Geylang Methodist School (Secondary)
End-of-Year Examination 2022

Candidate Name			
Class		Index Number	

MATHEMATICS

Sec 2 Express

Paper 1

Candidates answer on the Question Paper. **1 hour 15 minutes**

Setter : Mr Wong Han Ming
Mr Kenneth Soh

06 Oct 2022

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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 in the space below the question.
Omission of essential working will result in the loss of marks.
The total number of marks for this paper is 50.

You are expected to use a scientific calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to 3 significant figures. Give answers in degrees to one decimal place.

For π, use either your calculator value or 3.142.

For Examiner's Use
50

This document consists of **13** printed pages and 3 blank pages.

[Turn over

Mathematical Formulae

Geometry and Measurement

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

Answer **all** the questions.

1 **(a)** Express 26.5% as a fraction in its simplest form.

Answer _____ [1]

(b) Express the ratio of 6 kg to 350 g in its simplest form.

Answer _____ : _____ [1]

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2 5 cm on a map represents 8 km on the ground.

(a) Calculate the distance between two houses, in km, which is represented by 5.5 cm on the map.

Answer _____ km [2]

(b) Calculate the area of a park on the map, in cm^2, if the actual area is 7.168 km^2.

Answer _____ cm^2 [2]

---

3 Simplify the following expressions.

(a) $\frac{3a}{4b} \times \frac{8b^3}{9a^2}$

Answer _____ [1]

(b) $\frac{3x-1}{x^2-5x-6} - \frac{2}{6-x}$

Answer _____ [3]

(c) $\frac{2x^2-8}{5y^3} \div \frac{6x-12}{10y}$

Answer _____ [3]

4 **(a)** A polygon has n sides.
Three of its exterior angles are 20°, 21° and 22°.
The remaining exterior angles are 27° each.
Find the value of n.

Answer $n =$ _____ [2]

(b) Find the sum of all its interior angles of the polygon in part **(a)**.

Answer _____ ° [2]

5 Expand and simplify the following completely.

(a) $x - 3(x + 2)$

Answer _____ [1]

(b) $(2a + 5)(a - 2) - (3a + 2)(2a - 5)$

Answer _____ [3]

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6 Given that $(x - y)^2 = 30$, and $xy = 3$, find the value of $x^2 + y^2$.

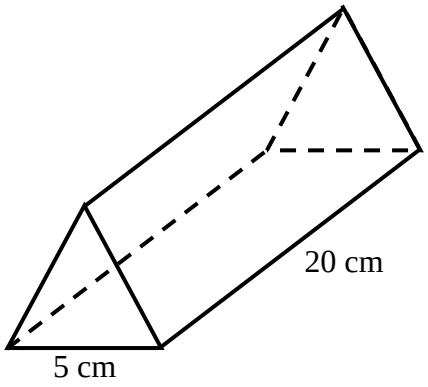
Answer _____ [3]

---

7 A handbag, originally priced at \$1599 was sold at a discount of x%.
If Janet bought the handbag for \$1327.17, find the value of x.

Answer $x =$ _____ [2]

8 A solid triangular prism, with an equilateral triangle cross-sectional area, is shown below.



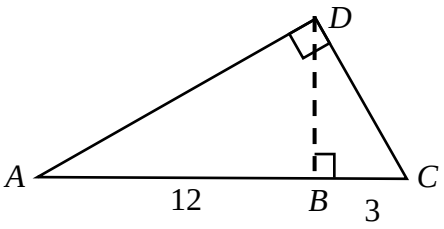
(a) Find the volume of the prism.

Answer _____ cm^3 [4]

(b) The prism is painted on all surfaces and the cost of painting 10 cm^2 of the prism is \$2.80. Calculate the total cost of painting the prism.

Answer \$ _____ [3]

9 A triangular field *ACD* is shown below. *AB* = 12 m, *BC* = 3 m and angle *DBC* = 90°. Triangle *ABD* is similar to triangle *DBC*.



(a) Find the length of *BD*.

Answer _____ m [3]

(b) A pole, *TA*, is erected at point *A*. The top of the pole, *T*, makes an angle of 20° with the horizontal at point *C*. Find the height of *TA*.

