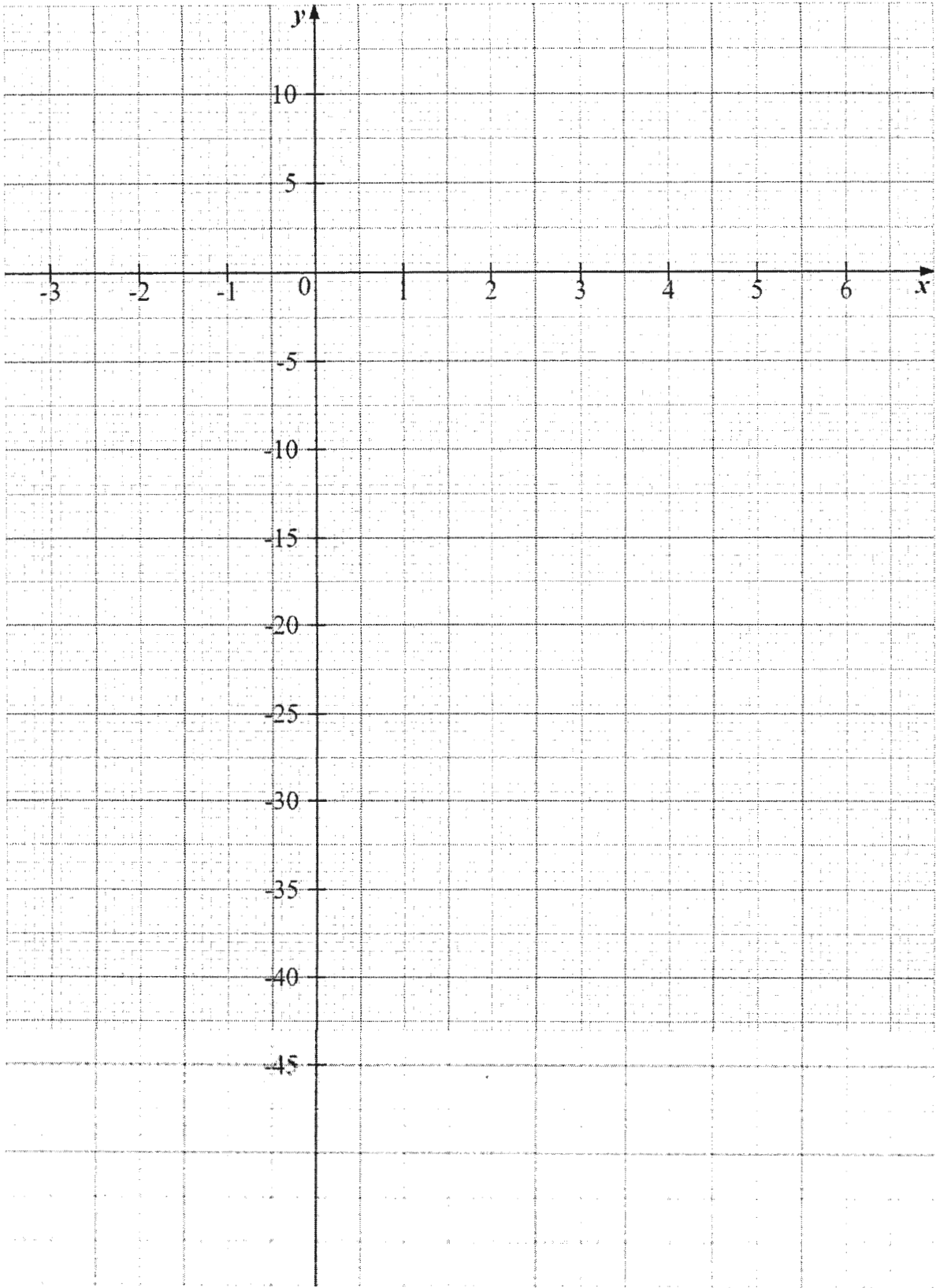
Answer (_____ , _____) [1]

- (ii) the values of x when $y = -27.5$.

Answer $x =$ _____ or _____ [2]

- (e) Explain why the equation $2x^2 - 8x - 24 = -40$ does not have solutions.

