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## OUTRAM SECONDARY SCHOOL END-OF-YEAR EXAMINATION 2022

**Subject** : Mathematics  
**Paper No.** : 4048/01  
**Level (Stream)** : Secondary Three Express  
**Date** : 11 October 2022  
**Duration** : 1 hour 30 minutes  
**Marks** : 50

### READ THESE INSTRUCTIONS FIRST

Candidates answer on the Question Paper.

Write your name, class and index number on all the work you hand in.

Write in dark blue or black pen.

You may use an HB 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.

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  $\pi$ , use either your calculator value or 3.142, unless the question requires the answer in terms of  $\pi$ .

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.

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This document consists of **12** printed pages, including this cover page.

Setter: Ms. Woo See Wei

Answer **all** the questions.

- 1 Nurul, Olivia and Philip shared 36 sweets in the ratio 4 : 3 : 2 . How many sweets does Nurul have?

Answer \_\_\_\_\_ [1]

---

- 2 Express  $\frac{6}{30}$  as a percentage.

Answer \_\_\_\_\_ % [1]

---

- 3 (a) Express 0.00045038924 in standard form.

Answer \_\_\_\_\_ [1]

- (b) Given that  $p = 7.8 \times 10^3$  and  $q = 1.74 \times 10^{-2}$ , find  $\frac{4p}{q^2}$ .

Leave your answer in standard form.

Answer \_\_\_\_\_ [2]

---

4 (a) Simplify  $(4x^4)^{\frac{1}{2}}$ .

Answer \_\_\_\_\_ [2]

(b) Solve  $9^x = 3^3 + 3^3 + 3^3$ .

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

---

5 Write  $\frac{3x+1}{3} - \frac{4-2x}{2}$  as a single fraction in its simplest form.

Answer \_\_\_\_\_ [2]

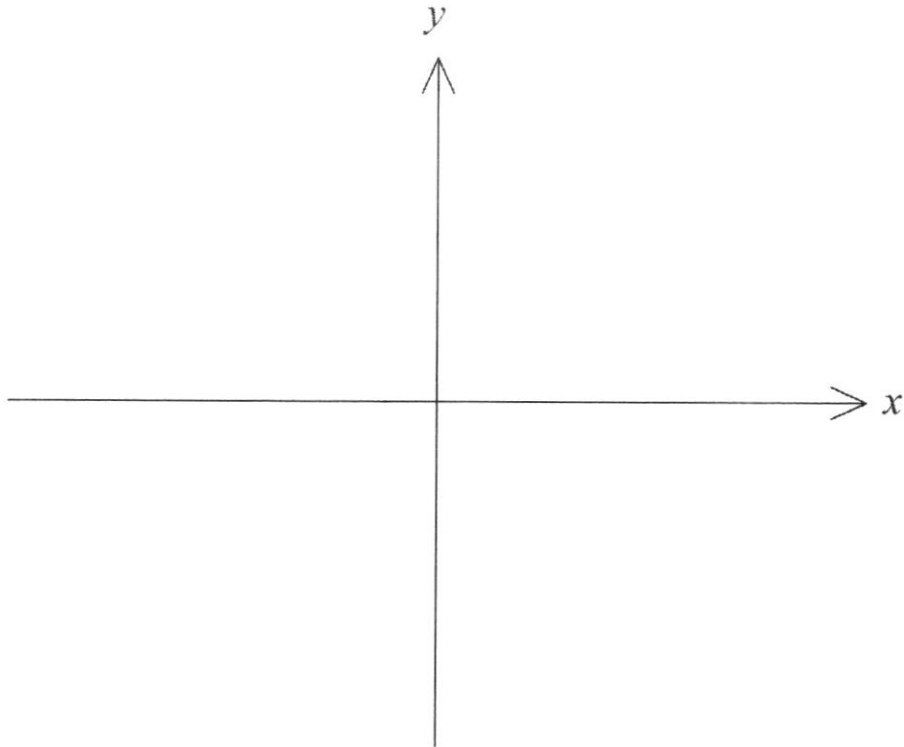
- 6 (a) Express  $x^2 - 4x + 9$  in the form of  $(x - h)^2 + k$ .

Answer \_\_\_\_\_ [2]

- (b) Write down the coordinates of the minimum point of the graph  $y = x^2 - 4x + 9$ .

Answer (\_\_\_\_\_, \_\_\_\_\_) [1]

- 7 Sketch the graph of  $y = (x - 3)(x + 4)$  on the axes below. Indicate clearly the values of the points where the graph crosses  $x$  and  $y$  axes on the curve.



[3]

- 8 (a) Solve the inequalities  $-2(x + \frac{1}{2}) < 3 \leq 2(5 - x)$ .

*Answer* \_\_\_\_\_ [3]

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

- (c) Hence, state the smallest prime number that satisfies the inequalities.

*Answer* \_\_\_\_\_ [1]

---

9 Factorise completely

(a)  $x^2 - 25$ ,

Answer \_\_\_\_\_ [1]

(b)  $4a + 6ab - 3b - 2$ .

Answer \_\_\_\_\_ [2]

(c) Using factorisation, solve  $8x^2 + 18x - 5 = 0$ .

Answer  $x =$  \_\_\_\_\_ or \_\_\_\_\_ [3]

---

- 10** The estimated number of babies born in Singapore decreased from 60 000 in 1990 to 45 600 in 2020. The number decrease by  $n\%$  every year.

Find the value of  $n$ .

*Answer*  $n =$  \_\_\_\_\_ [2]

---

- 11 (a)** Express 270 as a product of its prime factors.

*Answer* \_\_\_\_\_ [1]

- (b)** The number  $270p$  is a perfect cube.

Find the smallest value of  $p$ .

*Answer*  $p =$  \_\_\_\_\_ [1]

---

- 12** Sheila invests \$2500 at rate of  $r\%$  compound interest per annum.  
At the end of 6 years, the value of her investment is \$3100.

Find the value of  $r$ .

*Answer* \_\_\_\_\_ % [3]

---

- 13** Given that  $y = 36 - 2x^2$ ,

(a) find  $y$  when  $x = -2$ .

*Answer*  $y =$  \_\_\_\_\_ [1]

(b) Rearrange the formula to make  $x$  the subject of the given equation.

*Answer*  $x =$  \_\_\_\_\_ [2]

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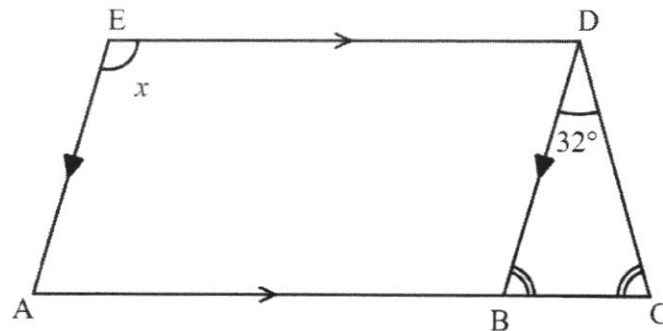
- 14 The sine of an angle,  $x^\circ$ , rounded to 3 significant figures is 0.378. Give two possible values for the angle.

Answer  $x =$  \_\_\_\_\_ or \_\_\_\_\_ [2]

- 15 Five positive integers have a mean of 5.6, a median of 7 and a mode of 2. Find the five numbers.

Answer \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ [2]

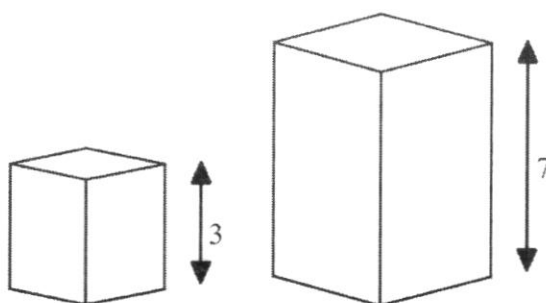
- 16  $ABCDE$  is a trapezium.  
Angle  $BDC = 32^\circ$ , angle  $DBC =$  angle  $DCB$ .



Find the value of  $x$ .

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

- 17 The diagram shows two geometrically similar rectangular blocks.  
 The height of the smaller rectangular block is 3 cm.  
 The height of the larger rectangular block is 7 cm.



- (a) Calculate the ratio of the base area of the two cuboids.

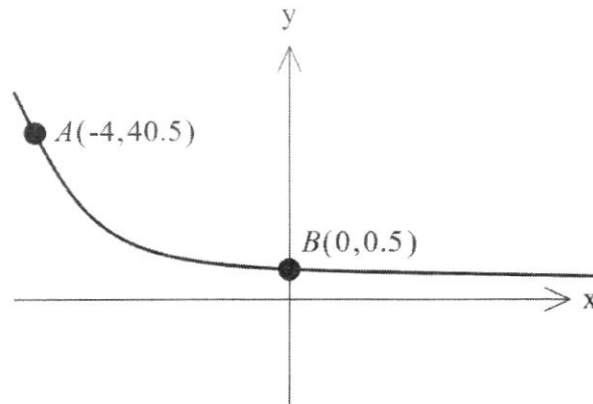
*Answer* \_\_\_\_\_ [1]

- (b) The base area of the smaller rectangular block is  $36 \text{ cm}^2$ .

