# YUYING SECONDARY SCHOOL
# PRELIMINARY EXAMINATION
Secondary 4 Express/ 5 Normal (Academic) / 4N1 'O'

| | | | |
|---|---|---|---|
| **NAME** | | | |
| **CLASS** | | **REG. NO** | |

## MATHEMATICS 4048/01

Paper 1

**26 August 2019**

**2 hours**

Candidates answer on the Question Paper. **Setter: Mr Tai Kay Seng**

**READ THESE INSTRUCTIONS FIRST**

Write your name, class and class register number on the work that 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.
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.
The total of the marks for this paper is 80.

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

## *Mathematical Formulae*

*Compound interest*

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

*Mensuration*

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

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

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

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

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

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

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

*Trigonometry*

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

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

*Statistics*

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

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

*For Examiner's Use*

**4** Given that $5 \times 5^{2n-2} = 125$, find the value of $n$.

*Answer* $n =$ [2]

---

**5** The first five terms of a sequence are as follows:

78, $a$, $b$, 69, $c$, ....

**(a)** Find the value of $a$, $b$, and $c$.

*Answer* (*a*) $a =$

$b =$

$c =$ [2]

**(b)** Write down an expression, in terms of $n$, for the $n$th term of the sequence.

*Answer* (*b*) [1]

**(c)** Explain why 32 is not a term of this sequence.

Answer (*c*)

[1]

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6 The angles, in degrees, of a quadrilateral $ABCD$ are represented by these expressions: Angle $A = (80 - 4x)°$, angle $B = (10 + 3x)°$, angle $C = (5x + 90)°$ and angle $D = (15x - 10)°$.

**(a)** Calculate the value of $x$.

*Answer (a)* [1]

**(b)** What is the name of the quadrilateral?

*Answer (b)* [1]

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7 Two boxes are geometrically similar. The base area of the smaller box is 64 $cm^2$ while the base area of the larger box is 81 $cm^2$.

Calculate the volume of the smaller box as a percentage of the volume of the bigger box.

*For Examiner's Use*

*Answer* % [2]

---

8 **(a)** Express 324 as a product of its prime factors.

*Answer (a)* [1]

**(b)** A number has exactly 8 factors. Two of the factors are 4 and 18.
List all the factors of the number.

*Answer (b)* [2]

---

**9** The length of a rectangle exceeds its width by 2 cm.
**(a)** If the diagonal is 10 cm, find the width of the rectangle.

*Answer* (*a*) cm [2]

**(b)** How many squares of side 3 cm can be cut out from this rectangle?

*Answer* (*b*) [1]

**10** Kenneth invests \$2000 for 3 years at a fixed rate of compound interest.
At the end of the first year there is \$2100 in his account.
**(a)** What is the rate of compound interest?

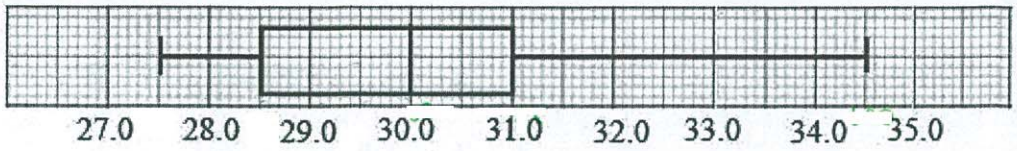
*For Examiner's Use*

*Answer* (*a*) % [2]

**(b)** How much does Kenneth have in his account at the end of 3 years?

*Answer* (*b*) \$ [2]

**11** The diagram shows the box-and-whisker plot for the power, in kilowatts(kW), supplied to an electrical circuit.




**(a)** Find the median of the power supplied.

*Answer* (*a*) kW [1]

**(b)** Find the interquartile range.

*Answer* (*b*) kW [1]

---

**12** $A$ is the point $(-1, 4)$, $B$ is the point $(2, -5)$ and $O$ is the origin.

**(a)** Find the gradient of the line $OA$.

*Answer* (*a*) [1]

**(b)** Find the equation of the line through $B$ parallel to $OA$.

*Answer* (*b*) [2]

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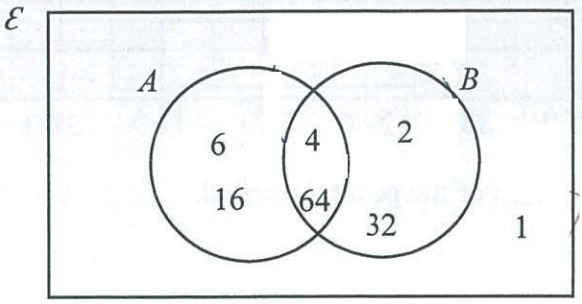
**13** The Venn Diagram represents the sets $A$ and $B$.




**(a)** List the elements of $(A \cup B)'$.

*Answer (b)* [1]

**(b)** Find $n(A' \cap B)$.

*Answer (b)* [1]

**(c)** Set $C$ is defined as the first two multiples of 32. Insert set $C$ in the Venn diagram above. [1]

---

**14** Simplify

**(a)** $27x^3y^{-2} \div 18xy^3$

*Answer (a)* [1]

**(b)** $\dfrac{2}{(x-3)^2} - \dfrac{1}{3-x}$

*Answer (b)* [3]

---

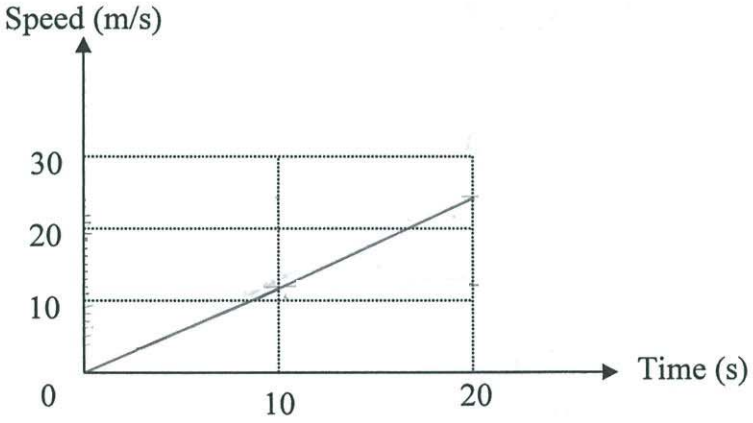
*For Examiner's Use*

**15** A bicycle accelerates from rest at a constant rate to a certain speed in 10 seconds. It maintains at this speed for the next 10 seconds. The total distance travelled by the bicycle in the 20 seconds is 240 metres.