Answer _____ m [2]

10 Triangle *ABC* is such that *AB* = 8 cm, *BC* = 6 cm and *AC* = 12 cm.
Construct the triangle *ABC* in the space below.
The line *AB* has been drawn for you.
Measure the size of angle *ABC*.

Answer

A ——————————————— *B*

Angle *ABC* = _____ [3]

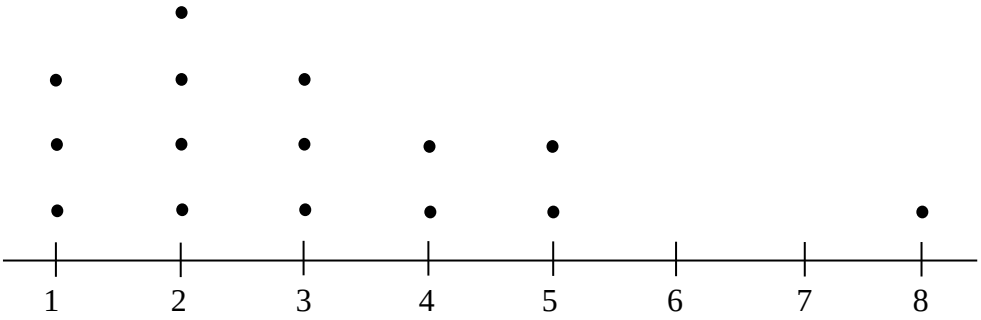
11 **(a)** It is given that y is inversely proportional to the square root of x, and that $y = 5$ when $x = 9$. Find the value of y when $x = 25$.

Answer $y =$ _____ [2]

(b) y is directly proportional to the cube of x.
$y = 10$ for a certain value of x.
Find the value of y when this value of x is increased by 200%.

Answer $y =$ _____ [2]

12 The dot diagram below represents the number of books read by 15 students in a month.



Number of books read

(a) State the modal number of books read.

Answer _____ books [1]

(b) Find the median number of books read.

Answer _____ books [1]

(c) Explain why finding the mean is not an appropriate average for this data set.

Answer

_____

_____ [1]

(d) Describe briefly the distribution of the data and what you can deduce from the data set.

Answer

_____

_____ [2]

END OF PAPER

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Geylang Methodist School (Secondary)
End – of – Year Examination 2022

Candidate Name			
Class		Index Number	

MATHEMATICS

Sec 2 Express

Paper 2

1 hour 15 minutes

Candidates answer on the Question Paper.

10 October 2022

Setter: Ms Tan Kai Wei

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
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Answer **all** questions.
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For π, use either your calculator value or 3.142.

The total number of marks for this paper is 50.

For Examiner's Use
50

Mathematical Formulae

Mensuration

Curved surface area of a cone $= \pi rl$

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

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

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

1 It is given that $a = \dfrac{2b-3c}{b+2c}$.

(a) Find a when $b = 1$ and $c = -2$.

Answer $a =$ _____ [1]

(b) Express b in terms of a and c.

Answer _____ [2]

2 Solve the following simultaneous equations.

$x + 2y - 2 = 0$
$1.5x - y - 5 = 0$

Answer $x =$ _____
$y =$ _____ [3]

3 There are 15 girls and x boys in a group. The probability of selecting a boy randomly from the group is $\frac{3}{8}$.

(a) Find the value of x.

Answer $x =$ _____ [2]

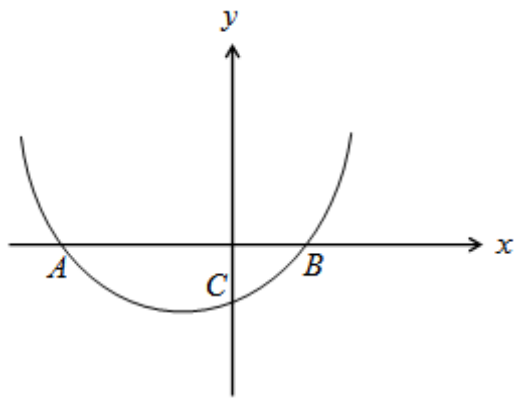
(b) How many **more** boys are needed to join the group so that the probability of selecting a boy randomly is $\frac{5}{8}$?

Answer _____ boys [2]

4 Solve $(3x+7)(x-3)=-x-11$.

Answer $x =$ _____ or _____ [3]

5 The diagram shows the graph of $y = x^2 + 2x - 8$.
The graph cuts the x-axis at A, B and the y-axis at C.



(a) Find the coordinates of A, B and C.