Calculate the base area of the larger rectangular block.

*Answer* \_\_\_\_\_  $\text{cm}^2$  [2]

- 18 The sketch shows the graph of  $y = ka^{-x}$ .  
The points  $A(-4, 40.5)$  and  $B(0, 0.5)$  lie on the graph.



- (a) A straight line is drawn from  $A$  to  $B$ .

Find the gradient of the line  $AB$ .

Answer \_\_\_\_\_ [1]

- (b) Find the values of  $k$  and  $a$ .

Answer  $k =$  \_\_\_\_\_ [1]

$a =$  \_\_\_\_\_ [1]

**End of Paper**

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# OUTRAM SECONDARY SCHOOL END-OF-YEAR EXAMINATION 2022

**Subject** : **Mathematics**  
**Paper No** : **4048/02**  
**Level (Stream)** : **Secondary Three Express**  
**Date** : **11 October 2022**  
**Duration** : **2 hours**  
**Marks** : **80**

## READ THESE INSTRUCTIONS FIRST

Candidates answer on the Question Paper.

Write your name, class and index number on all the work you hand in.

Write in dark blue or black pen.

You may use an HB 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.

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  $\pi$ , use either your calculator value or 3.142, unless the question requires the answer in terms of  $\pi$ .

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.

|                           |
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| 80                        |

This document consists of **20** printed pages, including this cover page.

Setter: Ms. Woo See Wei

Answer **all** the questions.

- 1 (a) Express  $1 + \frac{p+2}{4} - \frac{5(p-3)}{6}$  as a single fraction in its simplest form.

Answer \_\_\_\_\_ [2]

- (b) Solve the inequality  $\frac{y+1}{2} \geq \frac{2+y}{5}$ .

Answer \_\_\_\_\_ [2]

(c) Simplify  $\left(\frac{k^3}{8h^6}\right)^{-\frac{1}{3}}$ .

*Answer* \_\_\_\_\_ [2]

(d) Solve these simultaneous equations.

$$4x - 3y = 15$$

$$5x + 2y = 13$$

*Answer*  $x =$  \_\_\_\_\_

$y =$  \_\_\_\_\_ [3]

(e) Solve  $\frac{1}{x-1} + \frac{2}{x+2} = 1$ .

*Answer*     $x =$  \_\_\_\_\_ or \_\_\_\_\_ [4]

---

2 Line  $p$  passes the origin and point  $(4,10)$ .

(i) Show that the equation of line  $p$  is  $2y = 5x$ . [2]

(ii) The equation of line  $q$  is  $y = -3x + 11$ .

Find the coordinates of the points of intersection of line  $p$  and line  $q$ .

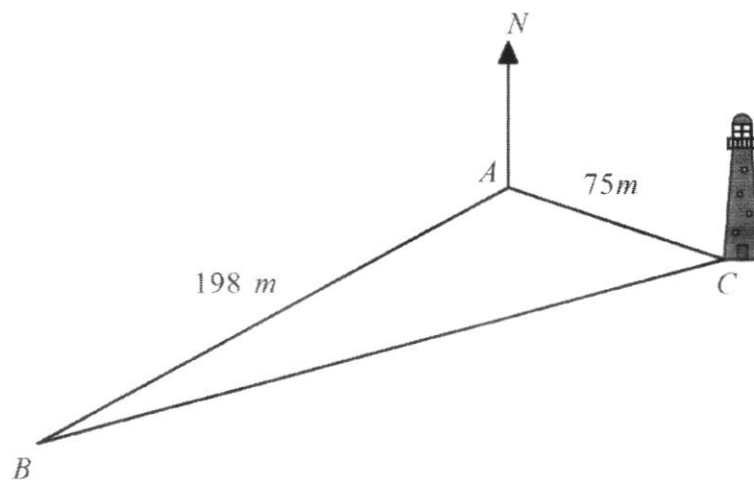
*Answer* ( \_\_\_\_\_ , \_\_\_\_\_ ) [2]

- (iii) Given that line  $p$  and line  $q$  forms a triangle with the  $x$  axis, calculate the area of the triangle.

*Answer* \_\_\_\_\_ unit<sup>2</sup> [3]

---

3



$A$ ,  $B$ , and  $C$  are three points on a horizontal ground. A vertical tower is situated at  $C$ .

$B$  is 198 m from  $A$  on a bearing of  $248^\circ$ .  
 $C$  is 75 m from  $A$  on a bearing of  $96^\circ$ .

(a) Calculate

(i)  $BC$ ,

Answer \_\_\_\_\_ m [3]

(ii) the bearing of  $A$  from  $C$ ,

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

(iii) the area of  $ABC$ .

Answer \_\_\_\_\_  $\text{m}^2$  [2]

(b) A car,  $D$ , travels in a straight line from  $B$  to  $C$ .

Calculate the shortest distance of  $D$  from  $A$  during this journey.

Answer \_\_\_\_\_  $\text{m}$  [3]

(c)  $T$  is the point on the top of the tower at  $C$ .

Given that the height of the tower is 32 m, calculate the angle of depression from the top of the tower to  $A$ .

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

---

- 4 (a) Complete the table of values for  $y = \frac{5}{x} + \frac{x^2}{4}$ .

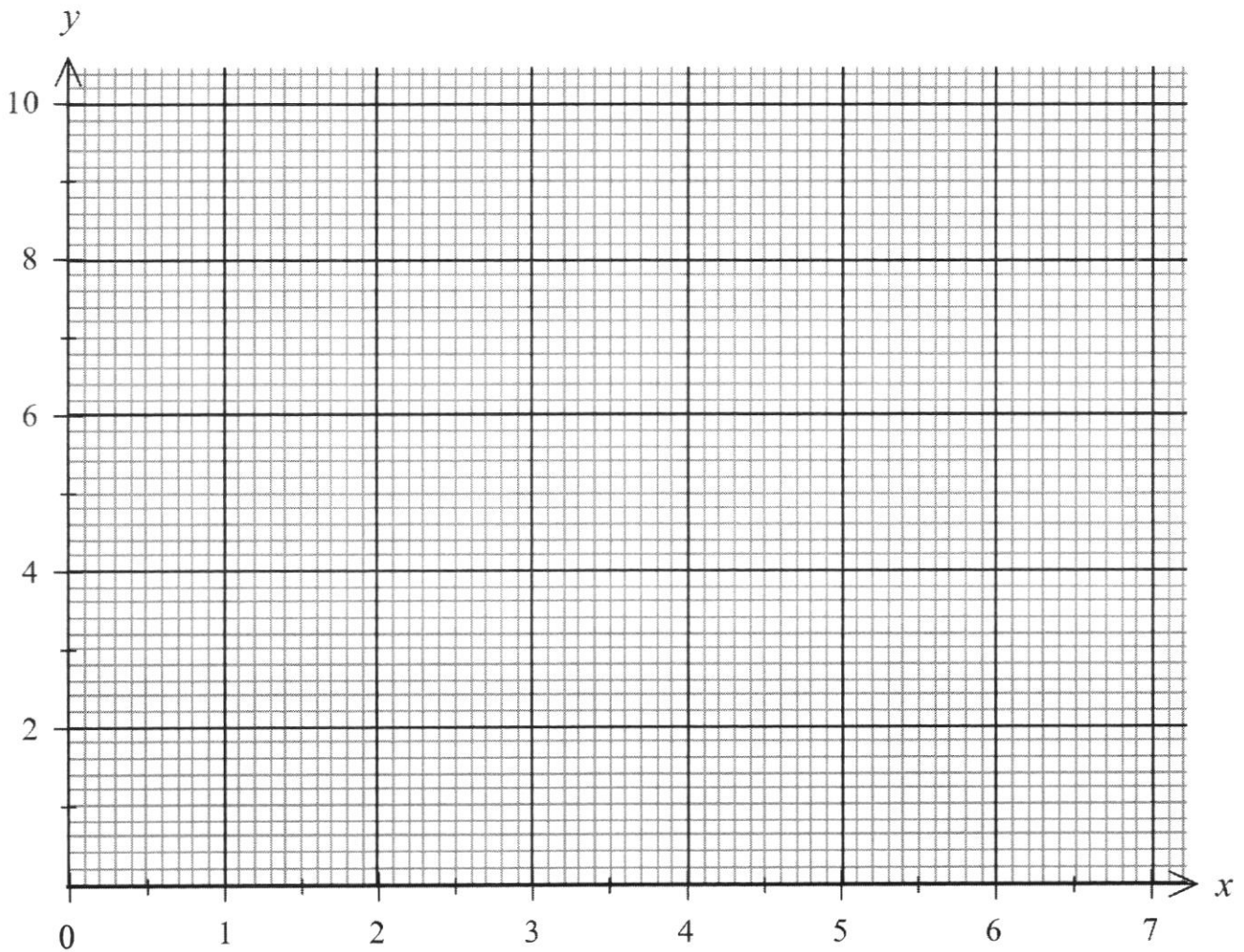
Values are given to 1 decimal place where appropriate.

|     |     |     |     |     |   |     |     |     |
|-----|-----|-----|-----|-----|---|-----|-----|-----|
| $x$ | 0.5 | 1   | 1.5 | 2   | 3 | 4   | 5   | 6   |
| $y$ | 10  | 5.3 | 3.9 | 3.5 |   | 5.3 | 7.3 | 9.8 |

[1]

- (b) On the grid, draw the graph of  $y = \frac{5}{x} + \frac{x^2}{4}$  for  $0.5 \leq x \leq 6$ .