**(a)** Calculate the speed of the bicycle in the tenth second and

*Answer (a)* _____ m/s [2]

**(b)** draw the speed-time graph of the bicycle journey for the first 20 seconds.




[2]

**16** Factorise completely

**(a)** $4x^2 - 10x - 6$,

*Answer (a)* [2]

**(b)** $10x^2y - 5xy + 2x - 1$.

*Answer (b)* [2]

**[Turn Over**

*For Examiner's Use*

17 A two digit number is formed using the digits 4, 8 and 9. Repetition of the digit is allowed.

**(a)** List the sample space.

*Answer (a)* [1]

**(b)** Find the probability that a number selected at random is

**(i)** a prime number,

*Answer (b)(i)* [1]

**(ii)** divisible by 5.

*Answer (b)(ii)* [1]

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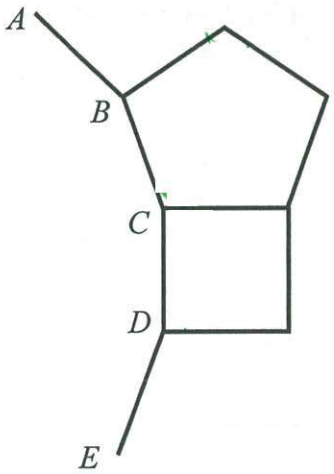
18




The diagram above is made up of a square, a regular pentagon and an incomplete regular polygon *ABCDE* of $n$ sides. Find the value of $n$.

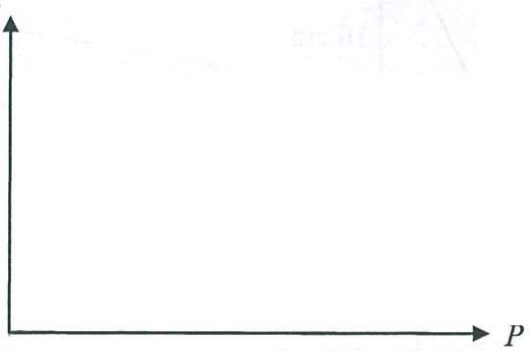
*Answer* $n =$ [3]

19 The volume, $V$, of a given mass of gas, is inversely proportional to the pressure, $P$.

For Examiner's Use

**(a)** Sketch a volume-pressure graph for the mass of gas.

*Answer (a)*




[1]

When the volume is 3 $m^3$, the pressure of the gas is 200 $N/m^2$.

**(b)** Find the equation for $V$ in terms of $P$.

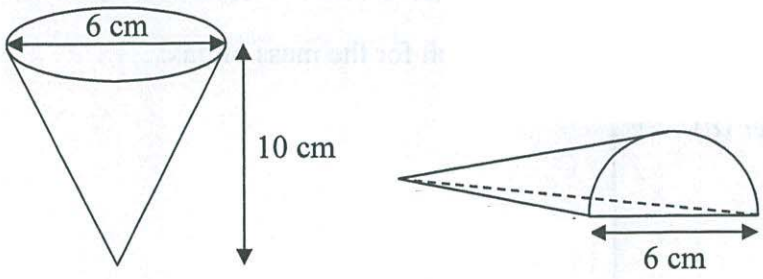
*Answer (b)* $V =$ _____ [2]

**(c)** Calculate the pressure when the volume is 5 $m^3$.

*Answer (c)* _____ $N/m^2$ [1]

20

*For Examiner's Use*




A rubber cone of diameter 6 cm and height 10 cm is cut in half to make two rubber door stoppers. Find

**(a)** the volume of a rubber stopper,

*Answer (a)* $cm^3$ [1]

**(b)** the total surface area of a rubber stopper.

*Answer (b)* $cm^2$ [3]

21 The following shows the Formula 1 track where the turns along the track are numbered 01 to 23.

*For Examiner's Use*

**(a)** Estimate the actual length of the track from turn 04 to turn 07.

*Answer (a)* _m [1]

**(b)** A racer finished the 309.316 km race in 1 h 45.599 min. Calculate the average speed in km/h.

*Answer (b)* km/h [1]

**(c)** Suggest and explain a possible speed when the racer
**(i)** went past the grandstand,

*Answer (i)*

[1]

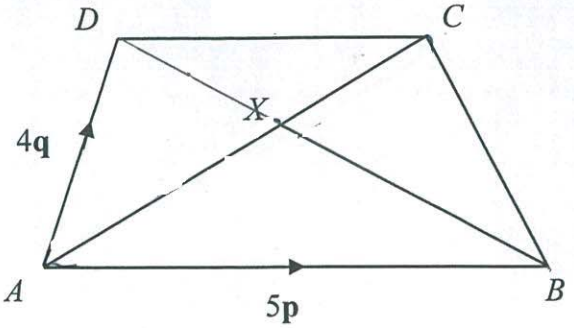
**(ii)** was at turn 05.

*Answer (ii)*

..... [1]

22






$ABCD$ is a quadrilateral.
$\overrightarrow{AB} = 5\,\mathbf{p}$, $\overrightarrow{AD} = 4\,\mathbf{q}$, $DC : AB = 3 : 5$, $AX : AC = 5 : 8$.

