Name:	Class:	Class Register Number:

CHUNG CHENG HIGH SCHOOL (MAIN)

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PRELIMINARY EXAMINATION 2022

SECONDARY 4

MATHEMATICS 4048/02

Paper 2 **Wednesday 31 August 2022**

2 hours 30 minutes

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

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

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an approved scientific calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

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.

The total number of marks for this paper is 100.

For Examiner's Use	
Question Number	Marks Obtained
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total Marks	

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

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

[Turn over for Question 1]

1 **(a)** Express as a single fraction in its simplest form $\frac{x}{6}-\frac{3(x-1)}{8}$.

Answer …….. [2]

(b) Simplify $\left(\frac{27b^6}{w^9}\right)^{-\frac{1}{3}}$.

Answer …….. [2]

(c) Simplify $\frac{5p^2-12p+4}{25p^2-20p+4}$.

Answer …….. [3]

(d) Solve the equation $\frac{3}{x-2}+\frac{1}{2-x}=1$.

Answer …….. [3]

2 A is the point $(-5, -2)$ and B is the point $(-1, 3)$.

(a) Find the distance between point A and point B.

Answer …….. units [2]

(b) Line p passes through point A and point B.

Show that the equation of line p is $4y = 5x + 17$.

Answer

[3]

(c) The equation of line q is $8y - 7x = 43$.

Find the coordinates of the point of intersection of line p and line q.

Answer (……. , ……) [3]

(d) The equation of another line r is $2y - 2.5x = k$, where k is a constant and $k \neq 8.5$.
Without solving algebraically, explain why line p and line r will never meet.

Answer

……...

……...

……. [2]

3 An empty pool has a capacity of 20 000 litres.

Hose *A* can fill the pool at a rate of x litres per minute.

Hose *B* can fill the pool at a rate of $(x - 8)$ litres per minute.

(a) Write down an expression, in terms of x, for the number of minutes it would take to fill the pool using hose *A*.

Answer …… minutes [1]

(b) Write down an expression, in terms of x, for the number of minutes it would take to fill the pool using hose *B*.

Answer …… minutes [1]

(c) It takes 2 hours longer to fill the pool using hose *B* than it does using hose *A*.

Write down an equation to represent this information and show that it reduces to

$$3x^2 - 24x - 4000 = 0 .$$

(d) Solve the equation $3x^2 - 24x - 4000 = 0$, giving your solutions correct to two decimal places.

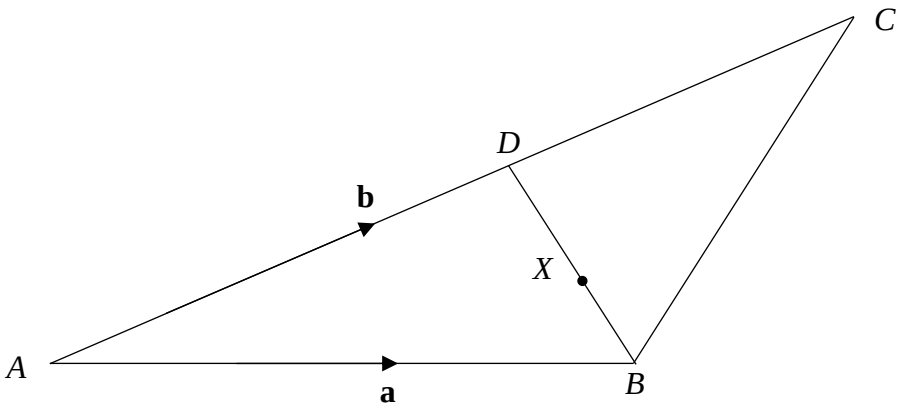
Answer x = ……..…..… or .……. [3]

(e) Calculate how long it would take to fill the empty pool using hose *A* and hose *B* together.

Give your answer in hours and minutes, correct to the nearest minute.

Answer ....……hours ……minutes [2]

4



ABC is a triangle where *D* is a point on *AC*.

$\overrightarrow{AB} = \mathbf{a}$, $\overrightarrow{AC} = \mathbf{b}$ and *AD* : *D*C = 3 : 2.

X is a point on *BD* such that *BX* : *XD* = 1 : 2 .