[3]



- (c) Use your graph to find the solutions to the equation  $\frac{5}{x} + \frac{x^2}{4} = 5$  in the range of  $0.5 \leq x \leq 6$ .

Answer  $x =$  \_\_\_\_\_

$x =$  \_\_\_\_\_ [2]

- (d) (i) On the same grid in part (b), draw the line of  $y = -x + 10$  for  $0.5 \leq x \leq 6$ .

[2]

- (ii) Write down the  $x$ -coordinates of the points where this line intersects the curve.

*Answer*  $x =$  \_\_\_\_\_

$x =$  \_\_\_\_\_ [2]

- (iii) These values of  $x$  are the solutions of the equation  $x^3 + 4x^2 + Ax + B = 0$ .

Find the value of  $A$  and the value of  $B$ .

*Answer*  $A =$  \_\_\_\_\_

$B =$  \_\_\_\_\_ [3]

- 5 (a) The price of a laptop is \$1879 in Singapore.  
The price of the same laptop in the USA is USD \$1299.  
The exchange rate between Singapore dollars (SGD) and US dollars (USD)  
is SGD \$1 = USD \$0.71.

Calculate how much cheaper the laptop is in the USA than in Singapore.  
Leave your answer in SGD\$.

*Answer* SGD\$ \_\_\_\_\_ [2]

- (b) The price of a camera after 7% tax refund is \$925.

Calculate the price of the camera before tax refund.  
Give your answer to the nearest dollar.

*Answer* \$ \_\_\_\_\_ [2]

- (c) The table shows information about the technical specifications and prices of the electronic devices of Brand A.

| Size (inches) \ Type | 11"    | 13"    | 14"    |
|----------------------|--------|--------|--------|
| <b>Tablet Lite</b>   | \$879  | \$1099 | \$1209 |
| <b>Tablet Pro</b>    | \$1099 | \$ $x$ | \$1999 |
| <b>Laptop</b>        | \$1879 | \$2179 | \$2329 |

- (i) The price difference of the devices follows a pattern.

Calculate the value of  $x$ .

*Answer*  $x =$  \_\_\_\_\_ [1]

- (ii) Calculate the percentage increase in the price of a 14" laptop from an 11" laptop.

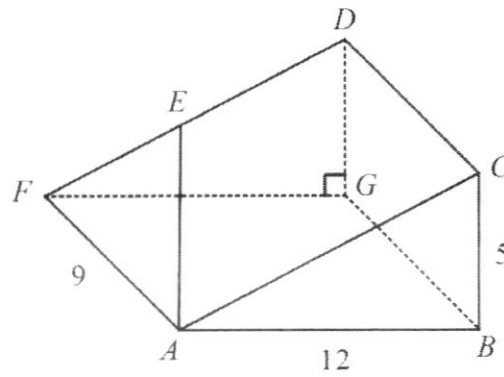
*Answer* \_\_\_\_\_ % [2]

- (iii) The total revenue made by Brand A in 2021 was \$1.6 million dollars, rounded to the nearest dollar.

Given that the sales of the 11" Tablet Lite contributed to 50% of its revenue, calculate the mean number of 11" Tablet Lite sold per day in 2021. Give your answer to the nearest whole number.

*Answer* \_\_\_\_\_ [2]

6



The diagram shows a right-angled triangular prism  $ABCDEFG$ .  
 $AB = 12\text{cm}$ ,  $CB = 5\text{ cm}$ , and  $FA = 9\text{ cm}$ .

- (a) Calculate the  $\angle BAC$ .

Answer \_\_\_\_\_  $^{\circ}$  [2]

- (b) Calculate the length of  $AC$ .

Answer \_\_\_\_\_ cm [2]

- (c) Calculate the angle of elevation from  $A$  to  $D$ .

Answer \_\_\_\_\_ ° [3]

- (d)  $E$  is a point on  $FD$ .

Given that triangle  $ABC$  is similar to triangle  $AFE$ , calculate the length of  $ED$ .

Answer \_\_\_\_\_ cm [3]

---

- 7 Shop A sells bubble tea at \$ $x$  per cup.

Shop B sells bubble tea at \$0.50 per cup less than shop A.

- (a) Write down an expression, in terms of  $x$ , for the selling price of Shop B's bubble tea.

*Answer* \$ \_\_\_\_\_ [1]

- (b) In September, the number of cups of bubble tea sold by Shop B was 10 percent higher than that of Shop A.

Given that the Shop A sold 1500 cups of bubble tea, write down an expression, in terms of  $x$ , for the total revenue Shop B earned from their sales of bubble tea.

*Answer* \$ \_\_\_\_\_ [1]

- (c) In September, Shop A's revenue was \$300 more than Shop B.

Form an equation in terms of  $x$  and find the total revenue made by each shop in September.

*Answer* Shop A \$ \_\_\_\_\_

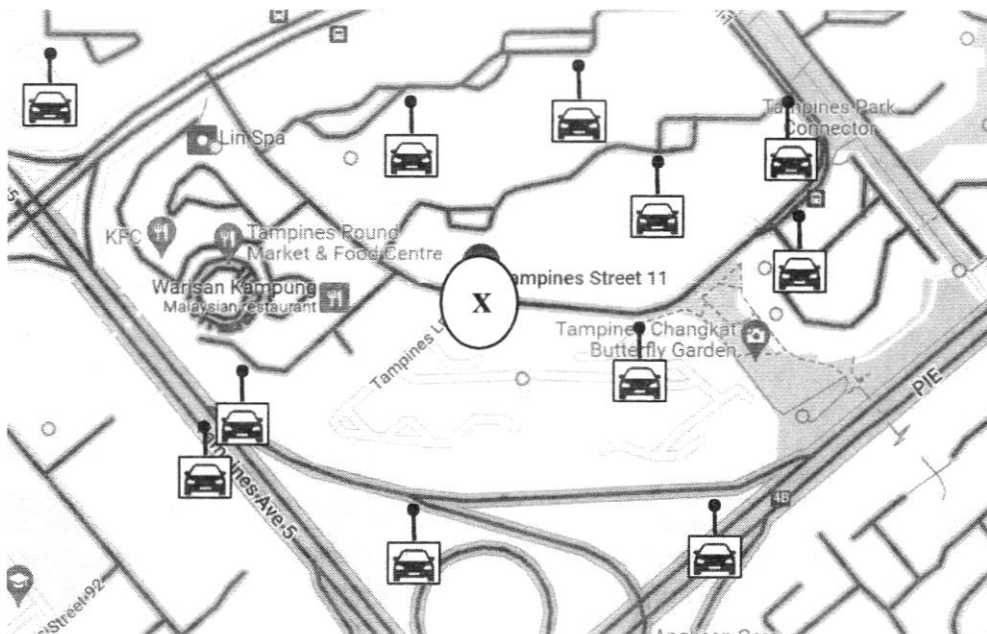
Shop B \$ \_\_\_\_\_ [4]

[BLANK PAGE]

- 8 Olivia travels to-and-fro school from Monday to Friday via a private hire car service offered by the company, ZipRide.

The screenshot below shows the cars available to her on a Monday morning. The centre of 'X' marks the position of Olivia.

The circle on top of the car icon indicates the exact position of the car.



Scale 1 cm : 150 m

- (a) (i) Calculate the actual distance of the car nearest to Olivia.

Answer \_\_\_\_\_ m [1]

- (ii) If the car travels at 18 km/hr, how long will it take for the car to reach Olivia?

Give your answer in minutes.

Answer \_\_\_\_\_ mins [2]

- (b) How many cars are there within 0.6 km radius of Olivia's location?

