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| Full Name | Class Index No. | Class |
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## Anglo-Chinese School (Barker Road)

END-OF-YEAR EXAMINATION 2024  
SECONDARY TWO EXPRESS

MATHEMATICS  
PAPER 1

1 HOUR 30 MINUTES

Candidates answer on the Question Paper.

### READ THESE INSTRUCTIONS FIRST

Write your index number and name 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.

Answer **all** questions.

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

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 total of the marks for this paper is 60.

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.

|                    |
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This document consists of **13** printed pages and **1** blank page.

**Mathematical Formulae***Compound interest*

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

*Mensuration*

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

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

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

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

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

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

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

- 1 Written as a product of its prime factors,  $4032 = 2^6 \times 3^2 \times 7$ .  
(a) Write 144 as a product of its prime factors in index notation.

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

- (b) Using your answer to **part (a)**, explain why 144 is a perfect square.

Answer

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

- (c) Find the highest common factor of 144 and 4032.

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

- (d) Find the smallest positive integer  $k$  such that  $4032k$  is a perfect cube.

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

---

- 2 A map of Singapore has a scale of 4 cm : 5 km.  
(a) Express this scale in the form 1 :  $n$ , where  $n$  is an integer.

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

- (b) The area of Sentosa is 4.75 km<sup>2</sup>.  
Find the area, in square centimetres, of Sentosa on the map.

Answer \_\_\_\_\_ cm<sup>2</sup> [2]

- (c) On the map, the distance between Newton MRT Station and City Hall MRT Station is 4.8 cm.  
Find the distance, in centimetres, between the two MRT Stations on another map of Singapore that is drawn to a scale of 1 : 50 000.

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

- 3 The stem-and-leaf diagram shows the weight, in kg, of a group of 28 secondary school boys in a class.

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

Key: 5 | 2 represents 52 kg

- (a) Find the median weight.

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

- (b) Given the ideal mass is more than 55 kg and less than 75 kg, find the percentage of boys whose mass is not ideal.

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

4 (a) Calculate  $\frac{13.8}{23.1^2 - \sqrt{105.6}}$ .

Write down the first five digits of your answer.

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

- (b) Write your answer to **part (a)** correct to 2 significant figures.

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

- 5 (a) It is given that  $p \geq 50\frac{1}{2}$ .

Write down the least possible value of  $p$  if  $p$  is

- (i) a prime number,

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

- (ii) a rational number,

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

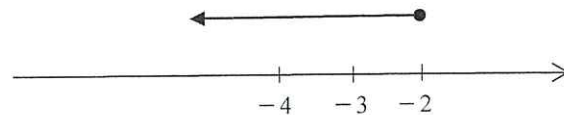
- (iii) a square number.

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

- (b) Solve the inequality  $\frac{3-q}{6} < -2$ .

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

- (c) A range of values for  $x$  is represented on the number line below.



Write down an inequality that represents this range of values for  $x$ .

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

6 Factorise completely

(a)  $2a^2 - 8a - 24$ ,

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

(b)  $7qr - 35pr - 4q + 20p$ .

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

---

7 Simplify  $\frac{3kh - 12k}{16 - h^2}$ .

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

---

- 8 The table below shows the number of books a group of youths have read over 2 months.

|                 |   |   |   |     |   |   |
|-----------------|---|---|---|-----|---|---|
| Number of books | 0 | 1 | 2 | 3   | 4 | 5 |
| Frequency       | 1 | 3 | 5 | $x$ | 2 | 0 |

- (a) If the mode is 2, write down the largest possible value of  $x$ .

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

- (b) If the median is 2, write down the smallest and the largest possible value of  $x$ .

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

largest  $x =$  \_\_\_\_\_ [1]

- (c) If the mean is 2, find the value of  $x$ .

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

- 9 A bag contains 30 balls of which  $(x - 2)$  balls are red, 8 balls are blue and the rest are white. A ball is drawn at random from the bag.

(a) Find the probability of picking

(i) a blue ball,

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

(ii) a black ball.

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

- (b) If the probability of picking a white ball is  $\frac{2}{5}$ , find the number of red balls.

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

---

- 10 The total cost of 7 pencils and 4 pens is \$9.45.  
The total cost of 10 pencils and 1 pen is \$6.90.

- (a) Let the price of 1 pencil be \$ $x$  and the price of 1 pen be \$ $y$ .  
Form a pair of simultaneous equations in terms of  $x$  and  $y$ .

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

- (b) Hence, find the value of  $x$  and  $y$ .

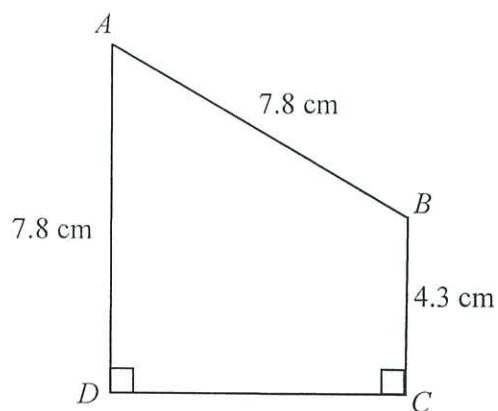
Answer  $x =$  \_\_\_\_\_  
 $y =$  \_\_\_\_\_ [3]

- (c) Clarence claims that \$50 is sufficient to buy 20 pencils and 20 pens. Do you agree with him? Show your working clearly.