(a) Express, as simply as possible, in terms of **a** and/or **b**,

(i) $\overrightarrow{CB}$,

Answer …….. [1]

(ii) $\overrightarrow{DB}$,

Answer …….. [2]

(iii) $\overrightarrow{CX}$.

Answer …….. [2]

(b) Y is a point on AB such that $ADXY$ is a trapezium.

(i) Explain why $\overrightarrow{XY}$ is not parallel to $\overrightarrow{CX}$.

……

……

…… [1]

(ii) Prove that triangles BXY and BDA are similar.

Give a reason for each statement you make.

……

……

……

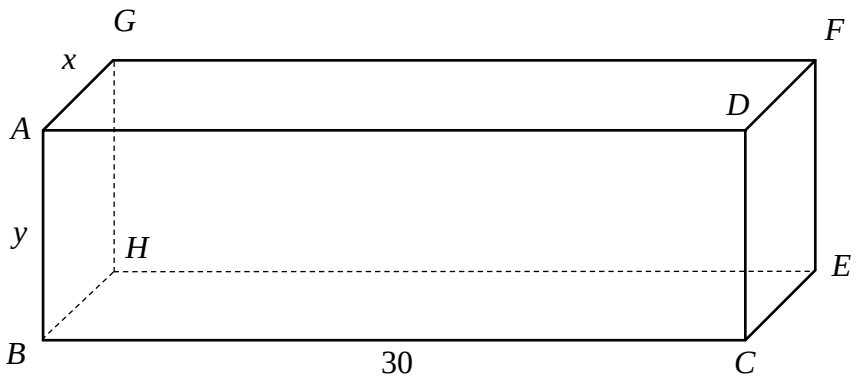
……

…… [3]

(iii) Find the ratio of the areas triangle BXY : trapezium $ADXY$.

Answer …… : …….. [2]

5



The diagram shows a cuboid of length 30 cm.

The width of the cuboid is x cm.

The height of the cuboid is y cm.

The surface area of the cuboid is 1200 cm^2.

(a) Find an expression, in terms of x, for y.

Answer $y =$ …….. [3]

(b) Show that the volume of the cuboid, V cm^3, is given by $V = \dfrac{18000x - 900x^2}{x + 30}$.

Answer

[2]

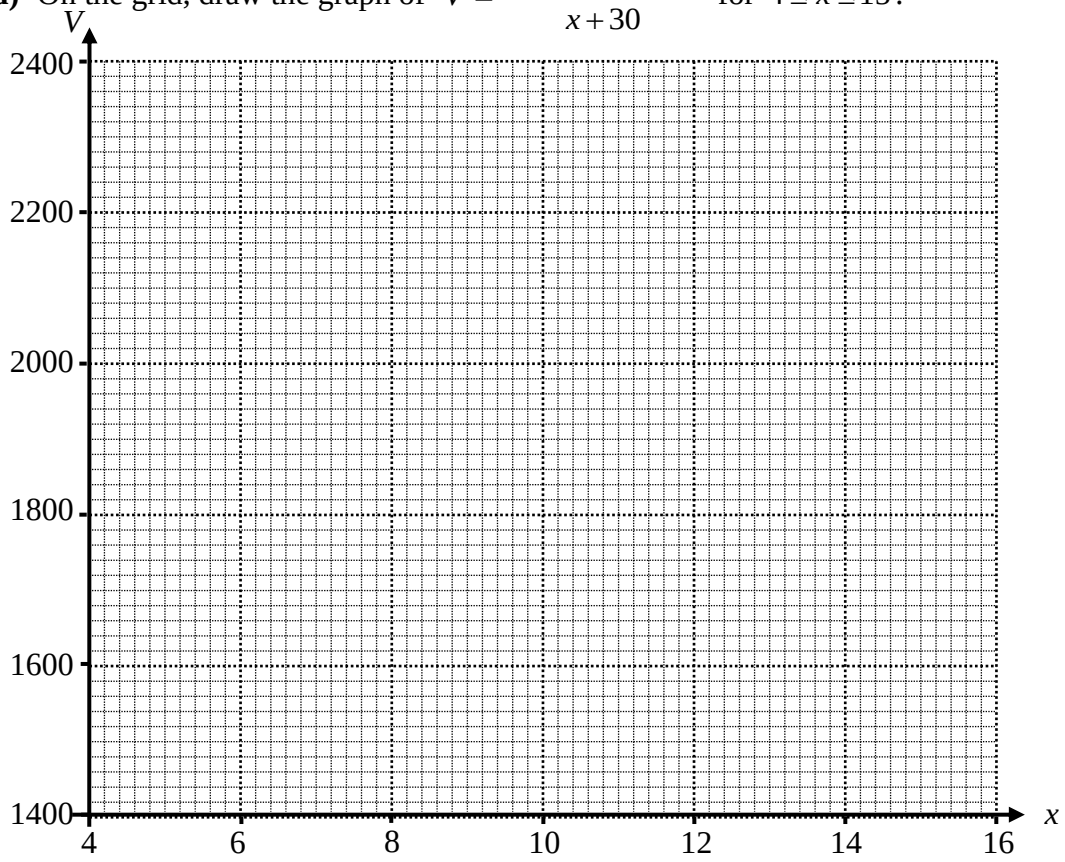
(c) Complete the table of values for $V = \dfrac{18000x - 900x^2}{x + 30}$.

