Name: …….. ( ) Class: Sec ……...

Queenstown Secondary School

Preliminary Examination 2020
Secondary Four Express / Five Normal (Academic)
Mathematics Paper 2
4048/02

27 August 2020
Thursday
Setter: Mr Tay Yee Kai

Time: 0800 – 1030
Duration: 2 hours 30 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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

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

For Examiner's Use
100

This document consists of **24** printed pages, including this cover page.

[Turn over

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

5

1 **(a)** The compression constant of combustion engine is given by $C = 1 + \frac{\pi b^2 s}{4V}$.

(i) Evaluate C when $b = 2$, $s = 2.5$ and $V = 3$.

Answer C = ... [1]

(ii) Express b in terms of C, V and s.

Answer b = ... [2]

(b) Express as a single fraction in its simplest form

(i) $\frac{8a^2b}{3} \div \frac{2a}{b}$,

Answer ..... [1]

(ii) $\frac{5}{3x-1} + \frac{4}{x-2}$.

Answer ..... [2]

(c) Given that $25^{3x-11} = 125^{x}$, find the value of x.

Answer x = ... [2]

(d) Solve these simultaneous equations.

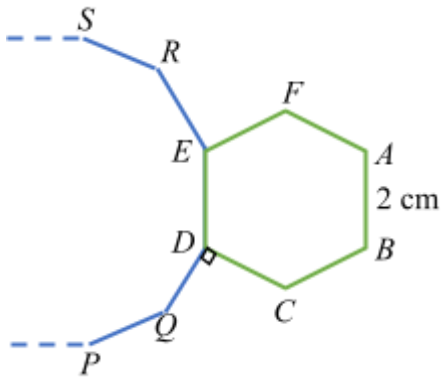
$$4x + 3y = 3$$
$$6x - 2y = 11$$

7

Answer $x =$ …….

$y =$ ……. [3]

2



The diagram shows a regular hexagon, *ABCDEF*, and five of the sides, *PQ*, *QD*, *DE*, *ER* and *RS*, of a second regular polygon.
Angle *QDC* = 90° and *AB* = 2cm.

(a) Find angle *EDC*.

Answer ……..° [1]

(b) Find the number of sides in the second regular polygon.

Answer ..... [3]

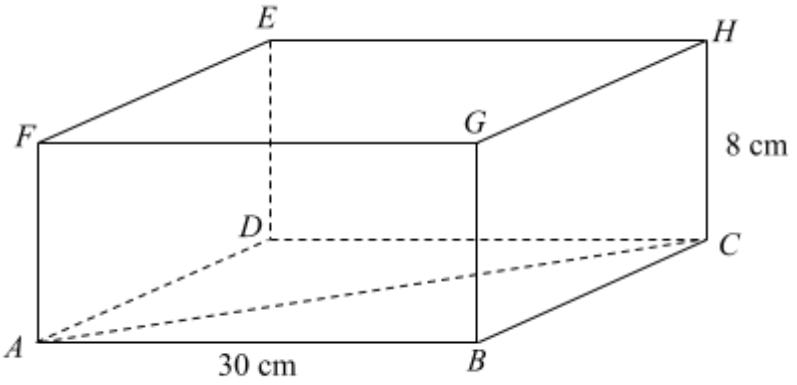
9

(c) Calculate the area of regular hexagon *ABCDEF*.

Answer ..... cm^2 [4]

11

3



The diagram shows a cuboid $ABCDEFGH$ with a volume of 4 800 cm^3.
AB = 30 cm and CH = 8 cm.

(a) Show that AC = 36.1 cm, correct to 1 decimal place.

Answer

[3]

(b) Find angle of elevation of H from A.

Answer ……..° [2]

[Turn over

(c) Find angle *AEC*.

Answer ……..° [4]

4 **(a)** The table below summarises the times taken by 500 participants in a 5 km run in 2019.

Time (t minutes)	Frequency
$30 < t \leq 40$	35
$40 < t \leq 50$	103
$50 < t \leq 60$	251
$60 < t \leq 70$	89
$70 < t \leq 80$	22

(i) Calculate the estimate of the mean time.

Answer …… [1]

(ii) Calculate the estimate of the standard deviation.

Answer …… [1]

(iii) Explain why the mean and standard deviation are estimates.

……

…… [1]

The table below shows the mean time and standard deviation of 500 participants in a 5 km run in 2020.