Answer

[2]

- 11 The diagram shows a quadrilateral  $ABCD$  where angle  $ADC = \text{angle } BCD = 90^\circ$ .  
 $BC = 4.3 \text{ cm}$  and  $AD = AB = 7.8 \text{ cm}$ .



- (a) Find angle  $BAD$ .

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

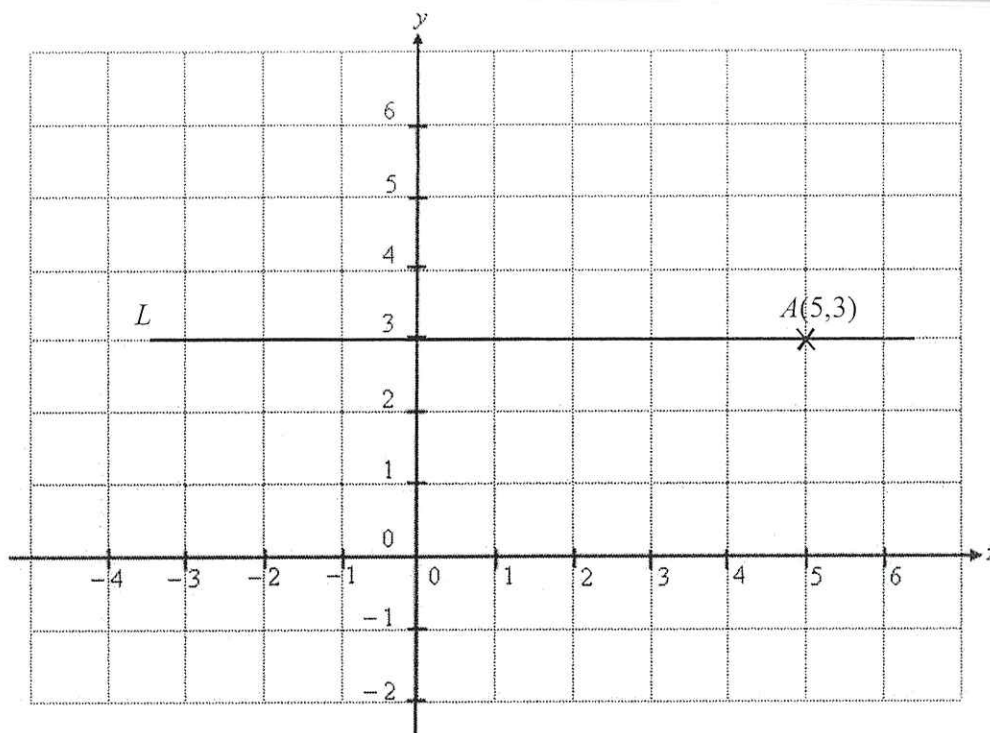
- (b) Name the quadrilateral.

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

- (c) Find the area of the quadrilateral.

Answer \_\_\_\_\_  $\text{cm}^2$  [3]

12



- (a) Write down the equation of line  $L$ .

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

- (b)  $B$  is a point  $(0, -1)$ . Plot and label point  $B$  in the grid. [1]

- (c)  $A$  is a point  $(5, 3)$ . Draw the line  $AB$  and find the equation of  $AB$ .

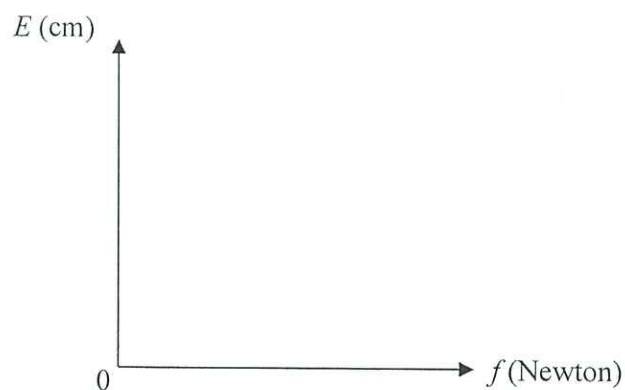
Answer \_\_\_\_\_ [2]

- (d) Find the area of the triangle formed by the line  $L$ , line  $AB$  and  $y$ -axis.

Answer \_\_\_\_\_ units<sup>2</sup> [1]

- 13 The extension,  $E$  cm, of a spring is directly proportional to the force,  $f$  Newton, applied to it.

(a) Sketch a graph of  $E$  against  $f$  for the extension of the spring.



[1]

When 6 Newton of force is applied, the spring extends by 9 cm.

(b) Find an equation connecting  $E$  and  $f$ .

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

When 5 Newton of force is applied, the total length of the spring is 12 cm.

(c) Find the original length of the spring.

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

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1 Expand and simplify

(a)  $(3 - x)(2x - 5)$ ,

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

(b)  $8pq - (3p + q)^2$ .