Answer A (,) [1]

B (,) [1]

C (,) [1]

(b) Write down the equation of the line of symmetry of the graph.

Answer _____ [1]

6 The variables x and y are connected by the equation $y = -x^2 + 4x - 3$.
Some corresponding values of x and y are given in the following table.

x	–2	–1	0	1	2	3	4
y	–15	p	–3	0	1	0	–3

(a) Find the value of p.

Answer $p =$ _____ [1]

(b) Answer part (b) on the sheet of graph paper on the next page.

On the axes provided, plot the points given in the table and join them with a smooth curve. [3]

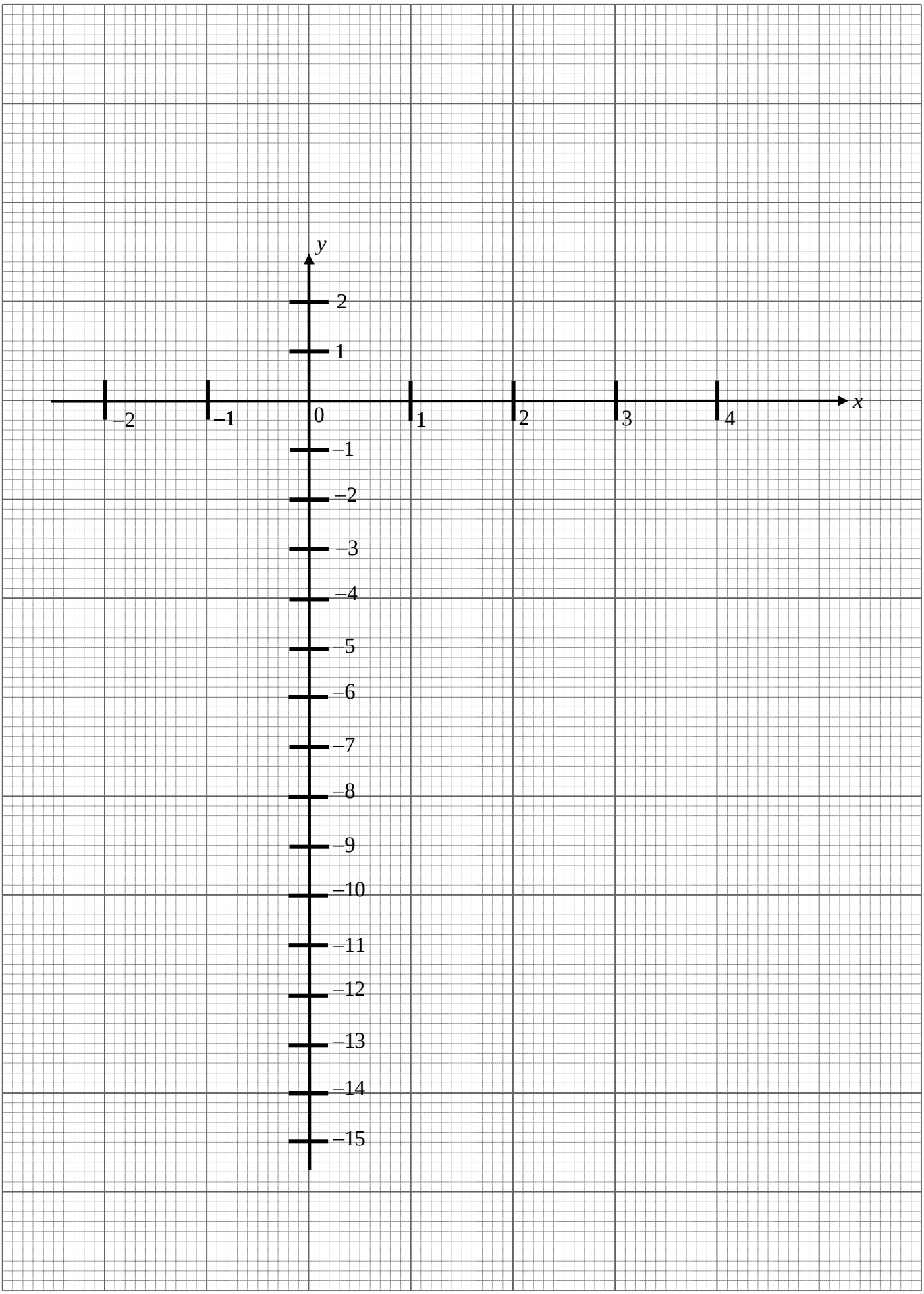
(c) Use your graph to estimate

(i) the values of x when $y = -1.5$,

Answer $x =$ _____ or $x =$ _____ [2]

(ii) the maximum value of y.