Values are given to the nearest whole number.

x	4	6	8	10	12	14	15
V	1694	2100		2250	2057	1718	1500

[1]

(d) On the grid, draw the graph of $V = \dfrac{18000x - 900x^2}{x + 30}$ for $4 \le x \le 15$.



[3]

(e) Use your graph to find the greatest value of x when the volume is equal to 2000 cm^3.

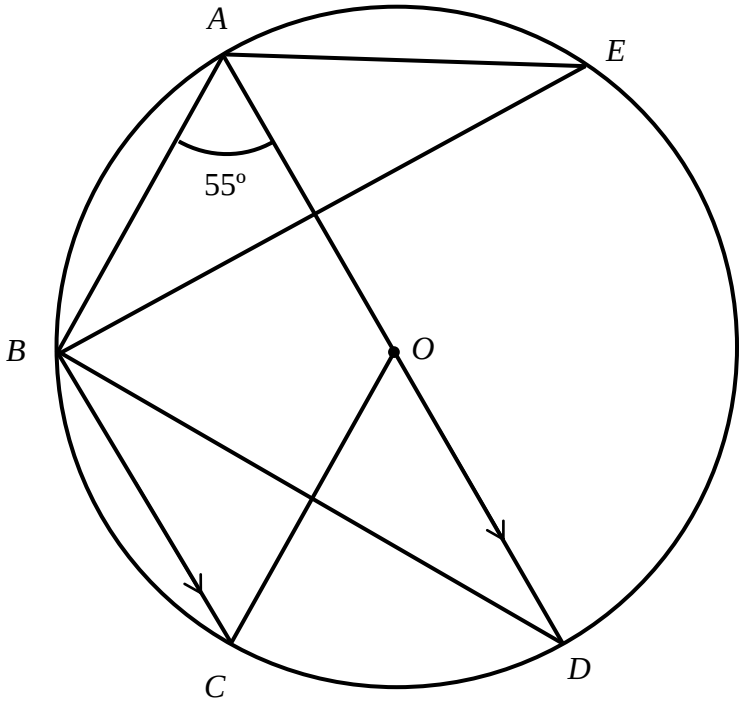
Answer $x =$ ..... [1]

(f) Explain how the graph shows that there is no solution to the equation

$$18000x - 900x^2 = 2400x + 72000.$$

..... [2]

6 (a)



In the diagram, O is the centre of the circle. Angle $BAO = 55^\circ$. BC is parallel to OD. AD is a straight line passing through O.

Find, giving reasons for each answer,

(i) angle ABD,

Answer …..……º [1]

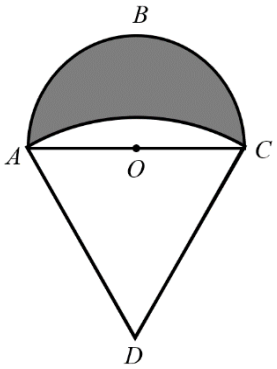
(ii) angle AEB,

Answer …..……º [2]

(iii) angle *AOC*.