**(a)** Write each of the following in terms of **p** and **q**.

**(i)** $\overrightarrow{AC}$

*Answer* (*a*)(i) [1]

**(ii)** $\overrightarrow{BX}$

*Answer* (*a*)(ii) [1]

**(iii)** $\overrightarrow{XD}$

*Answer* (*a*)(iii) [1]

**(iv)** Explain why $B$, $X$ and $D$ lie in a straight line.

*Answer* ..... .....

..... [1]

*For Examiner Use*

**23** A particular restaurant offers 3 different dinner set menu Deluxe, Superior and Economy Set Package. The following table shows the orders for the three set packages on three days of a particular week.

| | Deluxe | Superior | Economy |
|---|---|---|---|
| Friday | 35 | 45 | 60 |
| Saturday | 70 | 85 | 150 |
| Sunday | 90 | 130 | 180 |

**(a)** Represent the number of orders for each type of set package on the three days by a $3 \times 3$ matrix $A$.

*Answer* (*a*) $A =$ [1]

**(b)** Given that each Deluxe, Superior and Economy Set Package costs \$188, \$88 and \$38 respectively, write down a $3 \times 1$ matrix $B$ showing the price for each type of the set packages.

*Answer* (*b*) $B =$ [1]

**(c)** Evaluate the matrix $C = AB$.

*Answer* (*c*) $C =$ [1]

**(d)** State what the elements of $C$ represent.

*Answer* (*d*)

[1]

**(e)** For Mothers' Day, the restaurant gives a discount of 20% for Deluxe Set, 15% for Superior Set and 10% for Economy Set.

Matrix $N$ is a $3 \times 1$ matrix that represents the price for each type of the set packages after the respective discount.

$M = (20 \quad 30 \quad 45)$ represents the order for these set packages on Mothers' Day.
Evaluate $Q = MN$ and state what the element of $Q$ represents.

*Answer (e)* $Q =$ [2]

*Answer (e)*

[1]

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**24** Density, $d$ kg/m$^3$, of a material is the mass, $m$ kg, per unit volume, $v$ m$^3$, in which

$$d = \frac{m}{v}.$$

An alloy is a mixture of metals.

If 0.0002 m$^3$ of copper is mixed with 0.0008 m$^3$ of tin, 7.62 kg of the alloy is formed.

If 0.0005 m$^3$ of copper is mixed with 0.0005 m$^3$ of tin, 8.1 kg of the alloy is formed.

Calculate the density of each of the two metals.

*Answer* $d_{copper} =$ _____ kg/m$^3$, $d_{tin} =$ _____ kg/m$^3$ [5]

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~ End of Paper ~

# YUYING SECONDARY SCHOOL
# PRELIMINARY EXAMINATION
Secondary 4 Express / 5 Normal (Academic) / 4N1

**NAME** _____

**CLASS** _____ **REG. NO** _____

## MATHEMATICS 4048/02

Paper 2 **28 Aug 2019**

2 hours 30 minutes

Candidates answer on the Question Paper.
Additional Materials: Graph Paper (1 sheet)

**Setters: Mr Lee Mun Tat**
**Ms Wee Li Hui**

**READ THESE INSTRUCTIONS FIRST**

Write your name, class and register 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, 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 $\pi$.

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 | |
|---|---|
| Total | /100 |

## *Mathematical Formulae*

*Compound interest*

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

*Mensuration*

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

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

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

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

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

Arc length $= r\theta$, where $\theta$ 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*

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

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

Answer **all** the questions.

**1** **(a)** It is given that $V = \frac{1}{3}ax^2 + by$.

**(i)** Find $V$ when $x = 2$, $y = -1$, $a = 3$ and $b = 5$. [1]

**(ii)** Express $x$ in terms of $V$, $a$, $b$ and $y$. [2]

**(b)** Simplify $\frac{6ab + 15b}{4a^2 - 25}$. [2]

**(c)** Solve the equation $2 = \frac{3}{x+1} + \frac{1}{x(x+1)}$. [3]

**(d)** Solve the inequality $\frac{x}{3} + \frac{5}{6} < \frac{5x}{3}$ and state the smallest possible prime number which satisfies the inequality $\frac{x}{3} + \frac{5}{6} < \frac{5x}{3}$. [3]

2 The table shows the number of lightning flashes, in billions, on Earth, from year 2016 to 2018.

| Year 2016 | Year 2017 | Year 2018 |
|---|---|---|
| 3.21 | 2.98 | 3.11 |

**(a)** The number of lightning flashes in 2016 can be expressed as $k$ millions.
Find $k$. [1]

**(b)** Assuming there are 365 days in a year, find the average number of lightning flashes that can be seen in a day in 2018.
Give your answer in standard form, correct to 3 significant figures. [2]

**(c)** Express the lightning flashes in 2016 as a percentage of the total lightning flashes from 2016 to 2018. [2]

**(d)** The number of lightning flashes in 2015 is 3.65 billions.

Calculate the percentage decrease in the number of lightning flashes from 2015 to 2018. [2]

**(e)** It is predicted that the number of lightning flashes will increase by 25% from 2018 to 2019.

Calculate the predicted number of lightning flashes in 2019, giving your answer to the nearest billion. [2]

3 **Answer the whole of this question on a sheet of graph paper.**

The variables $x$ and $y$ are connected by the equation $y = \frac{x}{10}(15 - x^2)$.

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

| $x$ | −3 | −2 | −1 | 0 | 1 | 2 | 2.5 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|
| $y$ | −1.8 | −2.2 | −1.4 | 0 | 1.4 | 2.2 | 2.2 | $q$ | −0.4 | −5 |

**(a)** Calculate the value of $q$. [1]

**(b)** Using a scale of 2 cm to represent 1 unit on each axis, draw a horizontal $x$-axis for $-3 \le x \le 5$ and a vertical $y$-axis for $-5 \le y \le 3$.