Answer _____ [1]



- 20 Ivan is going for a holiday to Switzerland.
 He changes 1500 Singapore Dollars (SGD) into Swiss Francs (CHF).
 The exchange rate between SGD and CHF is 1 SGD = 0.6563 CHF.
 (a) Calculate the amount of CHF he received.

Answer _____ CHF [1]

- (b) During Ivan's Switzerland visit, he wanted to join a day tour with three friends to Mount Matterhorn.
 The price charged for each person is 109 CHF.
 There are three local tour operators P , Q and R who offered the following promotions.

P : 20% off up to a maximum of 3 people

Q : 10% off for each person and 5% from the total payment

R : 3 people at the regular price and 50% for the fourth person

Given that Ivan and his friends have a budget of 580 SGD for the tour, which of the three tour operators can match their budget.

Show your working clearly.

Continuation of working space for question 20(b)

Answer Tour operator _____ [4]

- (c) At the end of Ivan's holiday in Switzerland, he has 120 CHF left.
 If he converts this amount back to SGD at a bank, he will receive 178 SGD.
 Determine, when changing CHF back to SGD, whether the exchange rate found in part (c) is better value for Ivan than the exchange rate in (a).
 Justify your answer.

Answer Exchange rate in part () is better than the exchange rate in

part () because _____

_____ [1]

End of Paper



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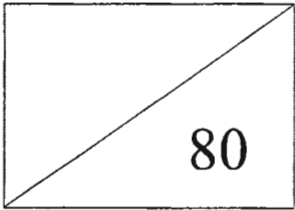
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 You are reminded of the need for clear presentation in your answers.

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is **80**.



Set by: Ms Ratiporn
 Vetted by: Ms June Yeo, Mr Francis Tan

This document consists of **23** printed pages and 1 blank page.

Mathematical Formulae

Mensuration

Curved surface area of a cone = πrl

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

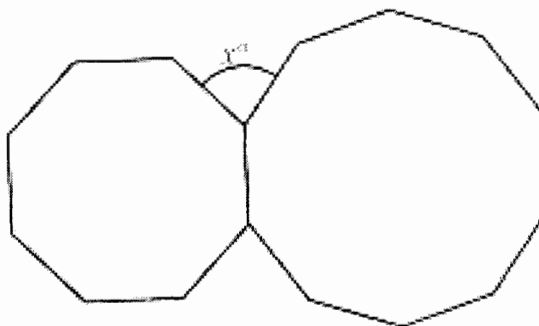
Volume of a cone = $\frac{1}{3}\pi r^2 h$

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

Statistics

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

- 1 The diagram below shows a regular octagon and a regular decagon.



Find the value of x .

$$\begin{aligned}\text{Each interior angle for octagon} &= \frac{(8-2) \times 180^\circ}{8} \\ &= 135^\circ\end{aligned}$$

$$\begin{aligned}\text{Each interior angle for decagon} &= \frac{(10-2) \times 180^\circ}{10} \\ &= 144^\circ\end{aligned}$$

$$\begin{aligned}x^\circ &= 360^\circ - 135^\circ - 144^\circ \\ &= 81^\circ\end{aligned}$$

$$\therefore x = 81$$

Alternative method:

$$\text{Ext. angle of octagon} = \frac{360^\circ}{8} = 45^\circ$$

$$\text{Ext. angle of decagon} = \frac{360^\circ}{10} = 36^\circ$$

$$\begin{aligned}x^\circ &= 36^\circ + 45^\circ \\ &= 81^\circ\end{aligned}$$

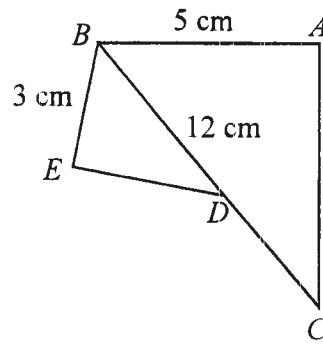
Answer $x =$ 81 [2]

- 2 Expand and simplify $3(8-5q)^2$.

$$\begin{aligned}3(8-5q)^2 &= 3(64-80q+25q^2) \\ &= 192-240q+75q^2\end{aligned}$$

Answer $192-240q+75q^2$ [2]

- 3 In the diagram, triangle ABC is similar to triangle EBD .
 $AB = 5$ cm, $BC = 12$ cm and $BE = 3$ cm.