Answer \_\_\_\_\_ [2]

- (c) The table below shows the price and the surge costs of ZipRide. [5]

|                                      | Ride charges                  |                 |
|--------------------------------------|-------------------------------|-----------------|
|                                      | Off-peak<br>(10 a.m. – 4p.m.) | Peak surcharges |
| Base fare                            | \$2.80                        | \$6             |
| Every 400m for the first 4km or less | \$0.50                        | \$0.80          |
| Every 500m thereafter or less        | \$0.90                        | \$1.20          |

Olivia has \$300 in her Zip Pay wallet. She leaves home for school at 6:50 a.m. and leaves school for home at 3:00 p.m. Given that her school is 5.8 km away, Olivia thinks that she will not have to top up her Zip Pay wallet for the next 2 weeks.

Is Olivia correct? Justify your answer.

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## OUTRAM SECONDARY SCHOOL END-OF-YEAR EXAMINATION 2022

**Subject** : Mathematics  
**Paper No.** : 4048/01  
**Level (Stream)** : Secondary Three Express  
**Date** : 11 October 2022  
**Duration** : 2 hours  
**Marks** : 50

READ THESE INSTRUCTIONS FIRST

# ANSWER SCHEME

|                           |
|---------------------------|
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This document consists of **12** printed pages, including this cover page.

Setter: Ms. Woo See Wei

## 3

Answer **all** the questions.

- 1 Nurul, Olivia and Philip shared 36 sweets in the ratio 4 : 3 : 2. How many sweets does Nurul have?

Answer 16 [1]

- 2 Express  $\frac{6}{30}$  as a percentage.

Answer 20 % [1]

- 3 (a) Express 0.00045038924 in standard form.

Answer  $4.50 \times 10^{-4}$  [1]

- (b) Given that  $p = 7.8 \times 10^3$  and  $q = 1.74 \times 10^{-2}$ , find  $\frac{4p}{q^2}$ .

Leave your answer in standard form.

$$\frac{4(7.8 \times 10^3)}{(1.74 \times 10^{-2})^2} = 103051922.3 \quad [\text{M1}] - \text{optional step}$$

$$1.03 \times 10^8 \quad [\text{A1}] \text{ full mark if correct with no M1}$$

Answer  $1.03 \times 10^8$  [2]

- 4 (a) Simplify  $(4x^4)^{\frac{1}{2}}$ .

$$4^{\frac{1}{2}} x^2 \quad [\text{M1 for correct } x^2]$$

$$= 2x^2 \quad [\text{A1}]$$

Answer  $2x^2$  [2]

4

(b) Solve  $9^x = 3^3 + 3^3 + 3^3$ .

$$\begin{aligned}
 9^x &= 3^3 + 3^3 + 3^3 \\
 3^{2x} &= 3(3^3) \quad [\text{M1}] \\
 3^{2x} &= 3^{1+3} \\
 2x &= 4 \\
 x &= 2 \quad [\text{A1}]
 \end{aligned}$$

OR

$$9^x = 81$$

$$9^x = 9^2 \quad \text{M1 given only if bases are equal}$$

$$x = 2$$

Common Error: Many students applied all sorts of wrong law of indices immediately in the addition form without changing base or changing it to multiplication

Answer  $x = 2$  [2]

5 Write  $\frac{3x+1}{3} - \frac{4-2x}{2}$  as a single fraction in its simplest form.

$$\begin{aligned}
 &\frac{3x+1}{3} - \frac{4-2x}{2} \\
 &= \frac{2(3x+1)}{2(3)} - \frac{3(4-2x)}{3(2)} \quad [\text{M1}] \\
 &= \frac{6x+2-12+6x}{6} \\
 &= \frac{12x-10}{6} \\
 &= \frac{6x-5}{3} \quad [\text{A1}]
 \end{aligned}$$

Common Error:  $-6x$ 

Answer  $\frac{6x-5}{3}$  [2]

5

- 6 (a) Express  $x^2 - 4x + 9$  in the form of  $(x - h)^2 + k$ .

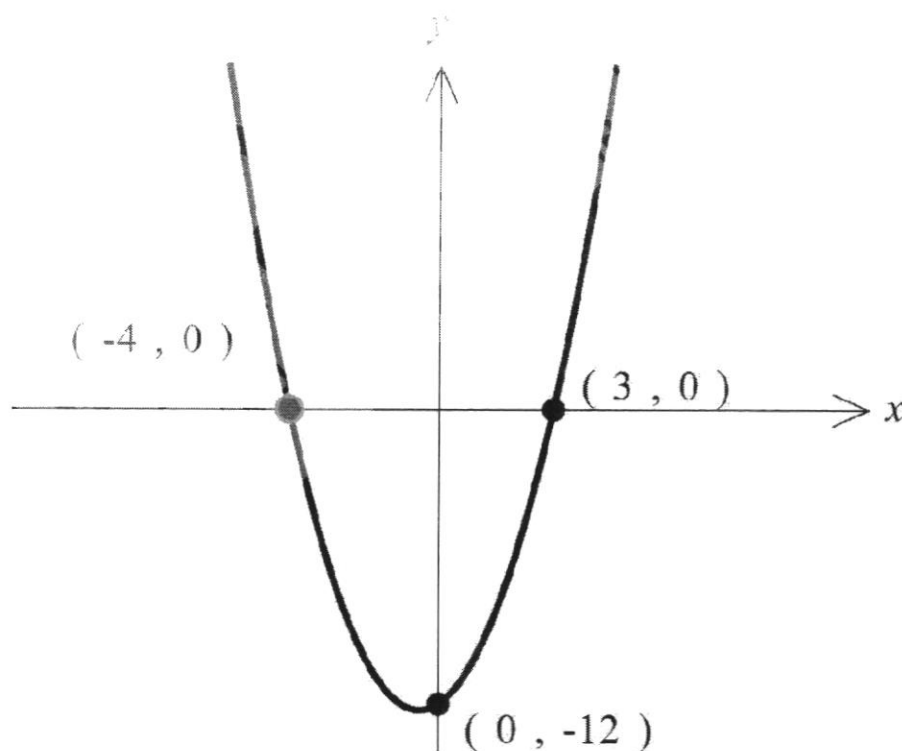
$$\begin{aligned} (x-2)^2 + 9 - 4 & \quad [\text{B1 for } (x-2)^2] \\ = (x-2)^2 + 5 & \quad [\text{B1 for 5}] \text{ Common error: } +4 \end{aligned}$$

Answer  $(x-2)^2 + 5$  [2]

- (b) Write down the coordinates of the minimum point of the graph  $y = x^2 - 4x + 9$ .

Answer  $(2, 5)$  [1]  
ECF

- 7 Sketch the graph of  $y = (x-3)(x+4)$  on the axes below. Indicate clearly the values of the points where the graph crosses  $x$  and  $y$  axes on the curve.



[3]

[B1] symmetrical U-shape with minimum point on LHS of  $y$ -axis

[B1]  $x$ -intercepts

[B1]  $y$ -intercepts

Minus 1 mark if  $(0, -12)$  is the drawn as the min point (common error)

- 8 (a) Solve the inequalities  $-2(x + \frac{1}{2}) < 3 \leq 2(5 - x)$ .

$$-2(x + \frac{1}{2}) < 3 \quad \text{and} \quad 3 \leq 2(5 - x) \quad \text{M1}$$

$$-2x - 1 < 3 \quad \text{and} \quad 3 \leq 10 - 2x$$

$$-2x < 4 \quad \text{and} \quad 2x \leq 7 \quad \text{M1}$$

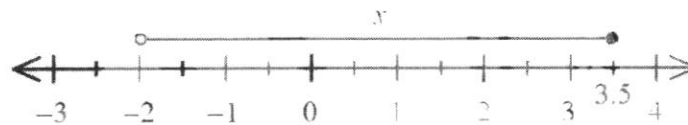
$$x > -2 \quad \text{and} \quad x \leq 3.5 \quad \text{A1}$$

$$-2 < x \leq 3.5$$

ECF only if the final inequality in A1 makes mathematical sense

Answer  $-2 < x \leq 3.5$  [3]

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



- (c) Hence, state the smallest prime number that satisfies the inequalities.  
Common Error: Never shade or never combine the two inequality lines. No mark given in such cases.