Answer …..……° [3]

(b)

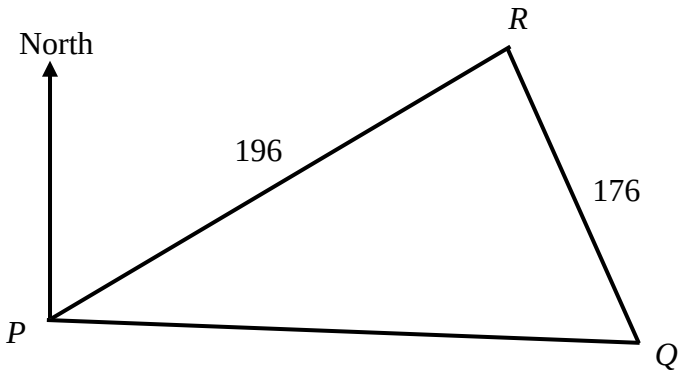


The diagram shows a sector *DAC* of the circle, centre *D*. Angle *ADC* = θ radians . *ABC* is a semi-circular arc, centre *O*, with radius *r* cm. *ACD* is an equilateral triangle.

Calculate the percentage of the diagram that is shaded.

Answer ….……% [5]

7



The diagram shows the positions of three buildings *P*, *Q* and *R* in a school.

R is 196 m from *P* on a bearing of 048º.

Q is 176 m from *R* on a bearing of 155º.

(a) Show that *PQ* = 222 m, correct to 3 significant figures.

Answer

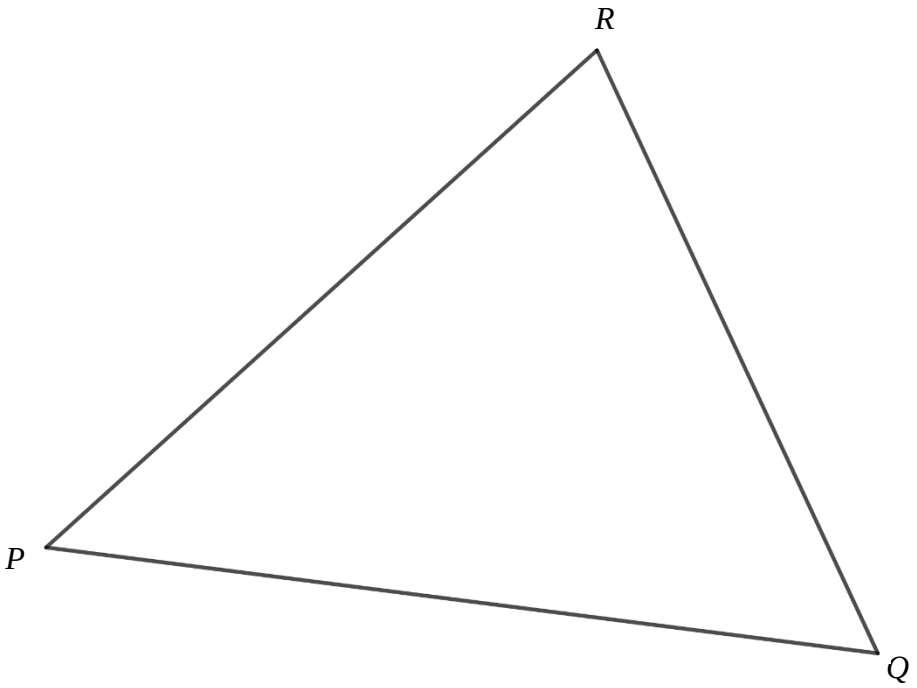
[4]

(b) Calculate the bearing of *P* from *Q*.

Answer.....º [3]

(c) The diagram below shows a scale drawing of the positions of the three buildings *P*, *Q* and *R* in the same school.

Scale: 1 cm represents 20 m



(i) On the diagram, construct the bisector of angle *PQR*. [1]

A new building, *S*, will be added to the school.