Find the length of DC .

$$\frac{BE}{BA} = \frac{BD}{BC}$$

$$\frac{3}{5} = \frac{BD}{12}$$

$$BD = 7.2 \text{ cm}$$

$$DC = 12 - 7.2$$

$$= 4.8 \text{ cm}$$

Answer 4.8 cm [2]

- 4 A map is drawn to a scale of 1:20 000.
 (a) The distance between a pineapple plantation and a rubber plantation on the map is 15 cm.
 Calculate the actual distance, in kilometres, between the two plantations.

1:20000

Map	Actual
-----	--------

15 cm represents	300000 cm
------------------	-----------

15 cm represents	3 km
------------------	------

Answer 3 km [1]

- (b) The area of the pineapple plantation is 20 km^2 .
Calculate the area, in square centimetres, of the pineapple plantation on the map.

1:20000

Actual Map

0.2 km is represented by 1 cm

0.04 km^2 is represented by 1 cm^2

20 km^2 is represented by $\frac{20}{0.04} = 500 \text{ cm}^2$

Answer 500 cm^2 [2]

- 5 A bag contains 7 red marbles, 5 green marbles and 4 blue marbles.
(a) If a marble is drawn at random from the bag, find the probability that it is a green marble.

Answer $\frac{5}{16}$ [1]

- (b) When x more blue marbles are added to the bag, the probability of drawing a blue marble becomes $\frac{1}{3}$.

Form an equation in x to find the value of x .

Let x be the no. of additional blue marbles.

$$\frac{4+x}{16+x} = \frac{1}{3}$$

$$12+3x=16+x$$

$$2x=4$$

$$x=2$$

Answer 2 [2]

- 6 (a) Solve the inequality $\frac{2x+3}{5} \geq \frac{4-x}{2}$.

$$\frac{2x+3}{5} \geq \frac{4-x}{2}$$

$$2(2x+3) \geq 5(4-x)$$

$$4x+6 \geq 20-5x$$

$$9x \geq 14$$

$$x \geq 1\frac{5}{9}$$

Answer $x \geq 1\frac{5}{9}$ [2]

- (b) Hence, write down the smallest prime number which satisfies $\frac{2x+3}{5} \geq \frac{4-x}{2}$.

Answer 2 [1]

7 It is given that $\sqrt{\frac{T}{g+5}} = \frac{p}{4}$.

(a) Evaluate p when $T = 392$ and $g = 3$.

$$\sqrt{\frac{392}{3+5}} = \frac{p}{4}$$

$$\frac{p}{4} = 7$$

$$p = 28$$

Answer $p = 28$ [1]

(b) Express g in terms of T and p .

$$\sqrt{\frac{T}{g+5}} = \frac{p}{4}$$

$$\frac{T}{g+5} = \left(\frac{p}{4}\right)^2$$

$$\frac{T}{g+5} = \frac{p^2}{16}$$

$$g+5 = \frac{16T}{p^2}$$

$$g = \frac{16T}{p^2} - 5$$

Answer $g = \frac{16T}{p^2} - 5$ [2]

8 Solve the equation $(2x-3)(3x+5)=7$.

$$(2x-3)(3x+5)=7$$

$$6x^2-9x+10x-15=7$$

$$6x^2+x-22=0$$

$$(6x-11)(x+2)=0$$

$$6x-11=0 \quad \text{or} \quad x+2=0$$

$$x=\frac{11}{6} \qquad x=-2$$

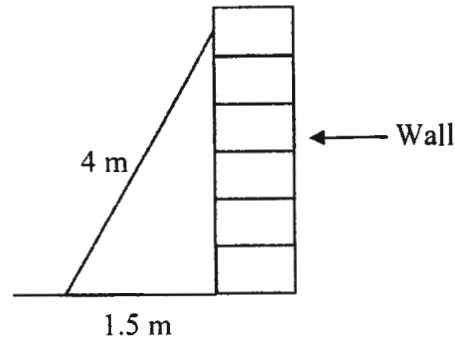
$$\text{Answer} \quad x = \frac{11}{6} \quad \text{or} \quad -2 \quad [3]$$

- 9 A ladder of length 4 m leans against a vertical wall and the bottom of the ladder is 1.5 m from the wall.