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

2 Express as a single fraction in its simplest form

(a)  $\frac{24m^2n}{5n^2} \div \frac{16mn^2}{30n},$

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

(b)  $\frac{2}{1-4x^2} + \frac{2}{2x-1}.$

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

3 It is given that  $r = \frac{5}{3a^2} - b$ .

(a) Find the value of  $r$  when  $a = -5$  and  $b = 8$ .

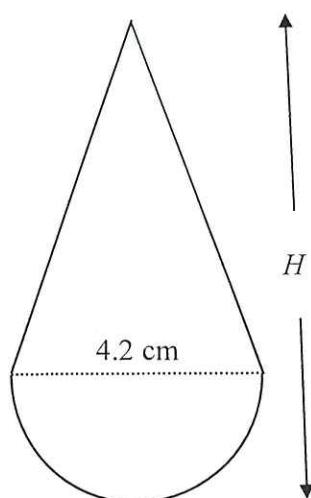
Answer  $r =$  \_\_\_\_\_ [1]

(b) Express  $a$  in terms of  $b$  and  $r$ .

Answer  $a =$  \_\_\_\_\_ [3]

---

- 4 A toy of volume of  $56 \text{ cm}^3$  is in the shape of a cone and a hemisphere.



- (a) Given that the diameter of the hemisphere is 4.2 cm, find the height of the toy,  $H$ .

Answer  $H =$  \_\_\_\_\_ cm [4]

- (b) Find the total surface area of the toy.

Answer \_\_\_\_\_  $\text{cm}^2$  [3]

---

- 5 In a sequence, a term is obtained by adding a number  $c$  to the previous term.  
The first term of the sequence is 5 and the seventh term is 29.

(a) Find the value of  $c$ .

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

(b) Find and simplify an expression, in terms of  $n$ , for the  $n$ th term of the sequence.

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

(c) One term in the sequence is 113.  
Find the value of  $n$  for this term.

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

(d) Explain why all the terms in the sequence are odd.

Answer

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

6 Tom and Jerry took part in a 8 km walkathon together.

- (a) Tom completed the walkathon at an average speed of  $x$  km/h.  
Write down, in terms of  $x$ , the time in hours that Tom took to complete the walkathon.

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

- (b) Jerry walked 2 km/h faster than Tom.  
Write down, in terms of  $x$ , the time in hours that Jerry took to complete the walkathon.

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

- (c) Given that Jerry finished the entire walkathon 20 minutes earlier than Tom, form an equation in  $x$  and show that it reduces to  $x^2 + 2x - 48 = 0$ .

Answer

[3]

- (d) Solve the equation  $x^2 + 2x - 48 = 0$ .

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

- (e) Find the time taken, in hours and minutes, by Tom to complete the walkathon.

Answer \_\_\_\_\_ hour \_\_\_\_\_ minutes [1]

- 7 A glider was launched vertically upwards from the ground. The height,  $h$  metres, of the glider above the ground after time,  $t$  seconds, is given by  $h = -5t^2 + 40t$ .

|     |   |    |    |    |    |    |     |    |   |
|-----|---|----|----|----|----|----|-----|----|---|
| $t$ | 0 | 1  | 2  | 3  | 4  | 5  | 6   | 7  | 8 |
| $h$ | 0 | 35 | 60 | 75 | 80 | 75 | $p$ | 35 | 0 |

- (a) Find the value of  $p$ .

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

- (b) On the grid opposite, draw the graph of  $h = -5t^2 + 40t$  for  $0 \leq t \leq 8$ .  
Using the scale of 2 cm to represent 1 unit, draw a horizontal  $t$ -axis for  $0 \leq t \leq 8$ .  
Using the scale of 2 cm to represent 10 units, draw a vertical  $h$ -axis for  $0 \leq h \leq 80$ . [3]

- (c) On your graph, draw the line of symmetry and state the equation of this line.