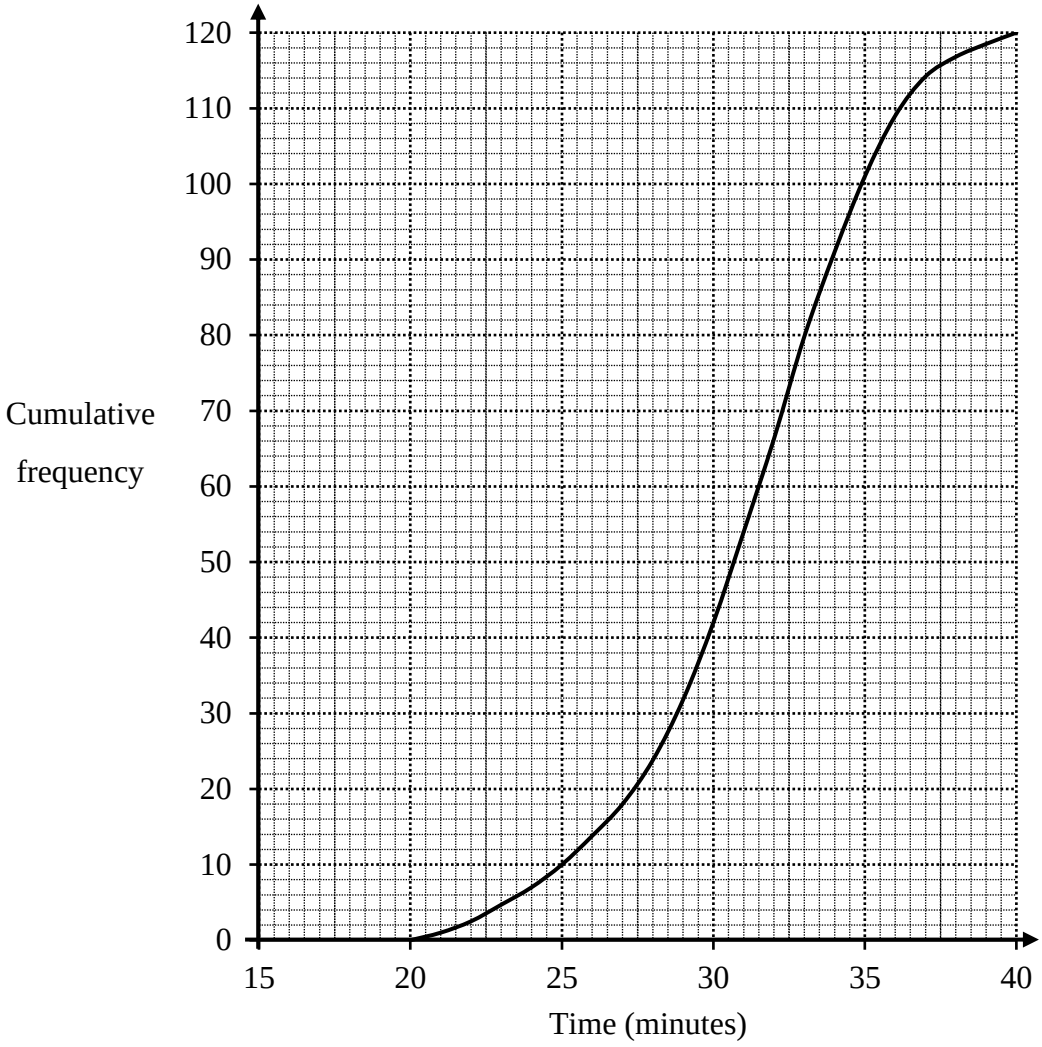
(ii) *S* is to be equidistant from *Q* and from *R*. By making a suitable construction, show the possible positions of *S* on the diagram. [1]

(iii) Given further that *S* is equidistant from *PQ* and from *QR*, find the actual distance of *S* from *P*.

Answer ....…… m [1]

8 **(a)** Marc records his traveling time to school for 120 days.

The cumulative frequency curve summarises the results.



(i) Use the graph to find

(a) the median time,

Answer …… minutes [1]

(b) the interquartile range of the times,

Answer …… minutes [2]

(c) the number of days his journey took more than half an hour.

Answer …… days [1]

(ii) Marc found a way to cut his traveling time by 5 minutes each day.

Describe the effect this change would have on the cumulative frequency curve.

……...

…….. [1]

(b) There are $(2n + 6)$ blue balls, $(27 – n)$ yellow balls and $(n – 3)$ red balls in a bag.

A ball is drawn at random.

(i) Find, in terms of n, the probability that a blue ball is drawn.