Answer $y =$ _____ [1]


y
x
2
1
0
−1
−2
−3
−4
−5
−6
−7
−8
−9
−10
−11
−12
−13
−14
−15
−2
−1
1
2
3
4

7 A shop sells yoghurt in cups as shown in Figure 1.

The cup can be modelled as a frustum, which is a part of a right circular cone, as shown in Figure 2.

The top of the cup is a circle of radius 5 cm. The base of the cup is a circle of radius 2 cm. The height of the cup is 9 cm.

All dimensions are given in centimetres.

Figure 1

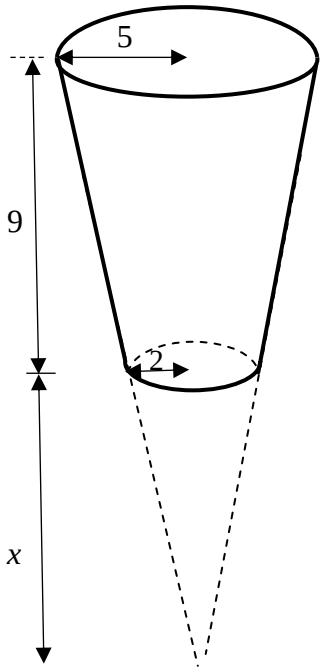


Figure 2

(a) Show that the value of x is 6. [1]

Answer

(b) Find the volume of the frustum.

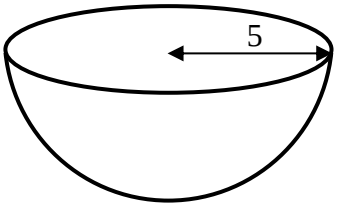
Answer _____ cm^3 [2]

(c) A plastic packaging will be printed around the side of the yoghurt cup. Each cm^2 of plastic packaging costs 0.1 cents.

Find the cost of the plastic packaging for each yoghurt cup in dollars. Leave your answer to two decimal places.

Answer $ _____ [3]

(d) The shop also sells yoghurt in a bowl. The bowl can be modelled as a hemisphere with radius 5 cm.



The prices for the yoghurt is as shown below:

Yoghurt in a cup	$1.80
Yoghurt in a bowl	$1.60

Determine if the yoghurt sold in a cup or a bowl is a better buy.

Answer

_____ is a better buy because _____

_____ [3]

8 **(a)** Solve the inequality $\frac{2(x+3)}{3} < x-2$.

Answer _____ [2]

(b) Represent the solution on a number line.

Answer

[1]

(c) Hence write down the smallest possible value of x if x is

(i) a prime number,

Answer $x =$ _____ [1]

(ii) a perfect square.

Answer $x =$ _____ [1]

9 A factory uses an automated machine to fill up orange juice in cartons and plastic bottles. It takes x minutes to fill up one orange juice carton.

(a) Write down in terms of x, an expression for the number of orange juice cartons that can be filled up in an hour.

Answer _____ [1]

(b) The process will take 1 minute longer if the orange juice is packed into a plastic bottle. Write down in terms of x, an expression for the number of orange juice bottles that can be filled up in an hour.

Answer _____ [1]

(c) Orange juice is packed into cartons and bottles at the same time.
A total of 50 cartons and bottles can be packed in an hour.
Form an equation in terms of x and show that it reduces to $5x^2 - 7x - 6 = 0$.

Answer [2]

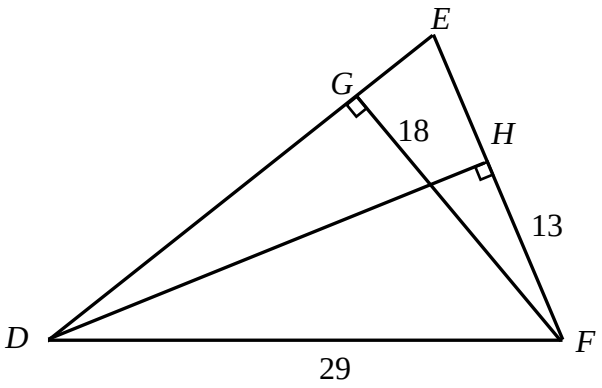
(d) Solve the equation to find the values of x.