The safe working angle for a ladder is between 74° and 76° to the horizontal.

Is the ladder in a safe position to use?

Show your working to justify your decision.



$$\cos \theta = \frac{1.5}{4}$$

$$\theta = 67.9756^\circ$$

$$= 68.0^\circ$$

Since $68.0^\circ < 74^\circ$, it is not a safe position.

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Answer The ladder _____ is is not * in a safe position to use because

68.0° is not within the safe working angle range of 74° and 76° .

[3]

*Please circle accordingly

- 10 The times taken, in minutes, by 20 students to complete an assignment are recorded. The results are shown in the stem-and-leaf diagram.

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

Key: 2 | 3 means 23 minutes

- (a) (i) Find the median time.

$$\begin{aligned}\text{Median time} &= \frac{31 + 34}{2} \\ &= 32.5\end{aligned}$$

Answer 32.5 minutes [1]

- ii) It was discovered that the times taken had been recorded incorrectly. The correct times taken were all 3 minutes less than those recorded. State the correct median time taken.

Answer 29.5 minutes [1]

- (b) Explain why the mean may not be an appropriate average to use to summarise the times taken by these students.

Answer There is an outlier (83 minutes) in the distribution which is significantly greater

than the rest of the values, hence the mean may not be an appropriate average to use. [1]

11 The lengths of service of 39 employees of an advertising agency are recorded in the table below.

Length of service (t years)	Number of employees
$0 < t \leq 5$	2
$5 < t \leq 10$	7
$10 < t \leq 15$	16
$15 < t \leq 20$	11
$20 < t \leq 25$	3

(a) Write down the modal class.

Answer 10 < t ≤ 15 [1]

(b) Calculate an estimated mean of the length of service of the 39 employees.

Mean = $\frac{2.5(2) + 7.5(7) + 12.5(16) + 17.5(11) + 22.5(3)}{2 + 7 + 16 + 11 + 3}$

= $\frac{517.4}{39}$

= 13.26666

= 13.3

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Answer 13.3 years [2]

- 12 The number of hours, N , required to dig a trench, is inversely proportional to the square of the number of men available, X .

It takes 6 men a total of 8 hours to dig a trench.

- (a) Find an equation connecting N and X .

$$N = \frac{k}{X^2}, \text{ where } k \text{ is a constant and } k \neq 0$$

When $N = 8$, $X = 6$,

$$8 = \frac{k}{6^2}$$

$$k = 8 \times 6^2$$

$$= 288$$

$$\therefore N = \frac{288}{X^2} \text{ or } NX^2 = 288$$

Tuition
with
Jason

Answer $N = \frac{288}{X^2} \text{ or } NX^2 = 288$ [2]

- (b) When X is increased by 100%, find the percentage reduction in the value of N .

$$X_{\text{new}} = 2X$$

Percentage change in N

$$= \frac{\frac{288}{(2X)^2} - \frac{288}{X^2}}{\frac{288}{X^2}} \times 100\%$$

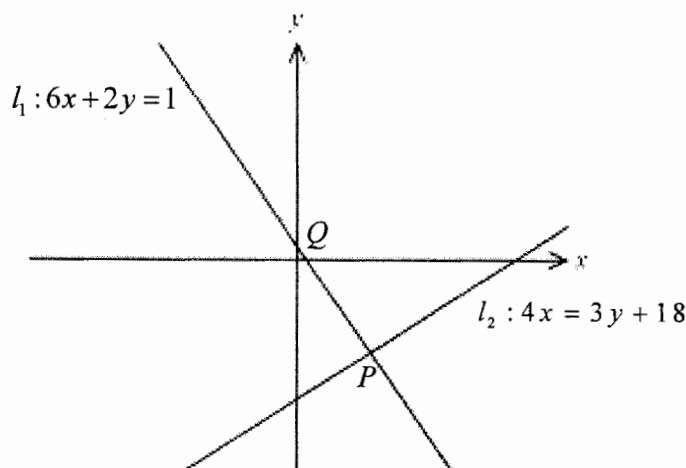
$$= \frac{\frac{288}{4X^2} - \frac{288}{X^2}}{\frac{288}{X^2}} \times 100\%$$

$$= -75\%$$

$\therefore$ percentage reduction is 75%.