Mean time	51.6
Standard deviation	9.51

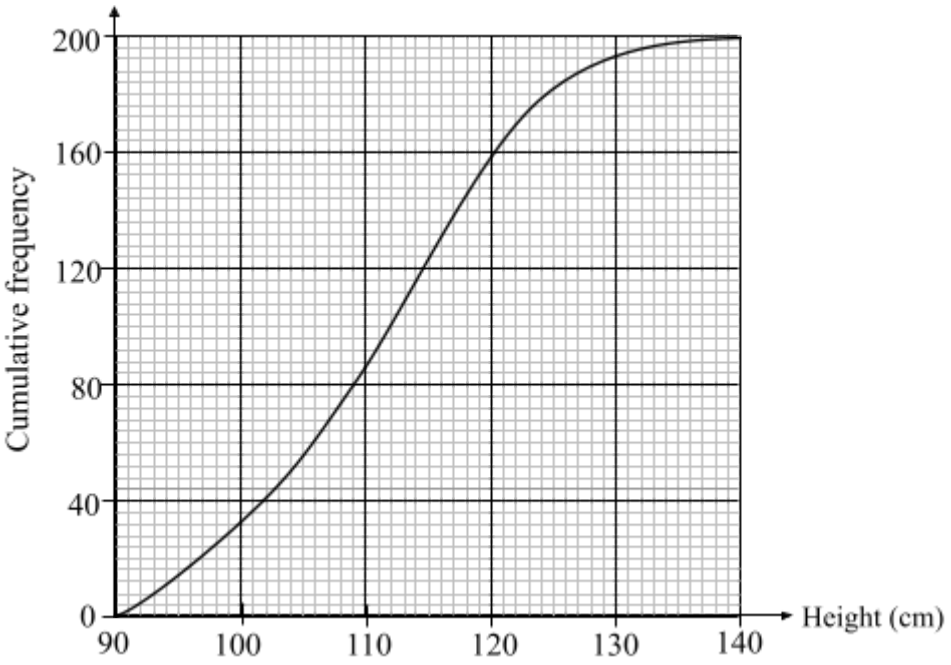
(iv) The organiser for the 5 km run states that a better running record has been attained in 2020.

Comment on whether the data above supports this claim.

…….

……. [1]

(b)



The cumulative frequency graph represents the heights of all Primary 4 pupils in Queens Primary School.

(i) How many Primary 4 pupils are there in the school?

Answer …… [1]

(ii) Find the median height.

Answer …….. cm [1]

(iii) Find the interquartile range of the heights.

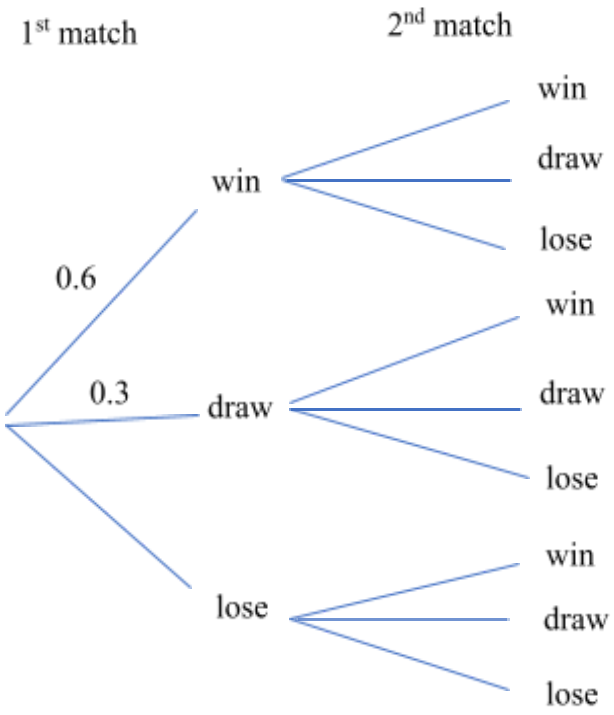
Answer …….. cm [2]

(iv) Only 4% of the Primary 4 pupils could get into the school basketball team based on their height.
What is the minimum height requirement to join school basketball team?

Answer ……..… cm [2]

5 **(a)** A football team takes part in two matches to qualify for the next round.
The probability that the team wins is 0.6.
The probability that the team draws is 0.3.

(i) Complete the tree diagram below.



[2]

(ii) To qualify for the next round, the team needs at least a win and a draw. Find the probability that the team will qualify for the next round.