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

**(c)** Use your graph to find the solutions of $\frac{x}{10}(15 - x^2) = -1$ for $-3 \le x \le 5$. [2]

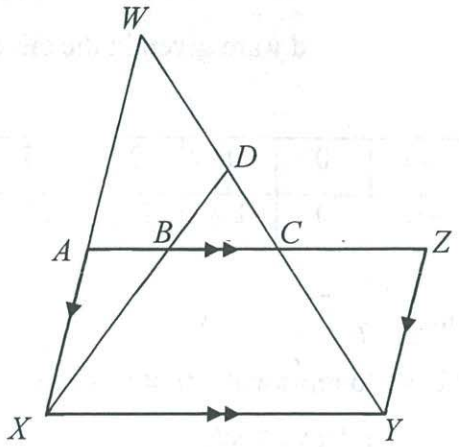
**(d)** By drawing a tangent, find the gradient of the curve at $x = 3.5$. [2]

**(e)** **(i)** On the same axes, draw the line with gradient $\frac{1}{2}$ that passes through the coordinates $(-3, -1)$. [1]

**(ii)** Write down the equation of the line. [1]

**(iii)** Write down the coordinates of the points where the line intersects the curve. [2]

4




In the diagram above, $AZ$ is parallel to $XY$ and $WX$ is parallel to $ZY$.

**(a)** State a triangle that is similar to triangle $DBC$. [1]

**(b)** Show that triangle $WAC$ is similar to triangle $YZC$. [2]

**(c)** It is given that $AB = 6$ cm, $BC = 8$ cm, $CZ = 10$ cm and $ZY = 12$ cm.

**(i)** If the area of triangle $DBC$ is 48 cm$^2$, find the area of triangle $DXY$. [1]

**(ii)** Find the ratio $WX : ZY$. [2]

**(iii)** Find $\dfrac{\text{area of trapezium } ACYX}{\text{area of triangle } CZY}$. [2]

5 **(a)** The position vector of point $A$ is $\begin{pmatrix} -1 \\ 5 \end{pmatrix}$ and the position vector of point $B$ is $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$.

**(i)** Find the column vector $\overrightarrow{AB}$. [1]

**(ii)** Find $\left|\overrightarrow{AB}\right|$. [2]

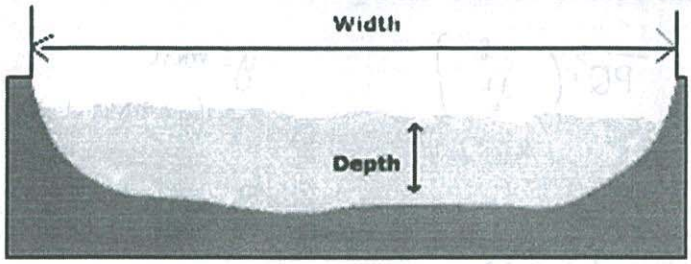
**(iii)** Given that $\overrightarrow{AC} = 3\overrightarrow{AB}$, find the coordinates of $C$. [2]

**(b)** The point $P$ has coordinates $(4, -2)$ and $\overrightarrow{PQ} = \begin{pmatrix} -8 \\ 12 \end{pmatrix}$.

**(i)** Find the equation of the line $PQ$. [2]

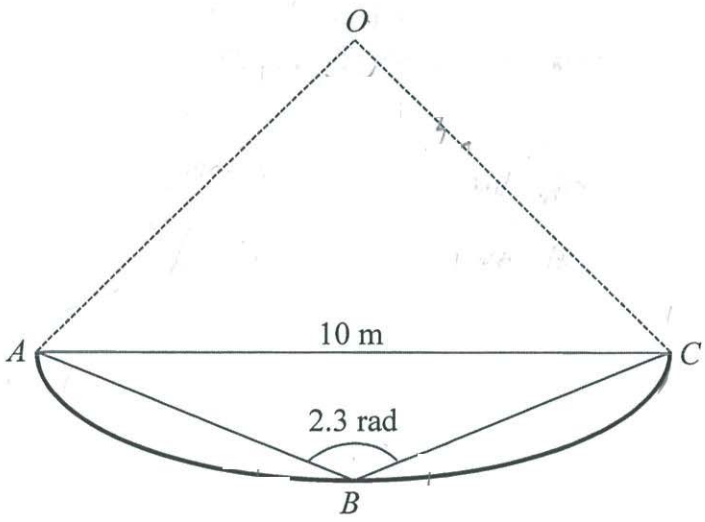
**(ii)** The equation of another line is $3x + 2y = 11$. Show how you can tell that this line does **not** intersect the line $PQ$. [2]

6 The diagram below shows a cross-sectional view of a river.



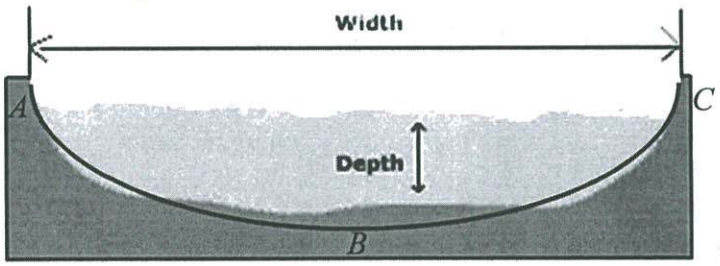

The profile of the river is modelled by the arc $ABC$ as shown in the diagram below.
The arc $ABC$ is part of a sector with centre $O$.
Given $AC = 10$ m and angle $ABC = 2.3$ *rad* ,

**(a) (i)** show that $AO = 6.703$ m, correct to 4 significant figures. [4]



**(ii)** find that the length of arc $ABC$. [1]

**(b)** The cross-section of the river with the arc $ABC$ superimposed on it is shown in the diagram below. The volume of rain flowing down a 100 m stretch of the river is 1700 $m^3$. Determine if the rain will overflow from the river and cause flooding to this stretch of the river. [5]



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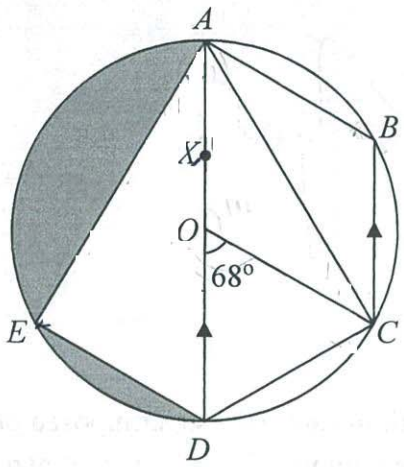



The diagram shows a circle with centre $O$ and passing through the points $A$, $B$, $C$, $D$ and $E$. $AD$ is a diameter of the circle and $\angle COD = 68°$.
$OA$ is parallel to $BC$.