Answer 75 % [2]

- 13 The lines l_1 and l_2 are shown in the diagram below.



- (a) Line l_1 meets the x -axis at Q .

Find the coordinates of Q .

$$\text{When } y = 0, 6 + 2(0) = 1$$

$$x = 0.167 \text{ or } \frac{1}{6}$$

$$\therefore Q(0.167, 0) \text{ or } Q\left(\frac{1}{6}, 0\right)$$

Answer ($\frac{1}{6}$, 0) [1]

- (b) Lines l_1 and l_2 intersect at P .

Find the coordinates of P .

$$6x + 2y = 1 \text{ --- (1)}$$

$$4x = 3y + 18 \text{ --- (2)}$$

$$(1) \times 3 : 18x + 6y = 3 \text{ --- (3)}$$

$$(2) \times 2 : 8x = 6y + 36$$

$$8x - 6y = 36 \text{ --- (4)}$$

$$(3) + (4) : (18x + 6y) + (8x - 6y) = 3 + 36$$

$$x = \frac{3}{2}$$

$$\text{Sub. } x = \frac{3}{2} \text{ into (1):}$$

$$y = -4$$

$$\therefore P\left(\frac{3}{2}, -4\right)$$

Answer ($\frac{3}{2}$, -4) [3]

14 (a) Simplify $\frac{5a^3}{-9b^2} \times \frac{3b^3}{(-2a)^2}$.

$$\begin{aligned}\frac{5a^3}{-9b^2} \times \frac{3b^3}{(-2a)^2} &= \frac{5a^3}{-9b^2} \times \frac{3b^3}{4a^2} \\ &= \frac{15a^3b^3}{-36a^2b^2} \\ &= -\frac{5ab}{12}\end{aligned}$$

Answer $-\frac{5ab}{12}$ [2]

(b) Express as a single fraction in its simplest form $\frac{5}{(x-3)^2} + \frac{2}{3-x}$.

$$\begin{aligned}\frac{5}{(x-3)^2} + \frac{2}{3-x} &= \frac{5}{(x-3)^2} - \frac{2}{x-3} \\ &= \frac{5}{(x-3)^2} - \frac{2(x-3)}{(x-3)^2} \\ &= \frac{5-2(x-3)}{(x-3)^2} \\ &= \frac{5-2x+6}{(x-3)^2} \\ &= \frac{11-2x}{(x-3)^2}\end{aligned}$$

Answer $\frac{11-2x}{(x-3)^2}$ [3]

- 15 (a) Factorise fully $2xy - 6y + 15 - 5x$.

$$\begin{aligned} 2xy - 6y + 15 - 5x &= 2y(x-3) + 5(3-x) \\ &= 2y(x-3) - 5(x-3) \\ &= (2y-5)(x-3) \end{aligned}$$

Answer $(2y-5)(x-3)$ [2]

- (b) (i) Factorise fully $72y^2 - 8x^2$.

$$\begin{aligned} 72y^2 - 8x^2 &= 8(9y^2 - x^2) \\ &= 8(3y-x)(3y+x) \end{aligned}$$

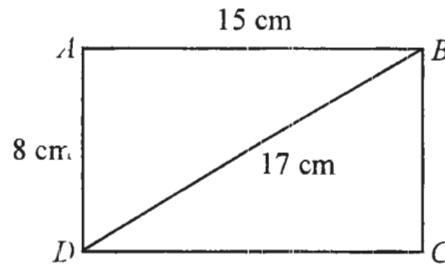
Answer $8(3y-x)(3y+x)$ [2]

- (ii) Hence, simplify $\frac{72y^2 - 8x^2}{36y^2 - 24xy + 4x^2}$.

$$\begin{aligned} \frac{72y^2 - 8x^2}{36y^2 - 24xy + 4x^2} &= \frac{8(3y-x)(3y+x)}{4(9y^2 - 6xy + x^2)} \\ &= \frac{2(3y-x)(3y+x)}{(3y-x)^2} \\ &= \frac{2(3y+x)}{(3y-x)} \end{aligned}$$

Answer $\frac{2(3y+x)}{(3y-x)}$ [3]

- 16 In the diagram, $ABCD$ is a quadrilateral and triangle ABD is congruent to triangle CDB .
 $AB = 15$ cm, $AD = 8$ cm and $BD = 17$ cm.