Answer ..... [2]

(b) A bag contains 2 red buttons and x yellow buttons.
Two buttons are chosen at random, one after another, without replacement.

The probability that both buttons chosen are red is $\frac{1}{10}$.

Find x.

Answer $x =$ …….. [5]

6 Derrick and Elle went on a cycling expedition using different routes. Derrick travelled by route A, which is 115 km long, at an average speed of x km/h. Meanwhile Elle travelled by route B, which is 5 km shorter, but has more challenging terrain. She covered the distance at an average speed that was slower than Derrick by 3 km/h.

(a) Write down an expression, in terms of x, for the time taken by Derrick.

Answer …….. hours [1]

(b) Write down an expression, in terms of x, for the time taken by Elle.

Answer …….. hours [1]

(c) Given that Derrick waited 40 minutes before Elle arrived at the same destination, form an equation and show that it reduces to

$$2x^2 + 9x - 1035 = 0 .$$

Answer

[3]

(d) Solve the equation $2x^2 + 9x - 1035 = 0$, giving both answers correct to 2 decimal places.

Answer x = …… or ……... [3]

(e) Explain why one of the solutions in part **(d)** must be rejected.

……... [1]

(f) Hence, calculate the total time taken by the two cyclists.

Answer ……..…… hours [2]

7 **(a)** In 2019, Mei Ling earned an annual income of $54 000.
In 2020, due to economic recession, she will have a pay reduction of $300 per month from August to December.
Calculate the percentage decrease in her annual income from 2019 to 2020.

Answer ...……..…….. % [2]

(b) In 2010, the number of mobile phones sold in Singapore was 6.95 million units.
Calculate the mean number of mobile phones sold in Singapore each month.
Give your answer in standard form.

Answer …….. units [2]

(c) The price of a smart watch is $1250 in Singapore.
For the same smart watch, it is sold at ¥89 999 from a shopping site in Japan.
The exchange rate between Singapore dollars ($) and Japanese Yen (¥) is ¥100 = $1.30.

Calculate how much cheaper the smart watch is in Japan than in Singapore.

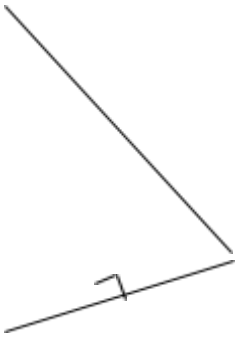
Answer $ ..... [2]

(d) Sharon buys a car on hire purchase which includes a deposit and 5 years of monthly payments.
She pays a deposit of one quarter of the cash price.
She then makes 5 years payment of $1250 per month.
With hire purchase, she realises that she pays 5% more than the cash price.
Find the hire purchase price of the car.

23

Answer $ ..... [4]

8



The diagram shows the points A, B and Q.
A lies on the y-axis and B is (3, 1).

(a) The gradient of AB is $-\frac{4}{3}$.
Find the equation of the line AB.

Answer ..... [2]

(b) $AOCB$ is a rhombus.
Find the coordinates of C.

Answer (……...… , ……...) [2]

(c) The equation of line l is $ay + 6x = 10$.
Line l does not intersect the line OB.
Find the value of a.

Answer $a =$ ..... [2]

(d) Q is a point on OB so that AQ is perpendicular to OB.

Show that triangle OAQ is congruent to triangle BAQ.
Give a reason for each statement you make.

Answer

[5]

9 The variables x and y are connected by the equation $y = \frac{4}{x} + x - 5.2$.

Some corresponding values of x and y are given in the table below.

x	0.7	1	1.5	2	3	4	5	6	7
y	1.2	p	–1.0	–1.2	–0.9	–0.2	0.6	q	2.4

(a) Find the values of p and q.

Answer p = …….

q = ……. [2]

(b) Draw the graph of $y = \frac{4}{x} + x - 5.2$ for $0.7 \le x \le 7$ on the grid next page. [3]

(c) Use your graph, estimate the solutions of the equation $\frac{4}{x} + x = 5.2$.