Must label 3.5 or else no mark

Answer 2 [1]  
ECF from (a)

- 9 Factorise completely

(a)  $x^2 - 25$ ,

Answer  $(x+5)(x-5)$  [1]

(b)  $4a + 6ab - 3b - 2$ .

$$\begin{aligned} &4a + 6ab - 3b - 2 \\ &= 2(2a - 1) + 3b(2a - 1) \quad \text{[M1]} \\ &= (2 + 3b)(2a - 1) \quad \text{[A1]} \end{aligned}$$

Answer  $(2 + 3b)(2a - 1)$  [2]

7

- (c) Using factorisation, solve
- $8x^2 + 18x - 5 = 0$
- .

$$8x^2 + 18x - 5 = 0$$

$$(4x - 1)(2x + 5) = 0 \quad [\text{M1}] \text{ No factorisation, zero mark overall}$$

$$4x - 1 = 0 \text{ or } 2x + 5 = 0 \quad \text{If never put } = 0, \text{ minus 1m}$$

$$x = \frac{1}{4} \text{ or } x = -\frac{5}{2} \quad [\text{A2}]$$

$$\text{Answer} \quad x = \frac{1}{4} \text{ or } x = -\frac{5}{2} \quad [3]$$

- 10 The estimated number of babies born in Singapore decreased from 60 000 in 1990 to 45 600 in 2020. The number decrease by  $n\%$  every year.

Find the value of  $n$ .

$$60000 \left(1 - \frac{n}{100}\right)^{30} = 45600 \quad [\text{M1}]$$

$$\left(1 - \frac{n}{100}\right)^{30} = \frac{45600}{60000}$$

$$1 - \frac{n}{100} = \sqrt[30]{\frac{45600}{60000}}$$

$$n = 0.911$$

[A1]

Common error: student treated this as simple interest or use

$$60000 \left(1 + \frac{n}{100}\right)^{30} = 45600$$

$$\text{Answer} \quad n = 0.911\% \quad [2]$$

- 11 (a) Express 270 as a product of its prime factors

$$\text{Answer} \quad 2 \times 3^3 \times 5 \quad [1]$$

- (b) The number  $270p$  is a perfect cube.

Find the smallest value of  $p$ .

$$\text{Answer} \quad p = 100 \quad [1]$$

Must evaluate

## 8

- 12 Sheila invests \$2500 at rate of  $r\%$  per year compound interest. At the end of 6 years, the value of her investment is \$3100.

Find the value of  $r$ .

$$\$2500\left(1 + \frac{r}{100}\right)^6 = \$3100 \quad [\text{M1}] \text{ Common error: students used \$600 instead of \$3100}$$

$$\left(1 + \frac{r}{100}\right)^6 = \frac{\$3100}{\$2500}$$

$$1 + \frac{r}{100} = \sqrt[6]{1.24} \quad [\text{M1}] \text{ for showing 6th root of 1.24}$$

$$r = (\sqrt[6]{1.24} - 1) \times 100 = 3.65 \quad [\text{A1}]$$

Answer 3.65 % [3]

- 13  $y = 36 - 2x^2$ .

- (a) Find  $y$  when  $x = -2$

Answer  $y =$  28 [1]

- (b) Rearrange the formula to make  $x$  the subject of the given equation.

$$y = 36 - 2x^2$$

$$2x^2 = 36 - y \quad [\text{M1}] \text{ accepts } -2x^2 = y - 36$$

$$x^2 = \frac{36 - y}{2}$$

$$x = \pm \sqrt{\frac{36 - y}{2}} \quad [\text{A1}] \text{ common error: most students for the plus or minus sign}$$

Answer  $x =$   $\pm \sqrt{\frac{36 - y}{2}}$  [2]

- 14 The sine of an angle,  $x^\circ$ , rounded to 3 significant figures is 0.378. Give two possible values for the angle.

Answer  $x =$   $22.2^\circ$  or  $157.8^\circ$  [2]

Common error: did not write the obtuse angle

9

- 15 Five positive integers have a mean of 5.6, a median of 7 and a mode of 2. Find the five numbers.

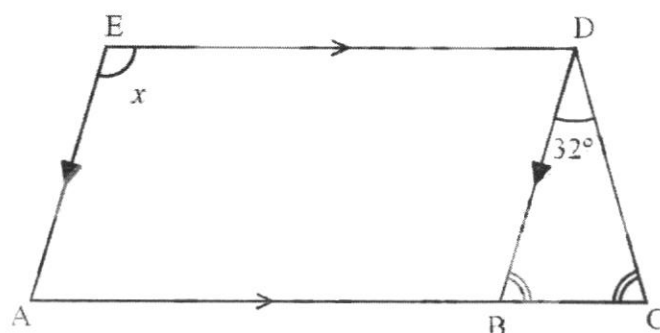
[B1] – 3 correct numbers (no need to be in order)

[B2] – 5 correct numbers

Common error: generally poorly done with all sorts of answers. Many students did not know how to interpret “mode of 2”

Answer 2, 2, 7, 8, 9 [2]

- 16  $ABCDE$  is a trapezium.  
Angle  $BDC = 32^\circ$ , angle  $DBC = \text{angle } DCB$ .



Find the value of  $x$ .

$$\angle DBC = \frac{180 - 32}{2} = 74 \quad (\text{Base angles of isosc. Triangles})$$

$$\angle DBA = 180 - 74 = 106 \quad (\text{Angles on a line})$$

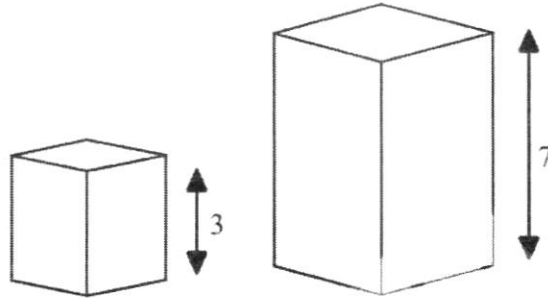
$$\angle DBC = \angle AED \quad (\text{Opp. angles of parallelogram})$$

Award [M1] as long as int angle, alt angle, corresp angle or angle on a straight line with names of angles stated

Common error: many students did not state which angle they are finding. Almost the whole cohort never wrote reasoning. National standard states that reasoning must be written even if not stated in instructions

Answer  $x = 106^\circ$  [2]

- 17 The diagram shows two geometrically similar rectangular blocks.  
The height of the smaller rectangular block is 3 cm.  
The height of the larger rectangular block is 7 cm.



- (a) Calculate the ratio of the base area of the two cuboids.

Answer  $\frac{9 : 49}{\text{Accepted } 49 : 9}$  [1]  
 $\frac{9}{49}$  or  $\frac{9}{49}$  . Common  
 error – 3:7

- (b) The base area of the smaller rectangular block is  $36 \text{ cm}^2$ .

Calculate the base area of the larger rectangular block.

$$\frac{\text{Base area}_{\text{large}}}{\text{Base area}_{\text{small}}} = \frac{49}{9}$$

$$\frac{\text{Base area}_{\text{large}}}{36} = \frac{49}{9} \quad [\text{M1}]$$

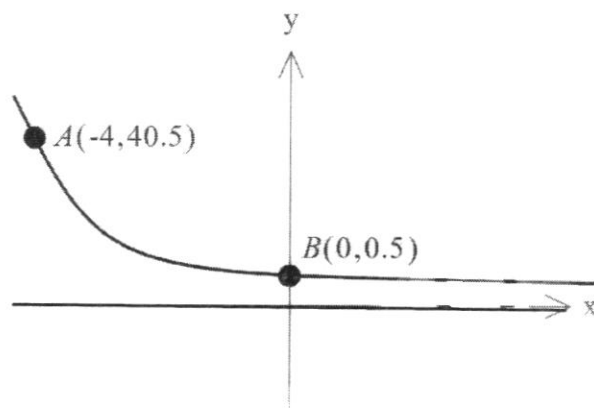
$$\text{Base area}_{\text{large}} = \frac{49}{9} \times 36$$

$$\text{Base area}_{\text{large}} = 196 \quad [\text{A1}] \text{ ECF}$$

If student assumed that base is a square with length 6 or randomly assigned a value of length without using ratio of areas, then minus 1m

Answer  $\underline{196} \text{ cm}^2$  [2]

- 18 The sketch shows the graph of  $y = ka^{-x}$ .  
The points  $A(-4, 40.5)$  and  $B(0, 0.5)$  lie on the graph.



- (a) A straight line is drawn from  $A$  to  $B$ .

Find the gradient of the line  $AB$ .

Answer  $-10$  [1]  
Common error:  $+10$

- (b) Find the values of  $k$  and  $a$ .

Answer  $k = 0.5$  [1]

$a = 3$  [1]

Common error:  
generally poorly  
done

**End of Paper**

|       |                 |
|-------|-----------------|
| Class | Index<br>Number |
|-------|-----------------|

Name: \_\_\_\_\_



# OUTRAM SECONDARY SCHOOL END-OF-YEAR EXAMINATION 2022

**Subject** : Mathematics  
**Paper No** : 4048/02  
**Level (Stream)** : Secondary Three Express  
**Date** : 11 October 2022  
**Duration** : 2 hours  
**Marks** : 80

**READ THESE INSTRUCTIONS FIRST**

Candidates answer on the Question Paper.

# ANSWER SCHEME

|                    |
|--------------------|
| For Examiner's Use |
| 80                 |

This document consists of **15** printed pages, including this cover page.