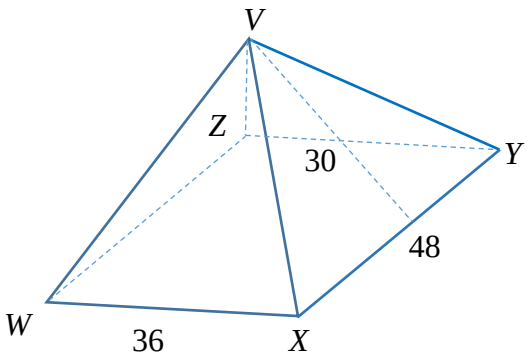
Answer …….. [1]

(ii) The probability that a yellow ball or a red ball is drawn is $\frac{6}{13}$.

Find, as a fraction in its simplest form, the probability that a red ball is drawn.

Answer …….. [3]

9



The diagram shows a pyramid *VWXYZ*.

The base of the pyramid is a rectangle of sides 36 cm by 48 cm.

V is vertically above the centre of the rectangular base.

The slant height of the pyramid is 30 cm.

(a) Find the vertical height of the pyramid.

Answer ..... cm [2]

(b) Find the largest angle of elevation of *V* from any point on the sides of the rectangle *WXYZ*.

Answer .....° [2]

(c) A smaller, geometrically similar pyramid of 64 cm^3 is removed from the top of the original pyramid. Find the vertical height of the smaller pyramid.

Answer .....…… cm [3]

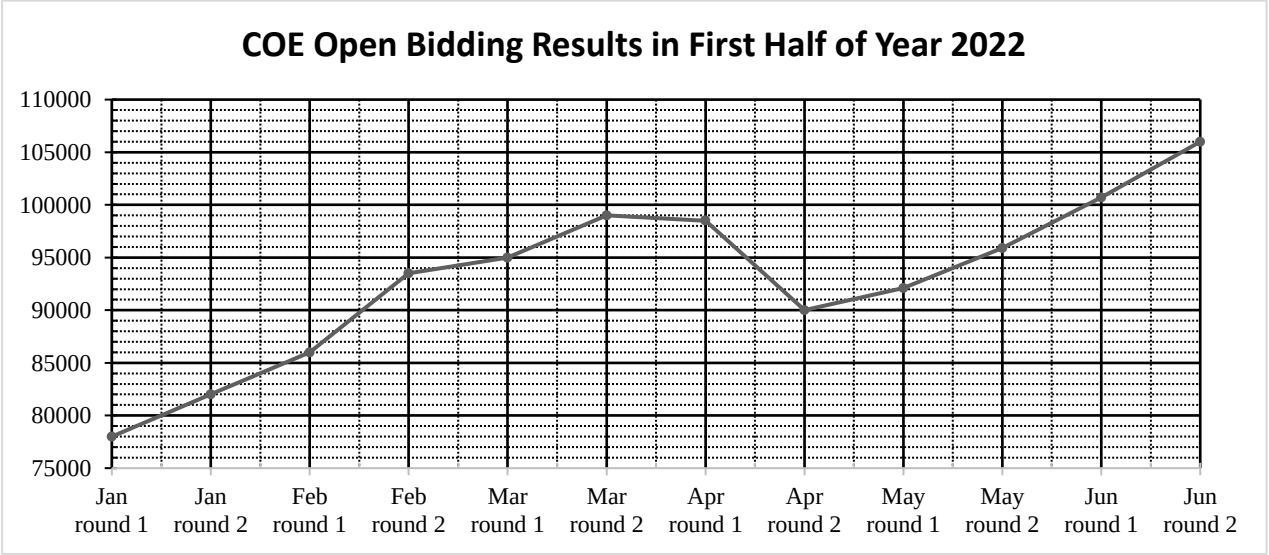
10 Paul intends to buy a car.

He wants to work out how much he needs to pay for his car monthly.

He finds the information below to help him work out the cost of his desired car.

Cost of Desired Car

Components	**Cost**
Certificate of Entitlement (COE)	Depending on the COE open bidding results
Open Market Value	$16 356
Excise Duty	$3 313
GST of 7% on the combined value of Open Market Value + Excise Duty	$1376.83
Registration Fee	$250
Other Charges	$7 604



(a) Write down the price of the Certificate of Entitlement (COE) for March round 2.