Answer $x =$ _____ or $x =$ _____ [2]

(e) Hence, find the number of orange juice bottles that can be filled up in an hour.

Answer _____ bottles [1]

10 In triangle *EDF*, *GF* is perpendicular to *DE* and *DH* is perpendicular to *EF*.
DF = 29 cm, *GF* = 18 cm and *HF* = 13 cm.



(a) Find angle *DEF* .

Answer _____ ° [3]

(b) Find the length of *EH*.

Answer _____ cm [2]

END OF PAPER

Answers for EOY Sec 2E P1

1a	$\frac{53}{200}$	B1
1b	120 : 7	B1
2a	5 cm : 8 km 1 cm : 1.6 km 5.5 cm : 8.8 km	 M1 A1 (accept B2)
2b	Area scale is 25 cm^2 : 64 km^2 (accept 1 cm^2 : 2.56 km^2) Hence, if actual area is 7.168 km^2, area on map $= \frac{25}{64} \times 7.168$ = 2.8 cm^2	 M1 for correct area scale A1
3a	$\frac{3a}{4b} \times \frac{8b^3}{9a^2} = \frac{2b^2}{3a}$	A1 for correct numerical fraction A1 for correct algebraic fraction
3b	$\frac{3x-1}{x^2-5x-6} - \frac{2}{6-x} = \frac{3x-1}{(x-6)(x+1)} - \frac{2}{6-x}$ $= \frac{3x-1}{(x-6)(x+1)} + \frac{2}{x-6}$ $= \frac{3x-1}{(x-6)(x+1)} + \frac{2(x+1)}{(x-6)(x+1)}$ $= \frac{3x-1+2x+2}{(x-6)(x+1)}$ $= \frac{5x+1}{(x-6)(x+1)}$	M1 for factorising quad denominator. M1 for ability to recognise to change sign correctly for the 2nd fraction A1
3c	$\frac{2x^2-8}{5y^3} \div \frac{6x-12}{10y}$ $= \frac{2(x^2-4)}{5y^3} \times \frac{10y}{6x-12}$ $= \frac{2(x-2)(x+2)}{5y^3} \times \frac{10y}{6(x-2)}$ $= \frac{2(x+2)}{3y^2}$	M1 for factorising common factor 6 M1 for factorising by special product A1

4a	Number of 27° angles = (360 – 20 – 21 – 22) ÷ 27 = 297 ÷ 27 = 11 Therefore, n = 11 + 3 = 14	 M1 M1 A1
4b	Sum of all interior angles = (14 – 2) x 180 = 2160°	 M1 A1

5a	$x - 3(x + 2)$ $= x - 3x - 6$ $= -2x - 6$	 B1
5b	$(2a + 5)(a - 2) - (3a + 2)(2a - 5)$ $= 2a^2 - 4a + 5a - 10 - (6a^2 - 15a + 4a - 10)$ $= 2a^2 - 4a + 5a - 10 - 6a^2 + 11a + 10$ $= -4a^2 + 12a$	M1 for expanding any one quad correctly M1 for removing the bracket after the operation of subtraction. A1
6	$(x-y)^2 = x^2 - 2xy + y^2$ $x^2 - 2xy + y^2 = 30$ $x^2 - 2(3) + y^2 = 30$ $x^2 + y^2 = 30 + 6$ $x^2 + y^2 = 36$	M1 for correct expansion of the special product M1 for subbing $xy = 3$ correctly A1
7	Discount = 1599 – 1327.17 = \$271.83 $x = \frac{271.83}{1599} \times 100\%$ = 17%	 M1 for any acceptable method A1
8a	Let the height of the triangle be h. Then, $h^2 + 2.5^2 = 5^2$ $h^2 = 25 - 6.25$ h = sqrt(18.75) = 4.3301 Vol = (0.5 x 5 x 4.3301) x 20 = 216.5063509 cm² = 217 cm^2 (correct to 3sf)	 M1 for recognising Pythagoras' Theorem as the (accept use TOA CAH SOH to find the perpendicular height) M1 for finding h M1 for using the prism volume correctly A1
8b	Area of 3 rectangular sides = (5 × 20) × 3 = 300 Area of 2 triangles $= = (\frac{1}{2} \times 5 \times 4.3301) \times 2$ = 21.6506 Total surface area = 300 + 21.6506 = 321.6506 cm²	M1 for any each correct calculation M1