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

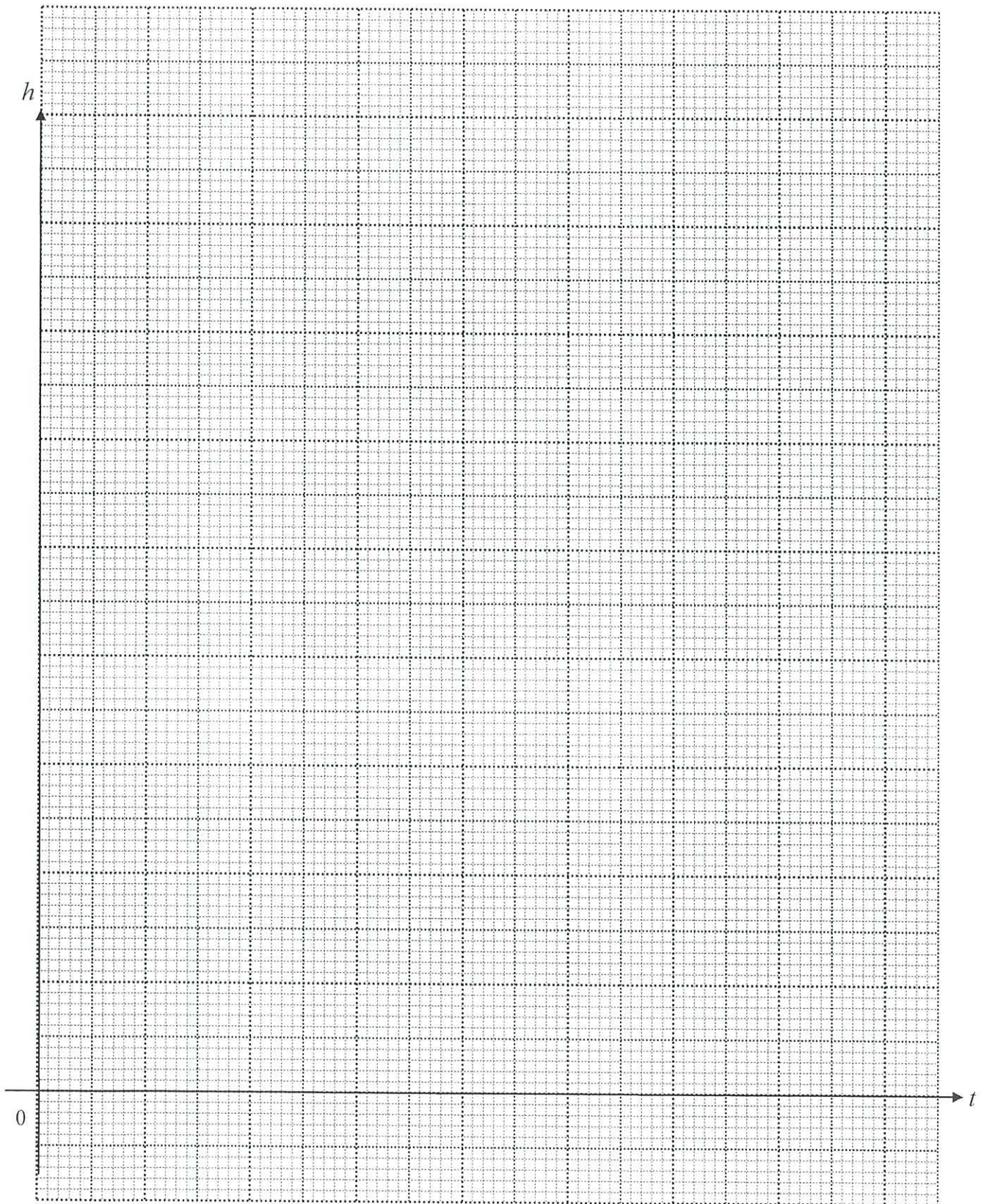
- (d) Using your graph,

- (i) state the coordinates of the maximum point,

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

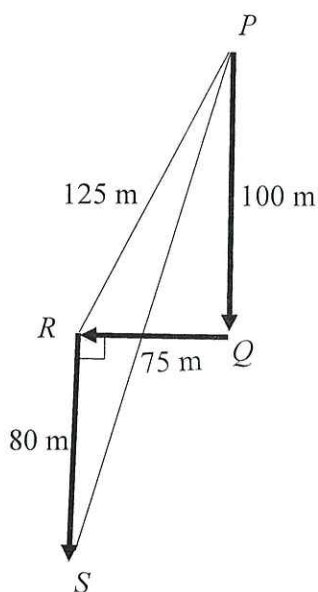
- (ii) find the length of time that the glider was more than 55 m above the ground.

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



- 8 A kayaker paddles 100 m from the shore at point  $P$  to his fishing spot at point  $Q$ , where he starts fishing. The underwater current drifts his kayak to point  $R$ , 75 m away from point  $Q$ .

From point  $R$ , the kayaker paddles 80 m to point  $S$  and angle  $QRS = 90^\circ$ .  
Upon reaching point  $S$ , it starts to rain heavily and the kayaker decides to head back to point  $P$  to seek shelter from the rain.



- (a) Given that the distance from point  $R$  to point  $P$  is 125 m, show that the triangle formed by points  $P$ ,  $Q$  and  $R$  is a right-angled triangle.

*Answer*

[2]

- (b) Show that the shortest distance the kayaker needs to paddle from point  $S$  to reach point  $P$  is 195 m.

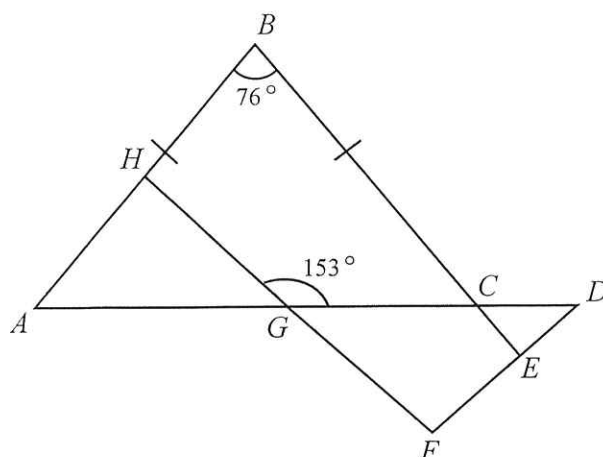
*Answer*

[2]

- (c) Given that the kayaker paddles his kayak at an average speed of 2 km/h, how long would he take to reach point  $P$  from point  $S$ ? Leave your answer in minutes.