**(a)** Find, giving reasons for each answer,

**(i)** angle $OAC$, [1]

**(ii)** angle $ODC$, [1]

**(iii)** angle $ABC$, [2]

**(iv)** angle $CAB$. [2]

**(b)** $X$ is a point on $AD$ such that $AX = \frac{1}{3}AD$.

Given that the area of $\Delta AED = 30\ \text{cm}^2$, find the area of $\Delta AXE$. [2]

**(c)** Given that the shaded area of the segments is $36.375\ \text{cm}^2$,

find the radius of the circle. [2]

**8** A water tank has a capacity of 1500 litres.

**(a)** The water is pumped into the tank at $x$ litres per minute.
Write down an expression, in terms of $x$, for the time taken, in minutes, for an empty water tank to be completely full. [1]

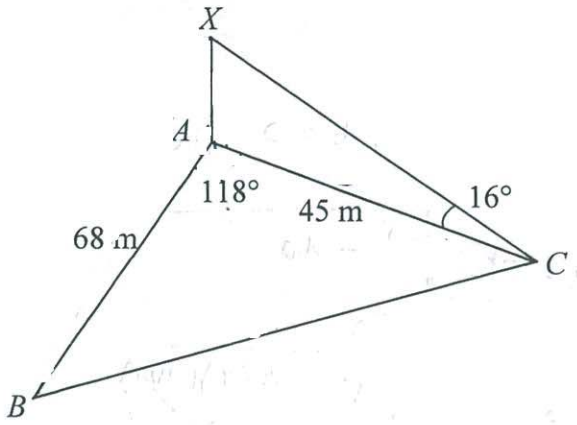
**(b)** If the rate of pumping water is increased by 3 litres per minute, write down an expression, in terms of $x$, for the time taken, in minutes, for an empty water tank to be completely full. [1]

**(c)** Given that the difference in the time taken is 28 minutes, form an equation in $x$ and show that it simplifies to $7x^2 + 21x - 1125 = 0$. [3]

**(d)** Solve the equation $7x^2 + 21x - 1125 = 0$, giving your solutions correct to 3 decimal places. [3]

**(e)** Hence, find the time taken for the tank to be completely full when the water is pumped in at a rate of $x$ litres per minute.
Give your answer in hours and minutes, correct to the nearest minute. [2]

**9**




In the diagram, $ABC$ is a horizontal triangular field in which $AB = 68$ m, $AC = 45$ m and $\angle BAC = 118°$.

**(a)** Calculate

**(i)** the length of $BC$, [2]

**(ii)** the area of triangle $ABC$, [2]

**(b)** Find the shortest distance from $A$ to $BC$. [2]

**(c)** A vertical tower $XA$ stands at $A$. The angle of elevation of the top of the tower from $C$ is 16°. Calculate

**(i)** the height of the tower. [2]

**(ii)** the greatest angle of elevation of the top of the tower when viewed from any point along $BC$. [2]

**10** The table below shows the weight of 40 students from class 4A.

| Weight (kg) | Frequency |
|---|---|
| $40 < x \leq 50$ | 13 |
| $50 < x \leq 60$ | 16 |
| $60 < x \leq 70$ | 8 |
| $70 < x \leq 80$ | 3 |

**(a)** Calculate an estimate of

**(i)** the mean weight, [2]

**(ii)** the standard deviation. [2]

**(b)** The mean and standard deviation weight of class 4B are shown below.

| | |
|---|---|
| Mean | 60.5 kg |
| Standard Deviation | 12.5 kg |

Make two comparisons between the weight of the two classes. [2]

**(c)** A student has seven 50 cents coins and five 20 cents coins in his wallet. He takes 2 coins out of the wallet, at random, one after the other. The coins taken out are not replaced.