Answer $ …….. [1]

(b) Use the graph to find the percentage increase in price of the COE from the lowest price to the highest price in the first half of year 2022.

Answer ….……% [3]

(c) Paul wishes to buy the car on hire purchase in July.

He will make a down-payment of one fifth of the cost of the car and take out a loan on the remaining sum over 7 years at a flat (simple) interest rate of 3% per annum.

Paul predicts that the price of the COE is unlikely to go down in the next round of bidding. He also finds this information about other car expenses that he may incur.

Other car expenses	**Cost per month**
Road tax	$48.67
Insurance	$300
Petrol	$380
Parking & Electronic Road Pricing (ERP)	$360

Suggest a suitable amount of money he should set aside monthly for the new car.
Justify any decisions you make and show your calculations clearly.

……...

..…… [6]

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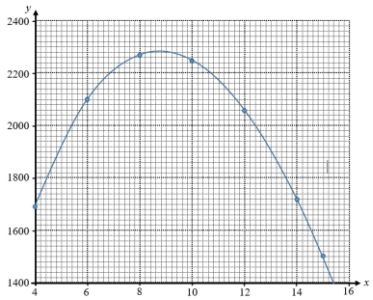
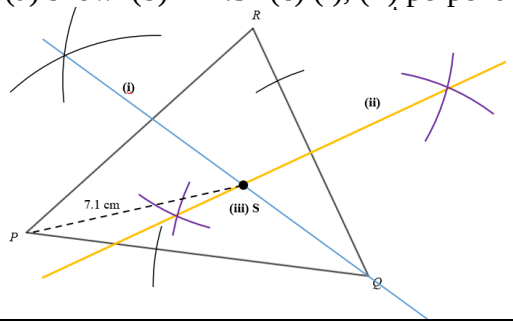
Answer Key

1	(a) $\frac{9-5x}{24}$ (b) $\frac{w^3}{3b^2}$ (c) $\frac{p-2}{5p-2}$ (d) $x = 4$
2	(a) 6.40 units (b) Show (c) (3, 8) (d) Since line r and line p have the same gradient, they are parallel lines or lines that overlap. As $2k \neq 17$, they do not have the same y-intercept and are parallel lines. Therefore, line p and line r will never meet.
3	(a) $\frac{20000}{x}$ (b) $\frac{20000}{x-8}$ (c) Show (d) 40.37 or −32.73 (e) 4 h 32 mins
4	(i) $\mathbf{a}-\mathbf{b}$ (ii) $\mathbf{a}-\frac{3}{5}\mathbf{b}$ (iii) $\frac{2}{3}\mathbf{a}-\frac{4}{5}\mathbf{b}$ (b)(i) Since XY is parallel to AC, $\overrightarrow{XY} = k\,\mathbf{b}$, where k is a constant. Hence, $\overrightarrow{XY} \neq m\overrightarrow{CX}$, where m is a constant . $\overrightarrow{XY}$ is not parallel to $\overrightarrow{CX}$. (ii) $\angle BXY = \angle BDA$ (corresponding angles, $XY // DA$) $\angle YBX = \angle ABD$ (common angle) By AA similarity test, triangles BXY and BDA are similar. (iii) 1 : 8
5	(a) $y = \frac{600-30x}{x+30}$ (b) show (c) 2274 (d)  (e) 12.4 ± 0.2 (f) $\frac{18000x-900x^2}{x+30} = 2400$ Since the maximum volume from the graph is about 2290 cm^3, the volume cannot be equal to 2400 cm^3. There is no solution to the equation.
6	(a)(i) 90° (ii) 35° (iii)110° (b) 36.6%
7	(a) show (b) 227.3° (c) (i), (ii) perpendicular bisector of QR (iii) 142 ± 0.2 m 
8	(a)(i)(a) 31.5 mins (b) 5.25 mins (c) 78 days (ii) The cumulative frequency curve will shift to the left by 5 minutes. (b)(i) $\frac{n+3}{n+15}$ (ii) $\frac{2}{13}$
9	(a) 24 cm (b) 53.1° (c) 4 cm
10	(a) \$99 000 (b) 35.9% (c) at least \$2643.23