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

- 9 In the diagram,  $ABC$  is an isosceles triangle with  $AB = BC$ .  
 Angle  $ABC = 76^\circ$  and angle  $HGC = 153^\circ$ .  $AC$  is produced to the point  $D$ .  
 $AGD$ ,  $BCE$  and  $HGF$  are straight lines.



- (a) Find angle  $ACB$ .

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

- (b) Given that triangle  $AHG$  and triangle  $DFG$  are congruent, find  
 (i) angle  $CDE$ ,

Answer \_\_\_\_\_  $^\circ$  [1]

- (ii) angle  $GFD$ .

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

- (c) Determine whether triangle  $CDE$  is similar to triangle  $CAB$ .  
 Explain your answer.

Answer

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

- 10 Aden and his brother, Brad, did well for their End-of-Year examination. Their father intended to reward them with Pokémon cards from Japan. They found a promotion for these cards on an online shopping platform.

|                                                                   |                                                                                             |
|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Promotion Price                                                   | Was: \$15 per packet<br>Now: \$9.90 per packet                                              |
| Discount Voucher<br>(Limit to one voucher use per purchase order) | \$6 for purchases over \$40<br>\$8 for purchases over \$50<br>\$10 for purchases over \$80  |
| Shipping Fee per purchase order                                   | \$1.99<br>(Free shipping for purchases over \$60, to be applied after any discount voucher) |

- (a) Aden wanted 5 packets of Pokémon cards.  
Calculate the total cost that his father had to pay for this purchase order.

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

- (b) Brad wanted 7 packets of Pokémon cards. Their father suggested that combining both his sons' orders as a single purchase would be a better deal than having two separate purchases.  
Do you agree with their father? Show your working clearly.

Answer

I agree / disagree (circle your answer) with their father because \_\_\_\_\_

[4]

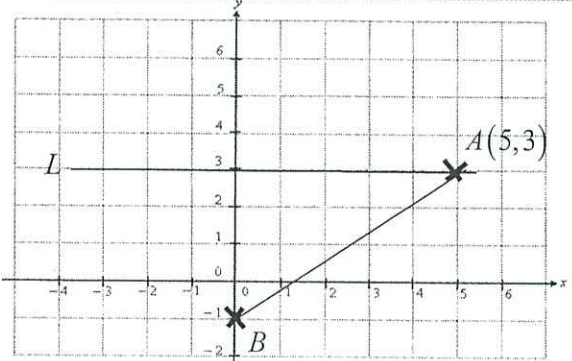
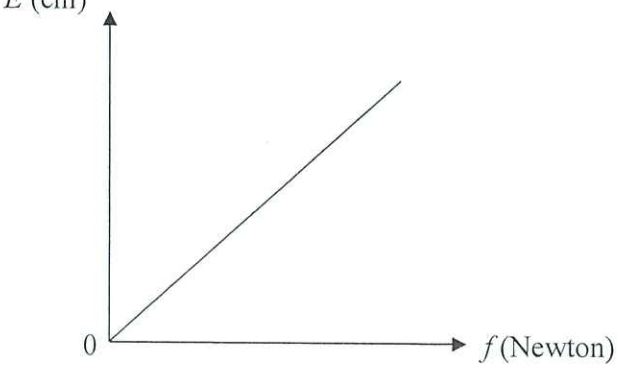
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|   |        |                                                                                                                                                                                                    |  |  |  |
|---|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| 1 | (a)    | $144 = 2^4 \times 3^2$                                                                                                                                                                             |  |  |  |
|   | (b)    | Since the indices of the prime factors are positive even numbers, 144 is a perfect square.                                                                                                         |  |  |  |
|   | (c)    | $2^4 \times 3^2$<br>$= 144$                                                                                                                                                                        |  |  |  |
|   | (d)    | $k = 3 \times 7^2$<br>$= 147$                                                                                                                                                                      |  |  |  |
| 2 | (a)    | 4 cm : 5 km<br>4 cm : 500 000 cm<br>1 cm : 125 000 cm<br>$n = 125\,000$                                                                                                                            |  |  |  |
|   | (b)    | 1 cm : 1.25 km<br>1.25 km : 1 cm<br>$(1.25\text{ km})^2 : (1\text{ cm})^2$<br>$1.5625\text{ km}^2 : 1\text{ cm}^2$<br>$4.75\text{ km}^2 : \frac{4.75}{1.5625}\text{ cm}^2$<br>$= 3.04\text{ cm}^2$ |  |  |  |
|   | (c)    | $4.8 \times 125\,000$ or $\frac{4.8 \times 5}{4}$<br>$= 600\,000\text{ cm}$ $= 6\text{ km}$<br>$= 6\text{ km}$                                                                                     |  |  |  |
|   |        | 50 000 cm : 1 cm<br>0.5 km : 1 cm<br>$6\text{ km} : \frac{6}{0.5} = 12\text{ cm}$                                                                                                                  |  |  |  |
| 3 | (a)    | median = 66 kg                                                                                                                                                                                     |  |  |  |
|   | (b)    | $\frac{12}{28} \times 100\%$<br>$= 42\frac{6}{7}\%$ or 42.9% (3 s.f.)                                                                                                                              |  |  |  |
| 4 | (a)    | 0.0263                                                                                                                                                                                             |  |  |  |
|   | (b)    | 0.026                                                                                                                                                                                              |  |  |  |
| 5 | (a)(i) | 53                                                                                                                                                                                                 |  |  |  |
|   | (ii)   | $50\frac{1}{2}$                                                                                                                                                                                    |  |  |  |
|   | (iii)  | 64                                                                                                                                                                                                 |  |  |  |