Determine if quadrilateral $ABCD$ is a rectangle.
 Justify your decision with clear working.

Answer

$$\begin{aligned} BD^2 &= 17^2 \\ &= 289 \\ AB^2 + AD^2 &= 15^2 + 8^2 \\ &= 289 \end{aligned}$$

Hence, $BD^2 = AB^2 + AD^2$

By converse of Pythagoras' Theorem,

triangle ABD is a right-angled triangle where angle $DAB = 90^\circ$.

$$\begin{aligned} \angle DAB &= \angle BCD \quad (\text{corresponding angles of congruent triangles are equal}) \\ &= 90^\circ \end{aligned}$$

Quadrilateral $ABCD$



is not *

a rectangle because

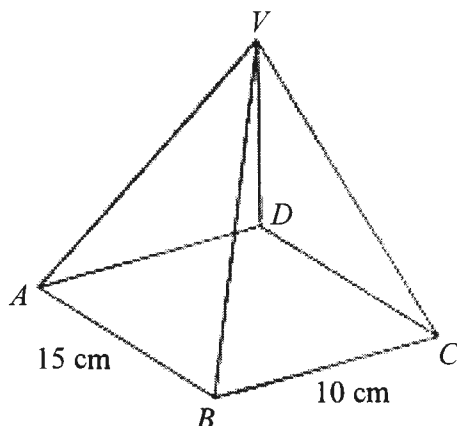
$$\begin{aligned} \angle DAB &= \angle BCD \quad (\text{corresponding angles of congruent triangles are equal}) \\ &= 90^\circ \end{aligned}$$

[3]

* Please circle accordingly

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- 17 The diagram shows a candle in the shape of a rectangular pyramid $VABCD$.
 $AB = 15 \text{ cm}$, $BC = 10 \text{ cm}$ and its volume is 600 cm^3 .



- (a) Find the height of the candle.

$$\frac{1}{3} \times (15 \times 10) \times \text{height} = 600$$

$$\text{height} = 12 \text{ cm}$$

Answer 12 cm [2]

The candle is melted and reshaped into a solid sphere of radius $r \text{ cm}$.

- (b) Show that $r = 5.232$, when corrected to 4 significant figures.

Answer

[1]

$$\frac{4}{3} \pi r^3 = 600$$

$$r^3 = \frac{450}{\pi}$$

$$r = \sqrt[3]{\frac{450}{\pi}}$$

$$= 5.23223$$

$$= 5.232$$

- (c) The spherical candle is cut into two equal hemispheres.
 Find the total surface area of the two hemispheres.

Area = curved SA + circular base

$$= 4\pi r^2 + 2\pi r^2$$

$$= 6\pi r^2$$

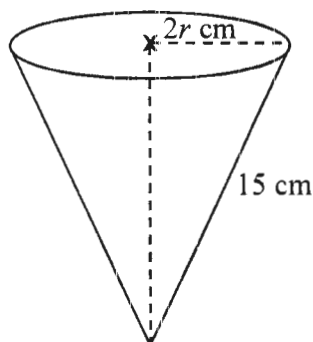
$$= 6\pi (5.232)^2$$

$$= 515.984$$

$$= 516 \text{ cm}^2$$

Answer 516 cm² [2]

- 18 The diagram shows a solid cone.
The slant height of the cone is 15 cm and its base radius is $2r$ cm.



- (a) If the total surface area of the cone is 16π cm², form an equation in r and show that it reduces to

$$2r^2 + 15r - 8 = 0.$$

Answer

[2]

$$\pi(2r)^2 + \pi(2r)(15) = 16\pi$$

$$4\pi r^2 + 30\pi r = 16\pi$$

$$4r^2 + 30r = 16$$

$$2r^2 + 15r = 8$$

$$2r^2 + 15r - 8 = 0$$

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with
Jason

- (b) Solve the equation in part (a) to find the radius of the cone.

$$2r^2 + 15r - 8 = 0$$

$$(2r-1)(r+8) = 0$$

$$r = \frac{1}{2} \quad \text{or} \quad r = -8 \quad (\text{rejected since } r > 0)$$

$$\begin{aligned} \text{Radius} &= 2 \times \frac{1}{2} \\ &= 1 \end{aligned}$$

Answer 1 cm [2]

- (c) Using the answer in part (b), find the volume of the cone.