Setter: Ms. Woo See Wei

## 2

*Mathematical Formulae**Compound interest*

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

*Mensuration*

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

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

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

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

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

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

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

*Trigonometry*

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

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

*Statistics*

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

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

## 3

Answer **all** the questions.

- 1 (a) Express  $1 + \frac{p+2}{4} - \frac{5(p-3)}{6}$  as a single fraction in its simplest form.

$$\begin{aligned}
 & 1 + \frac{p+2}{4} - \frac{5(p-3)}{6} \\
 &= \frac{12 + 3(p+2) - 10(p-3)}{12} \quad [\text{M1}] - \text{for common denominator} \\
 &= \frac{12 + 3p + 6 - 10p + 30}{12} \\
 &= \frac{48 - 7p}{12} \quad [\text{A1}]
 \end{aligned}$$

$$\begin{array}{l}
 \text{Ans} \quad \frac{48-7p}{12} \\
 \text{wer} \quad \underline{\hspace{1.5cm}} \quad [2]
 \end{array}$$

Common Error:

- Wrote -30 instead of -30 when doing expansion.
- Some students did not know how to convert 1 to a fraction.

- (b) Solve the inequality  $\frac{y+1}{2} \geq \frac{2+y}{5}$ .

$$\begin{aligned}
 & \frac{y+1}{2} \geq \frac{2+y}{5} \\
 & 5(y+1) \geq 2(2+y) \quad [\text{M1}] \\
 & 5y+5 \geq 4+2y \\
 & 3y \geq -1 \\
 & y \geq -\frac{1}{3} \quad [\text{A1}]
 \end{aligned}$$

$$\begin{array}{l}
 \text{Ans} \quad y \geq -\frac{1}{3} \\
 \text{wer} \quad \underline{\hspace{1.5cm}} \quad [2]
 \end{array}$$

Common error:

- Flipping the inequality sign even though the division is by a +ve number.

4

(c) Simplify  $\left(\frac{k^3}{8h^6}\right)^{-\frac{1}{3}}$ .

$$\left(\frac{k^3}{8h^6}\right)^{-\frac{1}{3}}$$

$$= \left(\frac{8h^6}{k^3}\right)^{\frac{1}{3}} \text{ OR } \left(\frac{k^{-\frac{3}{3}}}{8^{\frac{1}{3}}h^{\frac{6}{3}}}\right)^{-\frac{1}{3}} \quad \text{[M1] for demonstrating either concept}$$

$$= \frac{2h^2}{k} \quad \text{[A1]}$$

$$\begin{array}{l} \text{Ans} \\ \text{wer} \end{array} \quad \frac{2h^2}{k} \quad [2]$$

Marker's review

- Most students managed to attain [M1], error mostly occurred in  $8^{1/3}$ .

5

(d) Solve these simultaneous equations.

$$4x - 3y = 15$$

$$5x + 2y = 13$$

Substitution method:

$$x = \frac{15+3y}{4} \text{ OR Any other equation that made } x \text{ or } y \text{ the subject} \quad [\text{B1}]$$

$$5\left(\frac{15+3y}{4}\right) + 2y = 13$$

$$75 + 15y + 8y = 52$$

$$23y = -23$$

$$y = -1 \quad [\text{B1}]$$

$$4x - 3(-1) = 15$$

$$4x = 12$$

$$x = 3 \quad [\text{B1}]$$

Elimination Method:

$$8x - 6y = 30 \quad [\text{B1}] \text{ OR}$$

$$(5x + 6y = 39) \quad \text{Any common factor that allows elimination of a variable.}$$

$$23x = 69$$

$$x = 3 \quad [\text{B1}]$$

$$-3y = 15$$

$$-3y = 3 \quad [\text{B1}]$$

$$y = -1$$

$$\text{Ans } x = 3 \quad [\text{B1}]$$

wer

$$y = -1 \quad [\text{B1}] \quad [3]$$

6

(e) Solve  $\frac{1}{x-1} + \frac{2}{x+2} = 1$ .

$$\frac{1}{x-1} + \frac{2}{x+2} = 1$$

$$\frac{x+2+2(x-1)}{(x+2)(x-1)} = 1 \quad [\text{M1}]$$

$$x+2+2x-2 = (x+2)(x-1)$$

$$3x = x^2 + x - 2$$

$$x^2 - 2x - 2 = 0 \quad [\text{M1}]$$

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-2)}}{2(1)}$$

[-1] if answers for  $x$  derived without any working step of quadratic equation / completing the square.

Answer  $x =$  2.73 [B1] or -0.732 [B1] [4]

2 Line  $p$  passes the origin and point  $(4,10)$ .

(i) Show that the equation of line  $p$  is  $2y = 5x$ . [2]

$$\text{gradient} = \frac{10-0}{4-0} = \frac{5}{2} \quad [\text{B1}]$$

$$y\text{-intercept } c = 0$$

$$y = \frac{5}{2}x + 0 \quad [\text{B1}]$$

$$2y = 5x \text{ (shown)}$$

Common Error –

✖ Many students subbed in the coordinate values into the given equation to show that the coordinates fit the equation.

7

- (ii) The equation of line  $q$  is  $y = -3x + 11$

Find the coordinates of the points of intersection of line  $p$  and line  $q$ .

$$y = -3x + 11$$

$$y = \frac{5}{2}x$$

$$\frac{5}{2}x = -3x + 11 \quad [\text{M1}]$$

$$5x = -6x + 22$$

$$11x = 22$$

$$x = 2$$

$$y = \frac{5}{2}(2) = 5$$

Answer (2, 5) [A1] [2]

- (iii) Given that line  $p$  and line  $q$  forms a triangle with the  $x$  axis, calculate the area of the triangle.

$x$ -intercept of line  $q$ .

$$0 = -3x + 11$$

$$x = \frac{11}{3} \quad [\text{B1}]$$

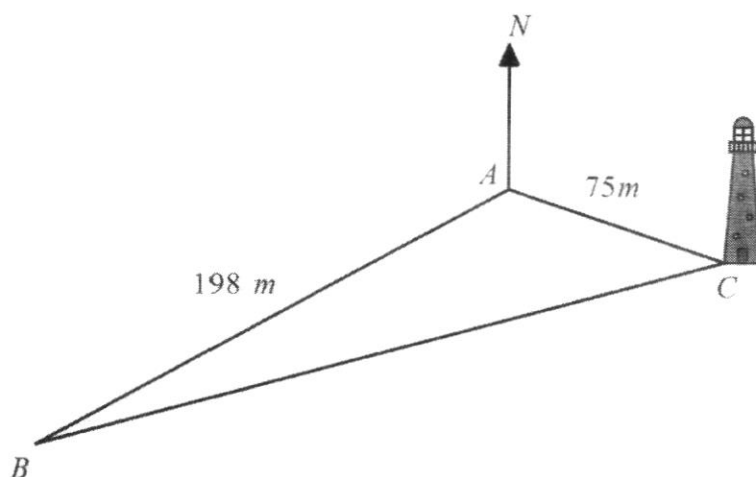
Perpendicular height: 5 units [B1]

Area of triangle = 9.17 units<sup>2</sup> [B1]

Answer 9.17 unit<sup>2</sup> [3]  
ECF

8

3



$A$ ,  $B$ , and  $C$  are three points on a horizontal ground. A vertical tower is situated at  $C$ .

$B$  is 198 m from  $A$  on a bearing of  $248^\circ$ .

$C$  is 75 m from  $A$  on a bearing of  $96^\circ$ .

(a) Calculate

(i)  $BC$ ,

$$\angle BAC = 248 - 96 = 152^\circ \quad [\text{B1}]$$

$$BC^2 = 75^2 + 198^2 - 2(75)(198)\cos 152 \quad [\text{M1}]$$

$$BC = 266.56 = 267 \text{ (3 s.f.)}$$

– ECF if angle from previous calculation was wrong. Max 1m.

Answer 267 [A1] m [3]

(ii) the bearing of  $A$  from  $C$ ,

$$180^\circ - 96^\circ = 84^\circ \text{ (interior angles of // lines)} \quad [\text{B1}]$$

$$360^\circ - 84^\circ = 276^\circ \text{ (angles at a point)} \quad [\text{B1}]$$

Answer 276  $^\circ$  [2]

(iii) the area of  $ABC$ .

$$\frac{1}{2}(75)(198)\sin 152 \quad [\text{M1}]$$

$$= 3485.8 = 3490 \text{ (3 s.f.)} \quad [\text{B1}]$$

Answer 3490  $\text{m}^2$  [2]  
ECF from (3ai)

9

- (b) A car,  $D$ , travels in a straight line from  $B$  to  $C$ .