|   |     |                                                                                                                        |  |  |  |
|---|-----|------------------------------------------------------------------------------------------------------------------------|--|--|--|
|   | (b) | $\frac{3-q}{6} < -2$<br>$3-q < -12$                                                                                    |  |  |  |
|   |     | $-q < -12-3$<br>$-q < -15$<br>$q > 15$                                                                                 |  |  |  |
|   | (c) | $x \leq -2$                                                                                                            |  |  |  |
| 6 | (a) | $2a^2 - 8a - 24$<br>$= 2(a^2 - 4a - 12)$<br>$= 2(a-6)(a+2)$                                                            |  |  |  |
|   | (b) | $7qr - 35pr - 4q + 20p$<br>$= (7qr - 35pr) - (4q - 20p)$<br>$= 7r(q-5p) - 4(q-5p)$<br>$= (7r-4)(q-5p)$                 |  |  |  |
| 7 |     | $\frac{3kh-12k}{16-h^2}$<br>$= \frac{3k(h-4)}{(4-h)(4+h)}$<br>$= \frac{-3k(4-h)}{(4-h)(4+h)}$<br>$= -\frac{3k}{(4+h)}$ |  |  |  |

|    |        |                                                                                                                                                                                   |  |  |  |
|----|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| 8  | (a)    | 4                                                                                                                                                                                 |  |  |  |
|    | (b)    | $1+3=4+x+2$<br>$4=6+x$<br>$x=-2$<br>smallest $x=0$                                                                                                                                |  |  |  |
|    |        | $1+3+4=x+2$<br>$8=x+2$<br>$x=6$<br>largest $x=6$                                                                                                                                  |  |  |  |
|    | (c)    | $\frac{0 \times 1 + 1 \times 3 + 2 \times 5 + 3x + 4 \times 2 + 5 \times 0}{1 + 3 + 5 + x + 2 + 0} = 2$ $\frac{0 + 3 + 10 + 3x + 8 + 0}{11 + x} = 2$ $\frac{21 + 3x}{11 + x} = 2$ |  |  |  |
|    |        | $21 + 3x = 2(11 + x)$<br>$21 + 3x = 22 + 2x$<br>$x = 1$                                                                                                                           |  |  |  |
| 9  | (a)(i) | $\frac{8}{30} = \frac{4}{15}$ or 0.267 (3 s.f.)                                                                                                                                   |  |  |  |
|    | (ii)   | 0                                                                                                                                                                                 |  |  |  |
|    | (b)    | $\frac{30 - (x - 2) - 8}{30} = \frac{2}{5}$ $\frac{24 - x}{30} = \frac{2}{5}$                                                                                                     |  |  |  |
|    |        | $5(24 - x) = 2(30)$<br>$24 - x = 12$<br>$x = 12$<br>$x - 2 = 12 - 2$<br>$= 10$                                                                                                    |  |  |  |
| 10 | (a)    | $7x + 4y = 9.45$<br>$10x + y = 6.90$                                                                                                                                              |  |  |  |
|    | (b)    | $7x + 4y = 9.45$ ----- (1)<br>$10x + y = 6.9$ ----- (2)<br>from (2), $y = 6.9 - 10x$ ----- (3)                                                                                    |  |  |  |
|    |        | Sub (3) into (1), $7x + 4(6.9 - 10x) = 9.45$<br>$7x + 27.6 - 40x = 9.45$<br>$-33x = 9.45 - 27.6$<br>$x = 0.55$                                                                    |  |  |  |

|    |     |                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
|----|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
|    |     | Sub $x = 0.55$ into (3)<br>$y = 6.9 - 10(0.55)$<br>$y = 1.4$                                                                                                                                                                                                                                                                                                                                                                       |  |  |  |
|    | (c) | cost of 20 pencils and 20 pens<br>$= 20(\$0.55) + 20(\$1.4)$<br>$= \$39$<br>Yes, I agree. $\$50 > \$39$ , so it's sufficient.                                                                                                                                                                                                                                                                                                      |  |  |  |
| 11 | (a) | Draw a line perpendicularly to $AD$ and label it as $E$<br>$AE = 7.8 - 4.3$<br>$= 3.5 \text{ cm}$                                                                                                                                                                                                                                                                                                                                  |  |  |  |
|    |     | $\cos \angle BAD = \frac{3.5}{7.8}$<br>$\angle BAD = \cos^{-1} \frac{3.5}{7.8}$<br>$\approx 63.338^\circ$<br>$= 63.3^\circ \text{ (1 dp)}$                                                                                                                                                                                                                                                                                         |  |  |  |
|    | (b) | trapezium                                                                                                                                                                                                                                                                                                                                                                                                                          |  |  |  |
|    | (c) | To find $BE$ :<br>Method 1:<br>By Pythagoras' Theorem,<br>$BE^2 + AE^2 = AB^2$<br>$BE^2 + 3.5^2 = 7.8^2$<br>$BE = \sqrt{7.8^2 - 3.5^2}$<br>$= \sqrt{48.59}$<br>$\approx 6.9706 \text{ cm}$<br>Method 2:<br>$\sin 63.338^\circ = \frac{BE}{7.8}$<br>$BE = 7.8 \sin 63.338^\circ$<br>$\approx 6.9706 \text{ cm}$<br>Method 3:<br>$\tan 63.338^\circ = \frac{BE}{3.5}$<br>$BE = 3.5 \tan 63.338^\circ$<br>$\approx 6.9706 \text{ cm}$ |  |  |  |
|    |     | Area of trapezium                                                                                                                                                                                                                                                                                                                                                                                                                  |  |  |  |