	Total cost = 321.6506 × (2.80 ÷ 10) = \$90.06 (nearest cents)	A1
9a	Ratio of $\frac{AB}{BD} = \frac{BD}{BC}$ $\frac{12}{BD} = \frac{BD}{3}$ $(BD)^2 = 36$ $BD = 6$	M1 for the ability to use the correct ratio M1A1 for finding the value of *BD*. Note: if a student uses inspection, full 3 marks can be awarded only if at least one step of using ratio to verify is show explicitly. Otherwise, 1 m only.
9b	$\tan 20^\circ = \frac{opp}{adj} = \frac{\text{height}}{15}$ Height = $15 \tan 20^\circ$ = 5.45955 m = 5.46 m	M1 A1
10	Construction	B1, B1 for each of the lines *BC* and *AC*. A1 for correct angle. +/- 1 degree
11a	$y\sqrt{x} = k$ $5\sqrt{9} = k$ $k = 15$ $y\sqrt{25} = 15$ $5y = 15$ $y = 3$	M1 A1
11b	$y = kx^3$ $10 = kx^3$ When *x* increases by 200%, *x* is now 3*x*. $y_{new} = k(3x)^3$ $= 27kx^3$ = 27(10) = 270	M1 for identifying 3*x* or triple the value of *x*. A1

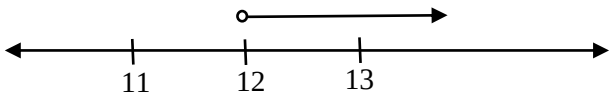
12a	2	B1
12b	3	B1
12c	The value 8 is an outlier and will increase the mean significantly. Hence, it will not be a good indication of the central tendency of the data set.	B1 for any other reasonable remarks. Key word is **value 8** "gap between 5 to 8" "no value for 6 and 7" without explaining that it will increase the mean will not get marks.
12d	The data clusters around 2 to 3 books There is a peak at 2 books The data ranges from 1 to 8 books There is a gap between 6 to 8 books Students should read more books. Students read too little. Students reads book every month.	B1 for any 1 reasonable observation (not limited to the examples given) B1 for deduction (statement should be general and not specific)

Answers for 2022 Sec 2E EOY P2

1a	$a = \frac{2b-3c}{b+2c}$ $= \frac{2(1)-3(-2)}{(1)+2(-2)}$ $= -\frac{8}{3}$	B1
1b	$a = \frac{2b-3c}{b+2c}$ $a(b+2c) = 2b-3c$ $ab+2ac = 2b-3c$ $ab-2b = -3c-2ac$ $b(a-2) = -3c-2ac$ $b = \frac{-3c-2ac}{a-2}$	M1 (for forming linear equation) A1
2	$x+2y-2=0-(1)$ $\frac{3x}{2}-y-5=0-(2)$ From (1): $x = 2-2y-(3)$ Sub (3) into (2): $\frac{3(2-2y)}{2}-y-5=0$ $3(2-2y)-2y-10=0$ $6-6y-2y-10=0$ $-8y=4$ $y=-\frac{1}{2}$ Sub $y=-\frac{1}{2}$ into (3): $x = 2-2(-\frac{1}{2}) = 3$	M1 – For using substitution / elimination method (attempt to form a new equation with just 1 variable) A1 – value for y A1 – value for x