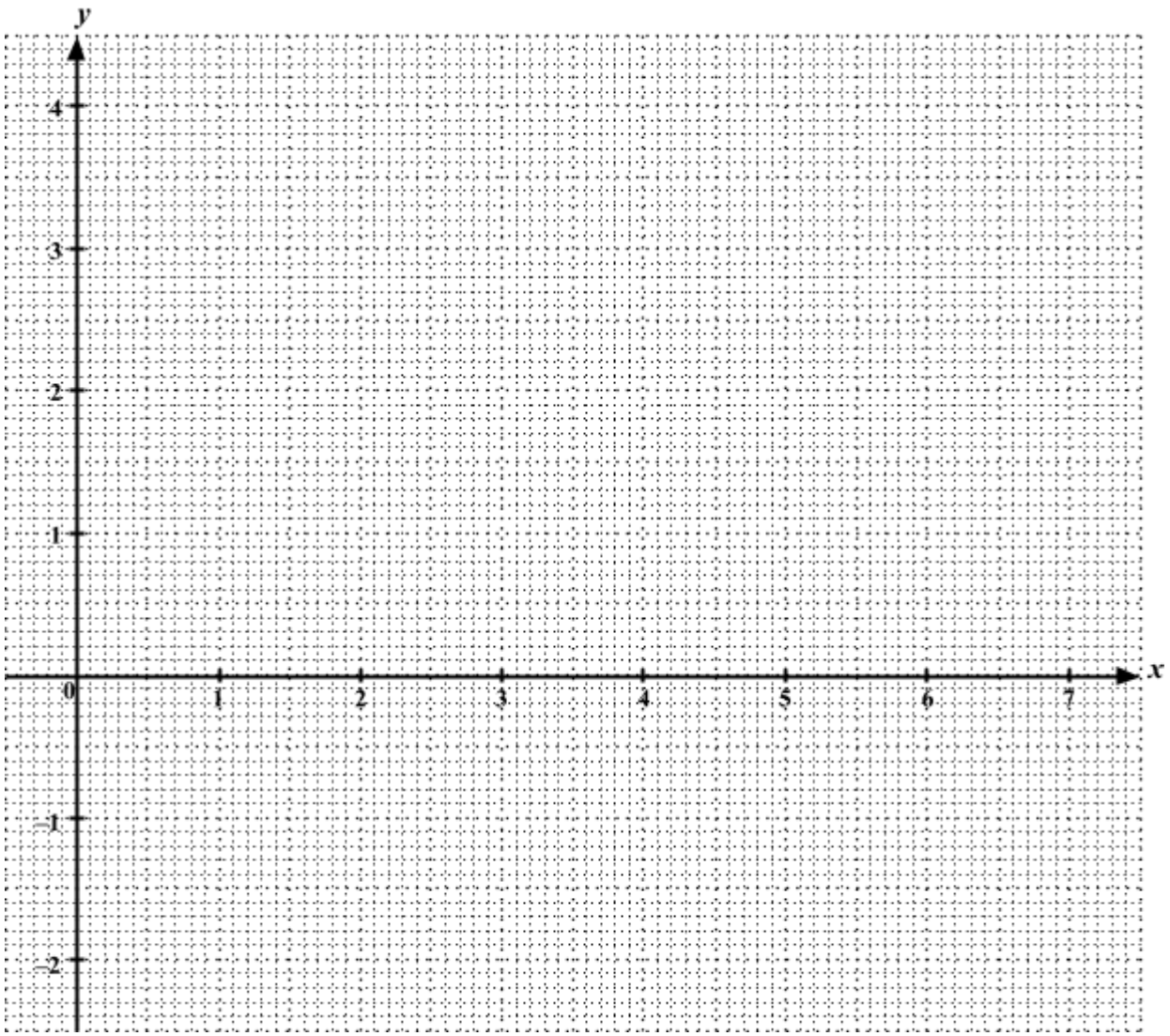
Answer x = …… or ……... [2]

(d) By adding a suitable straight line on your graph, estimate the solutions of the equation $\frac{4}{x} + x = 6.2 - \frac{1}{2}x$.

Answer x = …… or ……... [3]

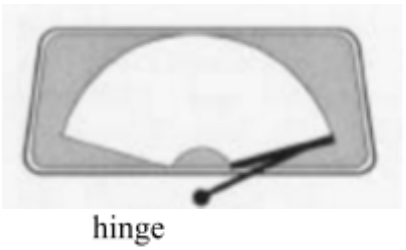
(e) On your graph of $y = \frac{4}{x} + x - 5.2$ for $0.7 \leq x \leq 7$, the gradient of the tangent is negative for $x < b$. State the largest value of b.