|    |     |                                                                                                         |  |  |  |
|----|-----|---------------------------------------------------------------------------------------------------------|--|--|--|
|    |     | $= \frac{1}{2} (7.8 + 4.3) \times 6.9706$ $= 42.17213$ $= 42.2 \text{ cm}^2 \quad (3 \text{ sf})$       |  |  |  |
| 12 | (a) | $y = 3$                                                                                                 |  |  |  |
|    | (b) |                        |  |  |  |
|    | (c) | Gradient of $AB$<br>$= \frac{4}{5}$ Equation of line $AB$ :<br>$y = \frac{4}{5}x - 1$                   |  |  |  |
|    | (d) | Area of triangle<br>$= \frac{1}{2} \times 4 \times 5$ $= 10 \text{ units}^2$                            |  |  |  |
| 13 | (a) |                     |  |  |  |
|    | (b) | $E = kf$ where $k$ is a constant<br>$9 = k(6)$<br>$k = \frac{3}{2}$<br>$E = \frac{3}{2}f$ or $E = 1.5f$ |  |  |  |

|  |     |                                                                                          |  |  |  |  |  |
|--|-----|------------------------------------------------------------------------------------------|--|--|--|--|--|
|  | (c) | $E = \frac{3}{2}(5)$ $= 7.5$ <p>original length = <math>12 - 7.5</math><br/>= 4.5 cm</p> |  |  |  |  |  |
|--|-----|------------------------------------------------------------------------------------------|--|--|--|--|--|

|   |     |                                                                                                                                                                                                                                                                           |  |  |  |
|---|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| 1 | (a) | $(3-x)(2x-5)$ $= 6x - 15 - 2x^2 + 5x$ $= -2x^2 + 11x - 15$                                                                                                                                                                                                                |  |  |  |
|   | (b) | $8pq - (3p+q)^2$ $= 8pq - (9p^2 + 6pq + q^2)$ $= 8pq - 9p^2 - 6pq - q^2$ $= 2pq - 9p^2 - q^2$                                                                                                                                                                             |  |  |  |
| 2 | (a) | $\frac{24m^2n}{5n^2} \div \frac{16mn^2}{30n}$ $= \frac{24m^2n}{5n^2} \times \frac{30n}{16mn^2}$ $= \frac{9m}{n^2}$                                                                                                                                                        |  |  |  |
|   | (b) | $\frac{2}{1-4x^2} + \frac{2}{2x-1}$ $= \frac{2}{(1-2x)(1+2x)} + \frac{2}{2x-1}$ $= \frac{2}{(1-2x)(1+2x)} - \frac{2}{1-2x}$ $= \frac{2-2(1+2x)}{(1-2x)(1+2x)}$ $= \frac{2-2-4x}{(1-2x)(1+2x)}$ $= \frac{-4x}{(1-2x)(1+2x)} \quad \text{or} \quad \frac{4x}{(2x-1)(1+2x)}$ |  |  |  |

|   |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |  |  |
|---|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| 3 | (a) | $r = \frac{5}{3(-5)^2} - 8$                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
|   |     | $r = -7\frac{14}{15}$                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
|   | (b) | $r = \frac{5}{3a^2} - b$                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |  |
|   |     | $r + b = \frac{5}{3a^2}$                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |  |
|   |     | $3a^2(r + b) = 5$                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |  |  |
|   |     | $3a^2 = \frac{5}{r + b}$                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |  |
|   |     | $a^2 = \frac{5}{3(r + b)}$                                                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |
|   |     | $a = \pm \sqrt{\frac{5}{3(r + b)}}$                                                                                                                                                                                                                                                                                                                                                                                                                      |  |  |  |
| 4 | (a) | $\text{volume of cone} = \frac{1}{3} \times \pi \times \left(\frac{4.2}{2}\right)^2 \times h$ $= 1.47\pi h \quad \text{or} \quad 4.6181h$ $\text{volume of hemisphere} = \frac{2}{3} \times \pi \times \left(\frac{4.2}{2}\right)^3$ $= 6.174\pi \quad \text{or} \quad 19.396h$ $1.47\pi h + 6.174\pi = 56$ $h \approx 7.92609 \text{ cm}$ $H = 7.92609 + 2.1$ $= 10.0 \text{ cm (3 s.f.)}$                                                              |  |  |  |
|   | (b) | $\text{slant height } l = \sqrt{7.92609^2 + 2.1^2} \quad (\text{Pythagoras' Theorem})$ $= \sqrt{67.233}$ $= 8.1996 \text{ cm}^2 \quad (5 \text{ s.f.})$ $\text{curved surface area of cone} = \pi(2.1)(8.1996)$ $\approx 54.095 \text{ cm}^2$ $\text{curved surface area of hemisphere}$ $= 2(\pi)(2.1)^2$ $= 8.82\pi \quad \text{or} \quad 27.708$ $\text{Total surface area of toy}$ $= 8.82\pi + 54.095$ $= 81.8 \text{ cm}^2 \quad (3 \text{ s.f.})$ |  |  |  |