By Pythagoras' Theorem,

$$\text{height} = \sqrt{15^2 - 1^2} \quad (\text{since height} > 0)$$

$$= 14.96662$$

$$\text{Vol.} = \frac{1}{3} \times \pi \times 1^2 \times 14.96662$$

$$= 15.67301$$

$$= 15.7 \text{ cm}^3$$

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with
Jason

Answer 15.7 cm³ [3]

- 19 The variables x and y are connected by the equation $y = 2x^2 - 8x - 24$.
Some corresponding values of x and y are given in the table below.

x	-2.5	-1	0	1	3	4	5	6
y	p	-14	-24	-30	-30	-24	-14	0

- (a) Find the value of p .

$$p = 2(-2.5)^2 - 8(-2.5) - 24$$

$$= 8.5$$

Answer $p =$ 8.5 [1]

- (b) On the grid on the opposite page, draw the graph of $y = 2x^2 - 8x - 24$ for $-2.5 \leq x \leq 6$. [3]

- (c) Write down the equation of the line of symmetry of the graph.

Answer $x = 2$ [1]

- (d) Use your graph in part (b) to find

- (i) the coordinates of the minimum point of the graph,

Answer (2 , -32) [1]

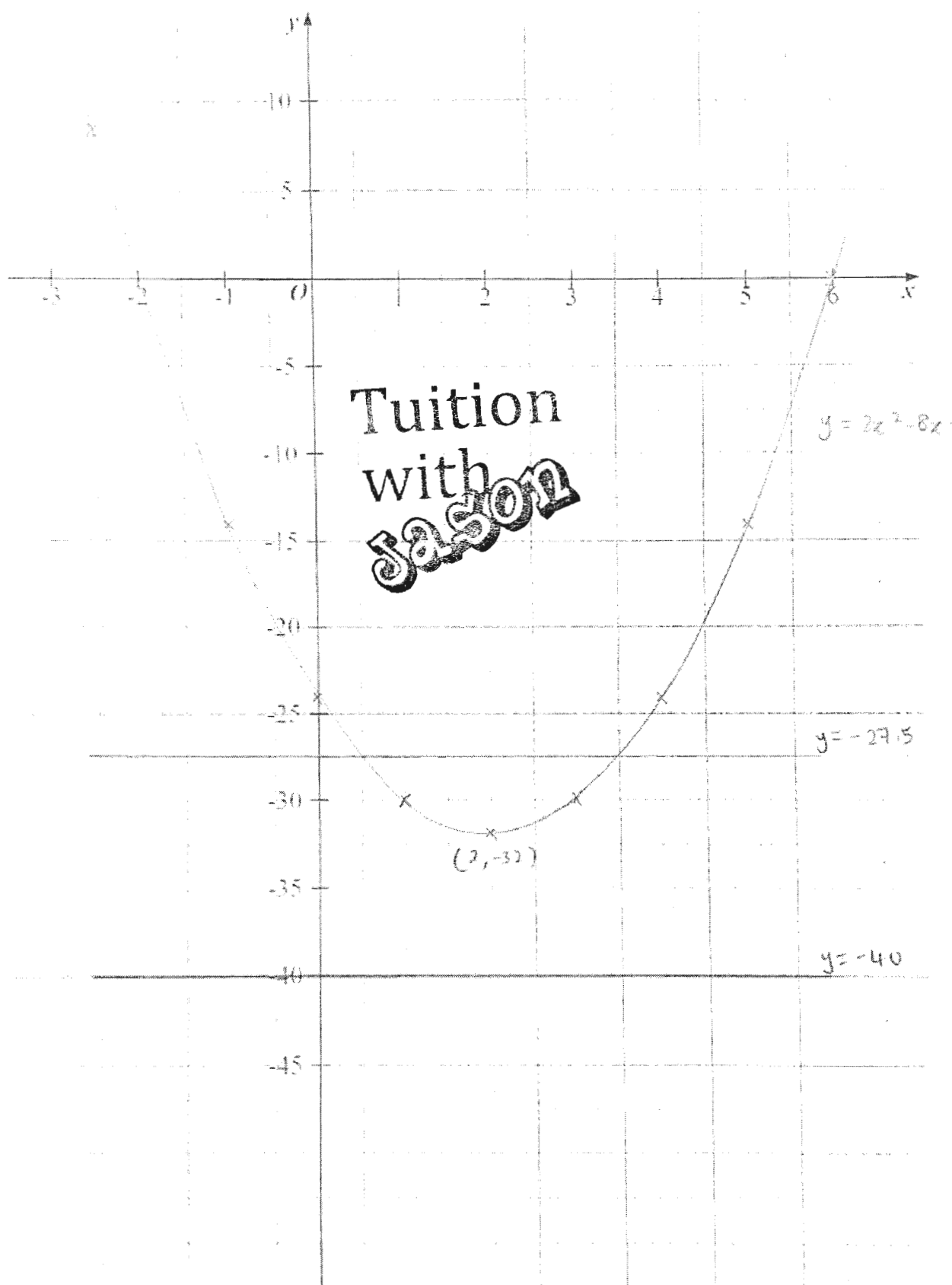
- (ii) the values of x when $y = -27.5$.