Calculate the shortest distance of  $D$  from  $A$  during this journey.

$$\frac{1}{2} \times \perp d \times 266.5568 = 3485.8 \quad [\text{M1}] \text{ ECF}$$

$$\perp d = 3485.8 \div 266.5568 \div \frac{1}{2} \quad [\text{M1}]$$

$$\perp d = 26.154 = 26.2 \text{ (3s.f.)} \quad [\text{A1}]$$

$$\frac{\sin \angle ACB}{198} = \frac{\sin 152}{266.5568} \quad [\text{B1}] \text{ ECF}$$

$$\sin \angle ACB = 0.34873$$

$$\angle ACB = 20.409^\circ$$

$$\sin 20.409^\circ = \frac{AD}{75} \quad [\text{M1}]$$

$$AD = 26.154 = 26.2 \text{ (3s.f.)} \quad [\text{A1}]$$

Answer 26.2 m [3]

- (c)  $T$  is the point on the top of the tower at  $C$ .

Given that the height of the tower is 32 m, calculate the angle of depression from the top of the tower to  $A$ .

$$\tan \theta = \frac{75}{32} \quad [\text{M1}]$$

$$\theta = 66.894^\circ$$

$$\text{angle of depression} =$$

$$90^\circ - 66.894^\circ = 23.1^\circ \text{ (1d.p.)} \quad [\text{A1}]$$

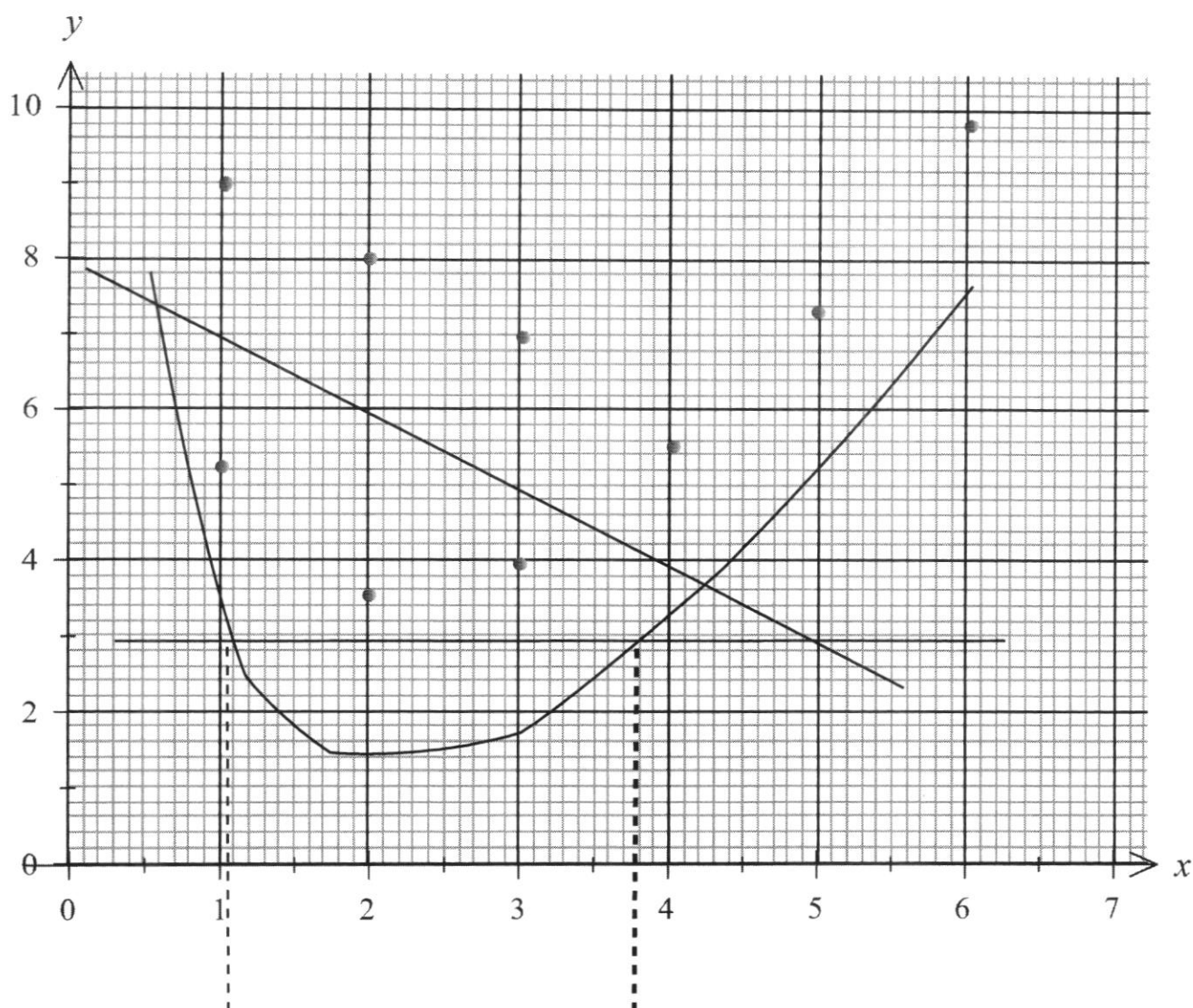
Answer 23.1 ° [2]

- 4 (a) Complete the table of values for  $y = \frac{5}{x} + \frac{x^2}{4}$ .

Values are given to 1 decimal place where appropriate.

| $x$ | 0.5 | 1   | 1.5 | 2   | 3   | 4   | 5   | 6   |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| $y$ | 10  | 5.3 | 3.9 | 3.5 | 3.6 | 5.3 | 7.3 | 9.8 |

111



[B1] Points (at least 6 correct points)

[B1] Curve (smooth curve)

[B1] Shape (correct shape)

- (c) Use your graph to find the solutions to the equation  $\frac{5}{x} + \frac{x^2}{4} = 5$  in the range of  $0.5 \leq x \leq 6$ .

Answer  $x = \underline{1 - 1.2 \text{ [B1]}}$

$x = \underline{3.6 - 3.8 \text{ [B1]}}$  [2]

ECF

- (d) (i) On the same grid in part (b), draw the line of  $y = -x + 10$  for  $0.5 \leq x \leq 6$ .

|     |   |   |   |
|-----|---|---|---|
| $x$ | 1 | 2 | 3 |
| $y$ | 9 | 8 | 7 |

[B1] Points

[2]

[B1] Line

- (ii) Write down the  $x$ -coordinates of the points where this line intersects the curve.

Answer  $x = \underline{0.5 - 0.7 \text{ [B1]}}$  [2]

$x = \underline{4.1 - 4.3 \text{ [B1]}}$

ECF

- (iii) These values of  $x$  are the solutions of the equation  
( )  $x^3 + 4x^2 + Ax + B = 0$ .

Find the value of  $A$  and the value of  $B$ .

$$\frac{5}{x} + \frac{x^2}{4} = -x + 10 \quad [\text{B1}]$$

$$20 + x^3 = -4x^2 + 40x$$

$$x^3 + 4x^2 - 40x + 20 = 0$$

Answer  $A = \underline{-40 \text{ [B1]}}$

$B = \underline{20 \text{ [B1]}}$  [3]

## 12

- 5 (a) The price of a laptop is \$1879 in Singapore.  
 The price of the same laptop in the USA is USD \$1299.  
 The exchange rate between Singapore dollars (SGD) and US dollars (USD) is SGD \$1 = USD \$0.71.

Calculate how much cheaper the laptop is in USA than in Singapore.

$$\$1299 \div 0.71 = \$1829.58 \quad [\text{B1}]$$

$$\$1879 - \$1829.58 = \$49.42 \quad [\text{B1}]$$

Answer SGD\$ 49.42 [2]

- (b) The price of a camera after 7% tax refund is \$925.

Calculate the price of the camera before tax refund.  
 Give your answer to the nearest dollar.

$$\frac{100}{93} \times \$925 \quad [\text{M1}]$$

$$= \$994.62 = \$995 \quad [\text{A1}]$$

Answer \$ 995 [2]

## 13

- (c) The table shows information about the technical specifications and prices of the electronic devices of Brand A.

| Size (inches) \ Type | 11"    | 13"    | 14"    |
|----------------------|--------|--------|--------|
| <b>Tablet Lite</b>   | \$879  | \$1099 | \$1209 |
| <b>Tablet Pro</b>    | \$1099 | \$x    | \$1999 |
| <b>Laptop</b>        | \$1879 | \$2179 | \$2329 |

- (i) The price difference of the devices follows a pattern.