**(i)** Draw a tree diagram to show the probabilities of the possible outcomes. [2]

**(ii)** Find the probability that the total value of the two coins taken out is

**(a)** 40 cents, [1]

**(b)** 70 cents. [2]

~~~ End of Paper ~~~
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Answer **all** the questions

*For Examiner's Use*

**1** Write the following numbers in order of size, starting with the smallest.

$$0.85,\quad \frac{8}{13},\quad (0.75)^2,\quad \sqrt{0.49}$$

*Answer* $(0.75)^2$ , $\frac{8}{13}$ , $\sqrt{0.49}$ , 0.85 [1]

---

**2** Leo is travelling to Johor Bahru from Singapore. He wants to change 400 Singapore Dollars into Malaysian Ringgit.
In Singapore, the exchange rate is 1 Singapore Dollar = 3.02 Malaysian Ringgit.
In Johor Bahru, the exchange rate is 1 Malaysian Ringgit = 0.328 Singapore Dollars.

Where should he change his money to get more Malaysian Ringgit and by how much more?

S'pore - $400 \times 302 = 1208$ Ringgit
JB - $400 \div 0.328 = 1219.51$ Ringgit

Difference = $1219.51 - 1208 = 11.51$ Ringgit

*Answer* Johor Bahru, 11.51 Ringgit [2]

---

**3** Show that $(5n-1)^2 + 4$ is a multiple of 5.

*Answer*

$(5n-1)^2 + 4 = 25n^2 - 10n + 5$ [M1]
$= 5(5n^2 - 2n + 1)$ [A1]

[2]





*For Examiner's Use*

**4** Given that $5 \times 5^{2n-2} = 125$, find the value of $n$.

$5 \times 5^{2n-2} = 5^3$
$5^{1+2n-2} = 5^3$
$1 + 2n - 2 = 3$ [M1]
$2n = 4$
$n = 2$ [A1]

*Answer* $n =$ _____ [2]

---

**5** The first five terms of a sequence are as follows:

78, $a$, $b$, 69, $c$, ....

**(a)** Find the value of $a$, $b$, and $c$.

$\frac{78 - 69}{3} = 3$

*Answer* (a) $a =$ 75
$b =$ 72
$c =$ 66 [2]

**(b)** Write down an expression, in terms of $n$, for the nth term of the sequence.

*Answer* (b) $81 - 3n$ [1]

**(c)** Explain why 32 is not a term of this expression.

Answer (c) ... $81 - 3n = 32$, $n = 16.3$. $n$ is not an integer. .....

Hence 32 is not a term of this expression. ..... [1]

---

**6** The angles, in degrees, of a quadrilateral $ABCD$ are represented by these expressions:
Angle $A = (80 - 4x)°$, angle $B = (10 + 3x)°$, angle $C = (5x + 90)°$ and
angle $D = (15x - 10)°$.

**(a)** Calculate the value of $x$.

$80 - 4x + 10 + 3x + 5x + 90 + 15x - 10 = 360$
$170 + 19x = 360$
$x = 10$

*Answer* (a) $x =$ 10 [1]

**(b)** What is the name of the quadrilateral?

*Answer* (b) Trapezium [1]

7 Two boxes are geometrically similar. The base area of the smaller box is 64 cm$^2$ while the base area of the larger box is 81 cm$^2$.

*For Examiner's Use*

Calculate the volume of the smaller box as a percentage of the volume of the bigger box.

$$\frac{A_1}{A_2}=\left(\frac{l_1}{l_2}\right)^2=\frac{64}{81}$$

$$\frac{l_1}{l_2}=\frac{8}{9} \qquad [M1]$$

$$\frac{V_1}{V_2}=\left(\frac{l_1}{l_2}\right)^3=\frac{512}{729}$$

$$\frac{V_1}{V_2}\times 100\%=\frac{512}{729}\times 100\%$$

$$=70.2\% \qquad [A1]$$

*Answer* _____% [2]

8 (a) Express 324 as a product of its prime factors.

*Answer (a)* $2^2\times 3^4$ [1]

(b) A number has exactly 9 factors. Two of the factors are 4 and 18. List all the factors of the number.

$4=2^2$

$18=2\times 3^2$

*Number* $=2^2\times 3^2=36$ [M1]

*Factors*: 1, 2, 3, 4, 6, 9, 12, 18, 36 [A1]

*Answer (b)* _____ [2]

9 The length of a rectangle exceeds its width by 2 cm.

(a) If the diagonal is 10 cm, find the width of the rectangle.

$x^2+(x+2)^2=10^2$ [M1]

$2x^2+4x-96=0$

$x^2+2x-48=0$

$(x+8)(x-6)=0$

$x=-8(rej)$ *or* 6 [A1]

*Answer (a)* _____cm [2]

(b) How many squares of side 3 cm can be cut out from this rectangle?

*Answer (b)* 4 [1]





10 Kenneth invests $2000 for 3 years at a fixed rate of compound interest. At the end of the first year there is $2100 in his account.

[Turn Over]

*For Examiner's Use*

(a) What is the rate of compound interest?

$$2100=2000\left(1+\frac{r}{100}\right)^1 \qquad [M1]$$

$$r=\left(\frac{2100}{2000}-1\right)\times 100=5 \qquad [A1]$$

*Answer (a)* _____% [2]

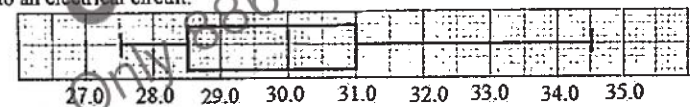
(b) How much does Kenneth have in his account at the end of 3 years?

Sum at the end of 3 years $=2000\left(1+\frac{5}{100}\right)^3$ [M1]

$=2315.25$ [A1]

*Answer (b)* $ _____ [2]

11 The diagram shows the box-and-whisker plot for the power, in kilowatts(kW), supplied to an electrical circuit.




(a) Find the median of the power supplied.