3a	$\frac{x}{15+x}=\frac{3}{8}$ $8x=45+3x$ $5x=45$ $x=9$	M1 – for showing $\frac{x}{15+x}=\frac{3}{8}$ A1
3b	Let y be the number of boys added. $\frac{9+y}{24+y}=\frac{5}{8}$ $5(24+y)=8(9+y)$ $120+5y=72+8y$ $-3y=-48$ $y=16$	M1 – for showing $\frac{9+y}{24+y}=\frac{5}{8}$ A1
4	$(3x+7)(x-3)=-x-11$ $3x^2-2x-21=-x-11$ $3x^2-x-10=0$ $(3x+5)(x-2)=0$ $x=-\frac{5}{3}$ or $x=2$	M1 – for expanding $(3x+7)(x-3)$ correctly A1 x2 for each value of x
5a	$y=x^2+2x-8$ To find coordinates of A and B: $y=0$ $0=x^2+2x-8$ $0=(x+4)(x-2)$ $x=-4$ or $x=2$ A (-4 , 0) B (2 , 0) To find coordinates of C: $x=0$ $y=(0)^2+2(0)-8$ $=-8$ C (0 , -8)	B1 – for coordinates of A B1 – for coordinates of B B1 – for coordinates of C
5b	$x=-1$	B1

6a	$p = -8$	
6b	Quadratic graph	B1 – smooth curve passing through all points B1 – correct plotting of points B1 – labelling of graph
6ci	$x = 0.4$ or 3.6	B1 $\times 2$ for each value read off the graph
6cii	$y = 1$	B1
7a	$\frac{2}{5} = \frac{x}{x+9}$ $5x = 2x + 18$ $3x = 18$ $x = 6$ (shown)	B1
7b	Volume of frustum $= \frac{1}{3}\pi(5)^2(15) - \frac{1}{3}\pi(2)^2(6)$ $= 367.5663405$ $= 368 \text{ cm}^2$ (3sf)	M1 – for any 1 correct volume seen A1
7c	Slant height of larger cone $= \sqrt{15^2 + 5^2}$ $= \sqrt{250}$ Slant height of smaller cone $= \sqrt{6^2 + 2^2}$ $= \sqrt{40}$ Curved surface area of frustum $= \pi(5)(\sqrt{250}) - \pi(2)(\sqrt{40})$ $= 208.6263536$ Cost $= 208.6263536 \times \frac{0.1}{100}$ $= \$0.2086263536$ $= \$0.21$ (2dp)	M1 – for finding either slant height M1 – for finding curved surface area of frustum A1 – for finding cost

7d	Volume of hemisphere bowl $= \frac{2}{3}\pi(5)^3$ $= 261.7993878 \text{ cm}^3$ Amt of yoghurt per \$ (in cup) $= 367.5663405 \div 1.80$ $= 204.2035 \text{ cm}^3 / \$$ Amt of yoghurt per \$ (in bowl) $= 261.7993878 \div 1.60$ $= 163.6246 \text{ cm}^3 / \$$ <u>Yoghurt in a cup is a better buy</u> because there is more yoghurt per dollar paid.	M1 – volume of hemisphere M1 – Amt of yoghurt per \$ (in both cup and bowl) A1 awarded only if method is reasonable Accept alternative method if students find the cost of the yoghurt per cm^3.
8a	$\frac{2(x+3)}{3} < x-2$ $2x+6 < 3x-6$ $-x < -12$ $x > 12$	M1 – cross multiplying A1 – correct inequality sign
8b		B1 – for circle and arrow pointing right
8ci	$x = 13$	B1
8cii	$x = 16$	B1

9a	$\frac{60}{x}$	B1
9b	$\frac{60}{x+1}$	B1
9c	$\frac{60}{x}+\frac{60}{x+1}=50$ $\frac{60x+60+60x}{x(x+1)}=50$ $120x+60=50x^2+50x$ $50x^2-70x-60=0$ $5x^2-7x-6=0$ (shown)	M1 – combining into one fraction M1 – simplifying
9d	$(5x+3)(x-2)=0$ $x=-\frac{3}{5}$ or $x=2$	M1 – factorizing A1 – both values of x
9e	20 bottles	B1
10a	$\angle HFD$ $=\cos^{-1}(\frac{13}{29})$ $=63.36688°$ $\angle GDF$ $=\sin^{-1}(\frac{18}{29})$ $=38.36651°$ $\angle DEF$ $=180-63.36688-38.36651$ $=78.26661$ $=78.3°$ (1dp)	M1 M1 A1
10b	$DH=\sqrt{29^2-13^2}$ $=25.92296$ $\tan 78.26661=\frac{25.92296}{EH}$ $EH=5.38414$ $=5.38$cm (3sf)	M1 – length of DH A1 – length of EH