Calculate the value of  $x$ .

$$\text{Answer } x = \underline{1699 \text{ [B1]}} \quad [1]$$

- (ii) Calculate the percentage increase in the price of a 14" laptop from an 11" laptop.

$$\begin{aligned} & \frac{\$2329 - \$1879}{1879} \times 100\% \quad [\text{M1}] \\ & = 23.9\% \quad [\text{A1}] \end{aligned}$$

$$\text{Answer } \underline{23.9} \quad \% \quad [2]$$

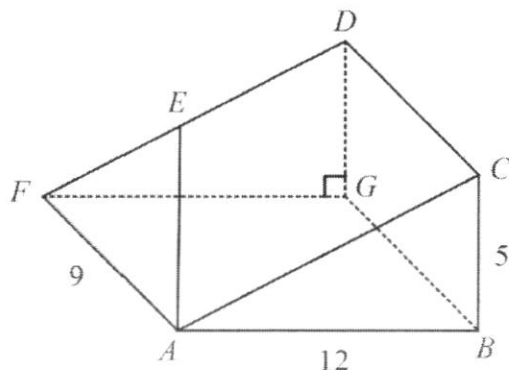
- (iii) The total revenue made from Brand A in 2021 was \$1.6 million dollars, rounded to the nearest dollar.

Given that the sales of the 11" Tablet Lite contributed to 50% of its revenue, calculate the mean number of 11" Tablet Lite sold per day in 2021. Give your answer to the nearest whole number.

$$\begin{aligned} & \frac{0.5(1.6 \times 10^6)}{\$879} \div 365 \quad [\text{M1}] \\ & = 2.49 = 2 \quad [\text{A1}] \end{aligned}$$

$$\text{Answer } \underline{2} \quad [2]$$

6



The diagram shows a right-angled triangular prism  $ABCDEFG$ .  
 $AB = 12\text{ cm}$ ,  $CB = 5\text{ cm}$ ,  $FA = 9\text{ cm}$ .

- (a) Calculate the  $\angle BAC$ .

$$\tan \angle BAC = \frac{5}{12} \quad [\text{B1}]$$

$$\angle BAC = 22.6199 = 22.6 \text{ (3s.f.)} \quad [\text{B1}]$$

Answer 22.6  $^{\circ}$  [2]

- (b) Calculate the length of  $AC$

$$AC = \sqrt{5^2 + 12^2} \quad [\text{M1}]$$

$$= 13 \quad [\text{A1}]$$

Answer 13 cm [2]

- (c) Calculate the angle of elevation from  $A$  to  $D$ .

$$AG = \sqrt{12^2 + 9^2}$$

$$= 15 \quad [\text{B1}]$$

angle of elevation:

$$\tan \theta = \frac{5}{15} \quad [\text{B1}]$$

$$\theta = 18.4^{\circ} \text{ (1d.p.)} \quad [\text{B1}]$$

Answer 18.4  $^{\circ}$  [3]

- (d)  $E$  is a point on  $FD$ .

Given that triangle  $ABC$  is similar to triangle  $AFE$ , calculate the length of  $ED$ .

$$\frac{EF}{5} = \frac{9}{12} \quad [\text{M1}]$$

$$EF = 3.75 \quad [\text{A1}]$$

$$ED = 13 - 3.75 = 9.25 \quad [\text{B1}]$$

Answer 9.25 cm [3]

- 7 Shop A sells bubble tea at \$ $x$  per cup.

Shop B sells bubble tea at \$0.50 per cup less than shop A.

- (a) Write down an expression, in terms of  $x$ , for the selling price of Shop B's bubble tea.

Answer \$  $x - 0.5$  [B1] [1]

- (b) In September, the number of cups of bubble tea sold by Shop B was 10 percent higher than that of Shop A.

Given that the Shop A sold 1500 cups of bubble tea, write down an expression, in terms of  $x$ , for the total amount Shop B made from selling bubble tea.

Answer \$  $1650(x - 0.5)$  [B1] [1]

- (c) In September, Shop A made \$300 more than Shop B in their sales of bubble tea.

Form an equation in terms of  $x$  and find the total amount made by each shop in September.

$$1500x - 1650(x - 0.5) = 300 \quad [\text{M1}]$$

$$-150x + 825 = 300$$

$$-150x = -525$$

$$x = 3.5 \quad [\text{A1}]$$

$$\text{Shop A} = 1500(\$3.5) = \$5250 \quad [\text{B1}]$$

$$\text{Shop B} = 1650(\$3) = \$4950 \quad [\text{B1}]$$

Shop A \$ 5250 [4]

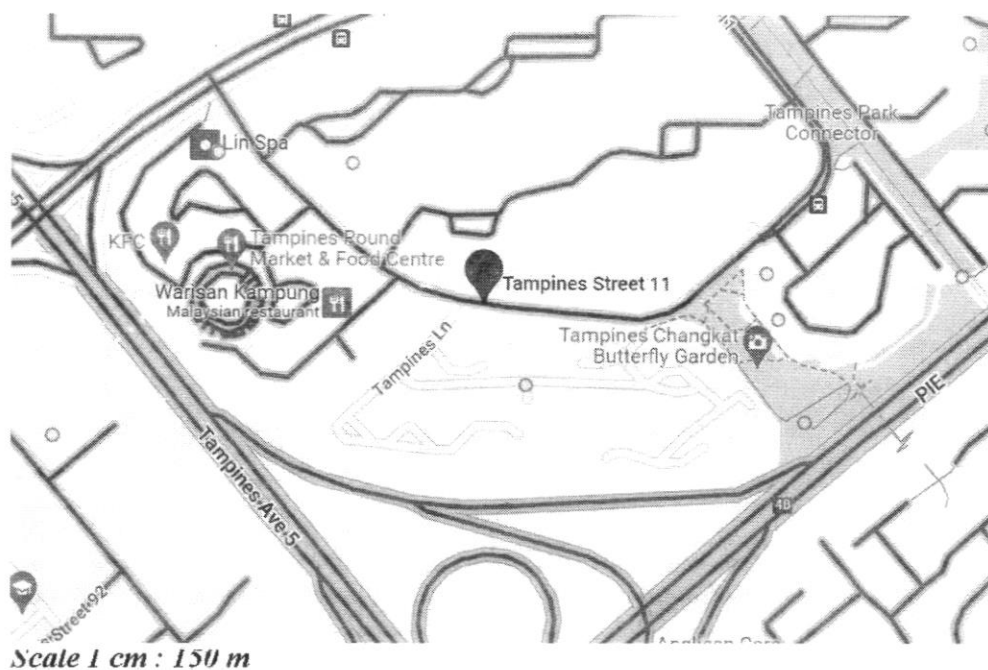
Shop B \$ 4950

- 8 Olivia travels to-and-fro school from Monday to Friday via a private hire car service offered by the company, ZipRide.

The screenshot below shows the cars available to her on a Monday morning.

The centre of 'X' marks the position of Olivia.

The circle on top of the car icon indicates the exact position of the car.



- (a) (i) Calculate the actual distance of the car nearest to Olivia.

Measurement: 2.2 – 2.4 cm

Answer 330 – 360m m [1]

- (ii) If the car travels at 18 km/hr, how long will it take for the car to reach Olivia?

Give your answer in minutes.

$$\frac{330}{18000} \times 60 \quad [\text{M1}]$$

$$= 1.1 \quad [\text{A1}]$$

Answer 1.1 – 1.2 mins [2]

- (b) How many cars are there within 0.6 km radius of Olivia's location?

$$600m = 4cm \text{ on map} \quad [B1]$$

Answer 6 [B1] [2]

- (c) The table below shows the price and the surge costs of ZipRide [5]

|                                      | Ride charges                  |                 |
|--------------------------------------|-------------------------------|-----------------|
|                                      | Off-peak<br>(10 a.m. – 4p.m.) | Peak surcharges |
| Base fare                            | \$2.80                        | \$6             |
| Every 400m for the first 4km or less | \$0.50                        | \$0.80          |
| Every 500m thereafter or less        | \$0.90                        | \$1.20          |

Olivia has \$300 in her Zip Pay wallet. She leaves home for school at 6:50 a.m. and leaves school for home at 3:00 p.m. Given that her school is 5.8 km away, Olivia thinks that she will not have to top up her Zip Pay wallet for the next 2 weeks.

Is Olivia correct? Justify your answer.

Cost of traveling from home to school:

$$\begin{aligned} & \$6 + (0.80 \times 10) + (\$1.20 \times 4) \quad [B2] \\ & = \$18.80 \quad [B1] \text{ show 2/3 of the working parts} \end{aligned}$$

Cost of traveling from school to home:

$$\begin{aligned} & \$2.80 + (\$0.50 \times 10) + (\$0.90 \times 4) \quad [B2] \\ & = \$11.40 \quad [B1] \text{ show 2/3 of the working parts} \end{aligned}$$

Total cost of traveling Mon-Fri for 2 weeks:

$$\begin{aligned} & (\$18.80 + \$11.40) \times 10 \quad [B1] \text{ to show 10 days of travel} \\ & = \$302 \end{aligned}$$

No, Olivia is wrong, she will be short of \$2 and will be required to top up her Zip Pay wallet.