Answer $x =$ 0.5 or 3.5 [2]

- (e) Explain why the equation $2x^2 - 8x - 24 = -40$ does not have solutions.

Answer No solutions as the minimum value of y is -32 OR there is no intersection point

between the curve and the line $y = -40$. [1]



- 20 Ivan is going for a holiday to Switzerland.
 He changes 1500 Singapore Dollars (SGD) into Swiss Francs (CHF).
 The exchange rate between SGD and CHF is 1 SGD = 0.6563 CHF.
 (a) Calculate the amount of CHF he received.

$$\begin{aligned} 1 \text{ SGD} &= 0.6563 \text{ CHF} \\ 1500 \text{ SGD} &= 1500 \times 0.6563 \\ &= 984.45 \text{ CHF} \end{aligned}$$

Answer 984.45 CHF [1]

- (b) During Ivan's Switzerland visit, he wanted to join a day tour with three friends to Mount Matterhorn.
 The price charged for each person is 109 CHF.
 There are three local tour operators P , Q and R who offered the following promotions.

P : 20% off up to a maximum of 3 people
 Q : 10% off for each person and 5% from the total payment
 R : 3 people at the regular price and 50% for the fourth person

Given that Ivan and his friends have a budget of 580 SGD for the tour, which of the three tour operators can match their budget.
 Show your working clearly.

For P

$$\begin{aligned} \text{Total cost} &= \left(\frac{80}{100} \times 109 \times 3 \right) + 109 \\ &= 370.6 \text{ CHF} \end{aligned}$$

For Q

$$\begin{aligned} 10\% \text{ off for 4 people} &= \frac{90}{100} \times 109 \times 4 \\ &= 392.4 \text{ CHF} \\ 5\% \text{ off from total} &= \frac{392.4}{100} \times 95 \\ &= 372.78 \text{ CHF} \end{aligned}$$

For R

$$\begin{aligned} \text{Total cost} &= (3 \times 109) + \left(\frac{109}{100} \times 50 \right) \\ &= 381.5 \text{ CHF} \end{aligned}$$

Continuation of working space for question 20(b)

$$\begin{aligned} 580 \text{ SGD} &= 0.6563 \times 580 \\ &= 380.654 \text{ CHF} \end{aligned}$$

Tour operators P or Q will match their budget.

Answer Tour operator _____ P or Q [4]

- (c) At the end of Ivan's holiday in Switzerland, he has 120 CHF left.
 If he converts this amount back to SGD at a bank, he will receive 178 SGD.
 Determine, when changing CHF back to SGD, whether the exchange rate found in part (c) is better value for Ivan than the exchange rate in (a).
 Justify your answer.

$$178 \text{ SGD} = 120 \text{ CHF}$$

$$1 \text{ SGD} = 0.674157 \text{ CHF}$$

From (a),

$$0.6563 \text{ CHF} = 1 \text{ SGD}$$

$$120 \text{ CHF} = 182.84 \text{ SGD}$$

Answer Exchange rate in part (a) is better than the exchange rate in

part (c) because Ivan will receive **more SGD** money when using the exchange rate in part (a). [1]

End of Paper