|   |     |                                                                                                                                                                         |  |  |  |
|---|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| 5 | (a) | $c = \frac{29-5}{6}$<br>$= 4$                                                                                                                                           |  |  |  |
|   | (b) | $4n+1$                                                                                                                                                                  |  |  |  |
|   | (c) | $4n+1=113$<br>$4n=112$<br>$n=28$                                                                                                                                        |  |  |  |
|   | (d) | Since $4n$ is even for all values of $n$ , adding 1 to $4n$ will become odd. Hence all the terms in the sequence are odd.                                               |  |  |  |
| 6 | (a) | $\frac{8}{x}$                                                                                                                                                           |  |  |  |
|   | (b) | $\frac{8}{x+2}$                                                                                                                                                         |  |  |  |
|   | (c) | $\frac{8}{x} - \frac{8}{x+2} = \frac{1}{3}$<br>$\frac{8(x+2)-8x}{x(x+2)} = \frac{1}{3}$<br>$\frac{8x+16-8x}{x(x+2)} = \frac{1}{3}$<br>$\frac{16}{x(x+2)} = \frac{1}{3}$ |  |  |  |
|   |     | $x(x+2)=16(3)$<br>$x^2+2x-48=0$ (shown)                                                                                                                                 |  |  |  |
|   | (d) | $(x+8)(x-6)=0$<br>$x=-8$ or $6$                                                                                                                                         |  |  |  |
|   | (e) | Time taken by Tom = $\frac{8}{6}$<br>$= \frac{4}{3}$<br>$= 1 \text{ hour } 20 \text{ minutes}$                                                                          |  |  |  |

|   |        |                                                                                                                                                                                          |  |  |  |
|---|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| 7 | (a)    | $p = -5(6)^2 + 40(6)$<br>$= 60$                                                                                                                                                          |  |  |  |
|   | (b)    | Correct scale<br>All points are plotted correctly<br>Smooth curve drawn                                                                                                                  |  |  |  |
|   | (c)    | draw $t=4$<br>Equation: $t=4$                                                                                                                                                            |  |  |  |
|   | (d)(i) | (4, 80)                                                                                                                                                                                  |  |  |  |
|   | (ii)   | Length of time = $6.25 - 1.75$<br>$= 4.5 \text{ s}$                                                                                                                                      |  |  |  |
| 8 | (a)    | $PR^2 = 125^2 = 15625$<br>$PQ^2 + RQ^2 = 75^2 + 100^2$<br>$= 15625$<br>Since $PR^2 = PQ^2 + RQ^2$ ,<br>by converse of Pythagoras' Theorem,<br>triangle $PQR$ is a right angled triangle. |  |  |  |
|   | (b)    | Shortest distance = $\sqrt{180^2 + 75^2}$<br>$= \sqrt{38025}$<br>$= 195 \text{ m (shown)}$                                                                                               |  |  |  |
|   | (c)    | $195\text{m} = 0.195\text{km}$<br>Time taken from P to S = $\frac{0.195}{2}$<br>$= \frac{39}{400}$ or 0.0975h<br>$= 5.85 \text{ minutes}$                                                |  |  |  |

- 9 (a)  $\angle ACB = \frac{180^\circ - 76^\circ}{2}$  (base angles of isos.  $\Delta$ )  
 $= 52^\circ$
- (b)(i)  $\angle CDE = \angle GDF = 52^\circ$   
(ii)  $\angle FGD = 180^\circ - 153^\circ$  (adj. angles on a str. line)  
 $= 27^\circ$   
 $\angle GFD = 180^\circ - 27^\circ - 52^\circ$  (angles sum of triangle)  
 $= 101^\circ$
- (c) Since  $\angle CDE = \angle CAB = 52^\circ$ ,  
 $\angle BCA = \angle ECD$  (vert. opp.  $\angle$ s)  
the corresponding angles of triangle  $CDE$  and triangle  $CAB$  are equal, hence triangle  $CDE$  and  $CAB$  are similar.

- 10 (a) Total cost  
 $= \$9.90 \times 5 - \$6 + \$1.99$   
 $= \$45.49$
- (b) Total cost if Brad buy on his own  
 $= \$9.90 \times 7 - \$8$   
 $= \$61.30$
- Total cost if they combined their purchase  
 $= \$9.90 \times 12 - \$10$   
 $= \$108.80$
- Total cost if they did not combine  
 $= \$61.30 + \$45.49$   
 $= \$106.79$

I disagree with their father as he will need to pay more overall/ it is cheaper to have separate purchases/ it is more expensive to combine purchases.