Answer $b =$ ..... [1]

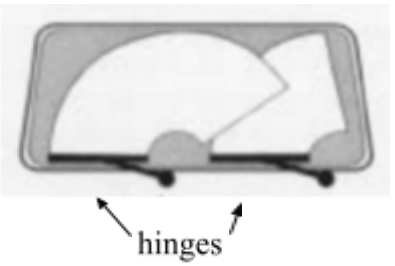


10 A windscreen wiper helps clear away water or snow from the windscreen so that drivers can see the road clearly.

There are two types of wipers, namely the single arm wiper system or the tandem wiper system.



Single arm wiper system

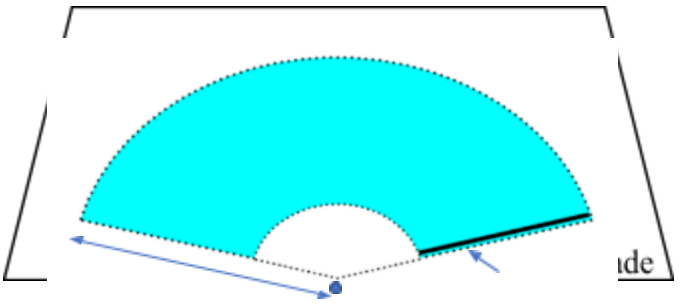


Tandem wiper system

In both systems, wipers rotate about a hinge.
Areas covered by the two systems are different.

(a) In a single arm wiper system, the wiper blade length is 60 cm.
The length from the tip of the wiper to the hinge is 80 cm.

The angle subtended at the hinge during one full swipe is 150°.



Single arm wiper system

Show that the perimeter of the region (shaded portion) covered by wiper blade is 382 cm, correct to the nearest cm.

Answer

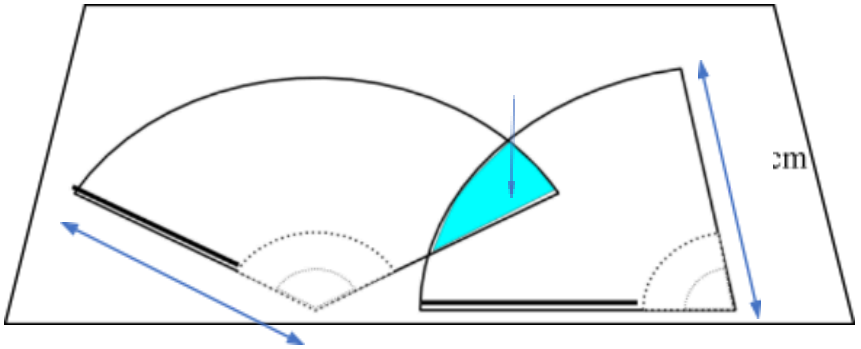
[2]

(b) In a tandem wiper system, wiper blades P and Q of lengths 60 cm each clean the windscreen simultaneously. The tip of each blade is 80 cm from the hinge.

The angles subtended at the hinge during one full swipe by P and Q are $120°$ and θ respectively.

The total area covered by both wipers is 9980 cm^2.

The intersecting area (shaded portion) of the two wipers is 800 cm^2.



Tandem wiper system

Calculate the area covered by wiper Q.

			Answer	……cm^2	[3]

(c) Both wiper blade and arm have to be replaced periodically due to wear and tear. Mr Smith is currently driving a large family car which uses the tandem wiper system (2 wiper arms and 2 wiper blades).

Wiper blades have to be replaced every 6 months.

The combined length of wiper and arm should cover about 80% of the height of the windscreen.

Mr Smith uses the following information to work out the replacement cost.

Dimension of Windscreen				
Car Type	Mini	Small family	Large family	SUV
Height	60 cm	75 cm	85 cm	100 cm

Wiper Blade  Wiper Arm 

Length of blade and arm combined (inches)	Cost of wiper blade		Material of wiper arm	Cost of wiper arm	Durablity
22	\$24		Plastic	\$12	6 months
25	\$28		Stainless Steel	\$16	1 year
27	\$32		Aluminium	\$30	2 years
30	\$34				
33	\$36				
35	\$38				
37	\$40				
39	\$42				
42	\$45				

1 inch = 2.54 centimetres

Mr Smith has the loyalty card which entitles him a 5% discount for wiper arm only.

Please advise Mr Smith what to purchase and why?
Assuming that both wiper blades have the same length.

[Continued on next page]

Continuation of working space for Question 10(c).

End of Paper

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……..

…….. [5]