*Answer (a)* 30.0 kW [1]

(b) Find the interquartile range.

*Answer (b)* 2.5 kW [1]

12 $A$ is the point $(-1, 4)$, $B$ is the point $(2, -5)$ and $O$ is the origin.

(a) Find the gradient of the line $OA$.

$$\frac{4-0}{-1-0}=-4$$

*Answer (a)* −4 [1]

(b) Find the equation of the line through $B$ parallel to $OA$.

$y=-4x+c$ [M1]

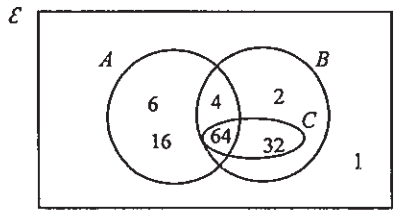
Sub (2, −5) into eqn

$c=3$

*Answer (b)* $y=-4x+3$ [A1] [2]

13 The Venn Diagram represents the sets $A$ and $B$.

*For Examiner's Use*




(a) List the elements of $(A \cup B)'$.

*Answer (b)* ____{1}_____ [1]

(b) Find $n(A' \cap B)$.

*Answer (b)* _____2_____ [1]

(c) Set $C$ is defined as the first two multiples of 32. Insert set $C$ in the Venn diagram above. [1]

14 Simplify

(a) $27x^3y^{-2} \div 18xy^3$

$\frac{27x^3y^{-2}}{18xy^3} = \frac{3}{2}x^{3-1}y^{-2-3}$

$= \frac{3}{2}x^2y^{-5}$ [A1]

*Answer (a)* _____ [1]

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

$= \frac{2}{(x-3)^2} + \frac{1}{x-3}$ [M1]

$= \frac{2+(x-3)}{(x-3)^2}$ [M1]

$= \frac{x-1}{(x-3)^2}$ [A1]

*Answer (b)* _____ [3]





15 A bicycle accelerates from rest at a constant rate to a certain speed in 10 seconds. It maintains at this speed for the next 10 seconds. The total distance travelled by the bicycle in the 20 seconds is 240 metres.

*For Examiner's Use*

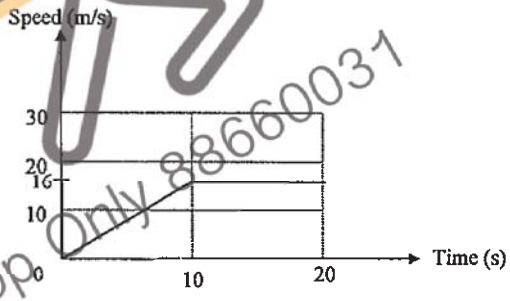
(a) Calculate the speed of the bicycle in the tenth second and

$\frac{1}{2}(x)(10) + (x)(10) = 240$ [M1]

$x = 16$ [A1]

*Answer (a)* _____m/s [2]

(b) draw the speed-time graph of the car's journey for the first 20 seconds,




[2]

16 Factorise

(a) $4x^2 - 10x - 6$,

$= 2(2x^2 - 5x - 3)$ [M1]

$= 2(2x+1)(x-3)$ [A1]

*Answer (a)* _____ [2]

(b) $10x^2y - 5xy + 2x - 1$.

$= 5xy(2x-1) + 1(2x-1)$ [M1]

$= (5xy+1)(2x-1)$ [A1]

*Answer (b)* _____ [2]

17 A two digit number is formed using the digits 4, 8 and 9. Repetition of the digit is allowed.

(a) List the sample space.

*Answer (a)* {44, 48, 49, 84, 88, 89, 94, 98, 99} [1]

(b) Find the probability that a number selected at random is

(i) a prime number,

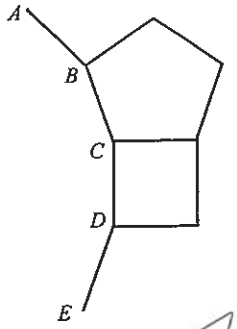
*Answer (b)(i)* $\frac{1}{9}$ [1]

(ii) divisible by 5.

*Answer (b)(ii)* 0 [1]

*For Examiner's Use*

18




The diagram below is made up of a square, a regular pentagon and an incomplete regular polygon *ABCDE* of *n* sides. Find the value of *n*.

Int. angle of pentagon $= \frac{(5-2)\times 180°}{5} = 108°$ [M1]

Int. angle of polygon $= 360° - 108° - 90° = 162°$ [M1]

Ext. angle of polygon $= 180° - 162° = 18°$ [M1]

$n = \frac{360°}{18°} = 20$ [A1]

*Answer* $n =$ [4]

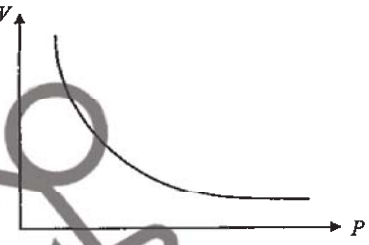




19 The volume, $V$, of a given mass of gas, is inversely proportional to the pressure, $P$.

(a) Sketch a volume-pressure graph for the mass of gas.

*Answer (a)*




[1]

When the volume is 3 $m^2$, the pressure of the gas is 200 $N/m^2$.

(b) Find the equation for $V$ in terms of $P$.

$V = \frac{k}{P}$ [M1]

$3 = \frac{k}{200}, k = 600$

$V = \frac{600}{P}$ [A1]

*Answer (b)* $V =$ [2]

(c) Calculate the pressure when the volume is 5 $m^2$.

$5 = \frac{600}{P}$

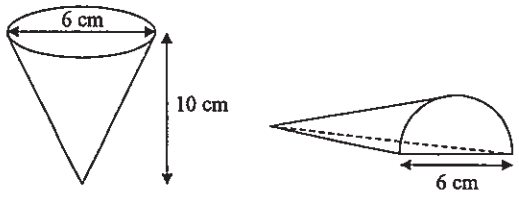
$P = \frac{600}{5}$

$= 120$ [A1]

*Answer (c)* $N/m^2$ [1]

*For Examiner's Use*

20




A rubber cone of diameter 6 cm and height 10 cm is cut in half to make two rubber door stoppers. Find

(a) the volume of a rubber stopper,

$$V = \frac{1}{2}\left[\frac{1}{3}\pi(3)^2(10)\right]$$
$$= 47.1 \qquad [A1]$$

*Answer (a)* _____ $cm^3$ [1]

(b) the total surface area of a rubber stopper.

Slant height $= \sqrt{10^2 + 3^2} = \sqrt{109}cm$ [M1]

$$A = \frac{1}{2}\times\left[\pi(3)^2\right] + \frac{1}{2}\times 6\times 10 + \frac{1}{2}\times\pi\times 3\times\sqrt{109} \quad [M1]$$
$$= 93.3 \qquad [A1]$$

*Answer (b)* _____ $cm^2$ [3]

*For Examiner's Use*





21 The following shows the Formula 1 track where the turns along the track are numbered 01 to 23.

(a) Estimate the actual length of the track from turn 04 to turn 07.

*Answer (a)* _1200 t0 1400___ m [1]

(b) A racer finished the 309.316 km race in 1 h 45.599 min. Calculate the average speed in km/h.

1 h 45.599 min = 1.759983 h

$$\text{Av. Speed} = \frac{309.316}{1.759983} = 176 \qquad [A1]$$

*Answer (b)* _____km/h [1]

(c) Suggest and explain a possible speed when the racer
(i) went past the grandstand,

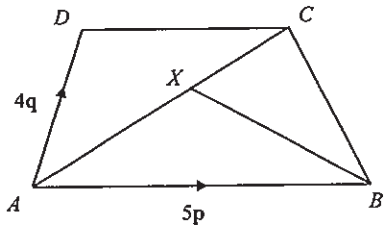
*Answer (i)* When the racer passed the grandstand, the speed should be higher than the average speed as the course is relatively straight. Speed should be around 200 km/h..... [1]

(ii) was at turn 05.

*Answer (ii)* The racer should slow down at turn 05 and the speed is lower than the average speed. Speed should be around 150 km/h. ..... [1]

*For Examiner's Use*

22




$ABCD$ is a quadrilateral.
$\overrightarrow{AB} = 5\,\mathbf{p}$, $\overrightarrow{AD} = 4\,\mathbf{q}$, $DC : AB = 3 : 5$, $AX : AC = 5 : 8$.
(a) Write each of the following in terms of **p** and **q**.

(i) $\overrightarrow{AC}$,

$$\overrightarrow{AC} = \overrightarrow{AD} + \overrightarrow{DC}$$
$$= 4q + \frac{3}{5}\overrightarrow{AB}$$
$$= 4q + \frac{3}{5}(5p)$$
$$= 4q + 3p \qquad [A1]$$

*Answer (a)(i)* _____ [1]

(ii) $\overrightarrow{BX}$

$$\overrightarrow{BX} = \overrightarrow{AX} - \overrightarrow{AB}$$
$$= \frac{5}{8}\overrightarrow{AC} - 5p$$
$$= \frac{5}{8}(4q + 3p) - 5p$$
$$= \frac{5}{2}q - \frac{25}{8}p \qquad [A1]$$

*Answer (a)(ii)* _____ [1]

(iii) $\overrightarrow{XD}$

$$\overrightarrow{XD} = \overrightarrow{AD} - \overrightarrow{AX}$$
$$= 4q - \frac{5}{8}\overrightarrow{AC}$$
$$= 4q - \frac{5}{8}(4q + 3p)$$
$$= \frac{3}{2}q - \frac{15}{8}p \qquad [A1]$$

*Answer (a)(iii)* _____ [1]

(iv) Explain why $B$, $X$ and $D$ lie in a straight line.

*Answer* ... $\overrightarrow{BX} = \frac{5}{8}(4q - 5p)$ *and* $\overrightarrow{XD} = \frac{3}{8}(4q - 5p)$, hence $BX = \frac{5}{3}XD$

... $B$, $X$ and $D$ lies in a straight line..... [1]

[Turn Over





23 A particular restaurant offers 3 different dinner set menu Deluxe, Superior and Economy Set Package. The following table shows the orders for the three set packages on three days of a particular week.

| | Deluxe | Superior | Economy |
|---|---|---|---|
| Friday | 35 | 45 | 60 |
| Saturday | 70 | 85 | 150 |
| Sunday | 90 | 130 | 180 |

(a) Represent the number of orders for each type of set package on the three days by a $3 \times 3$ matrix $A$.

$$\begin{pmatrix} 35 & 45 & 60 \\ 70 & 85 & 150 \\ 90 & 130 & 180 \end{pmatrix}$$

*Answer (a)* $A =$ _____ [1]

(b) Given that each Deluxe, Superior and Economy Set Package costs \$188, \$88 and \$38 respectively, write down a $3 \times 1$ matrix $B$ showing the price for each type of the set packages.

$$\begin{pmatrix} 188 \\ 88 \\ 38 \end{pmatrix}$$

*Answer (b)* $B =$ _____ [1]

(c) Evaluate the matrix $C = AB$.

$$C = \begin{pmatrix} 35 & 45 & 60 \\ 70 & 85 & 150 \\ 90 & 130 & 180 \end{pmatrix}\begin{pmatrix} 188 \\ 88 \\ 38 \end{pmatrix}$$

$$= \begin{pmatrix} 12820 \\ 33840 \\ 35200 \end{pmatrix} \qquad [A1]$$

*Answer (c)* $C =$ _____ [1]

(d) State what the elements of $C$ represents.

*Answer (d)* ...It represents the restaurant takings from the three set packages on each day. ..... [1]

(e) For Mothers' Day, the restaurant give a discount of 20% for Deluxe Set, 15% for Superior Set and 10% for Economy Set.
Matrix $N$ is a 3 x 1 matrix that represents the price for each type of the set packages after the respective discount.
$M = (20 \quad 30 \quad 45)$ represents the order for these set Packages on Mothers' Day.
Evaluate $Q = MN$ and state what the element of $Q$ represnt.

$$N = \begin{pmatrix} 150.4 \\ 74.8 \\ 34.2 \end{pmatrix} \qquad [M1]$$

$$Q = (20 \quad 30 \quad 45)\begin{pmatrix} 150.4 \\ 74.8 \\ 34.2 \end{pmatrix}$$

$$= (6791) \qquad [A1]$$

*Answer* (e) $Q =$ _____ [2]

*Answer* (e) ...The restaurant total takings from the three set packages on

...Mothers' day..... [1]

24 Density, $d$ kg/m$^3$, of a material is the mass, $m$ kg, per unit volume, $v$ m$^3$, in which

$$d = \frac{m}{v}.$$

An alloy is a mixture of metals.

If 0.0002 m$^3$ of copper is mixed with 0.0008 m$^3$ of tin, 7.62 kg of the alloy is formed.

If 0.0005 m$^3$ of copper is mixed with 0.0005 m$^3$ of tin, 8.1 kg of the alloy is formed.

Calculate the density of each of the two metals.

$7.62 = d_c \times 0.0002 + d_t \times 0.0008$

$38100 = d_c + 4d_t$ ----------(1) [M1]

$8.1 = d_c \times 0.0005 + d_t \times 0.0005$

$16200 = d_c + d_t$ ----------(2) [M1]

(1) – (2) [M1]

$3d_t = 21900$

$d_t = 7300$ [A1]

*Sub* $d_t = 7300$ *into* (2)

$d_c = 8900$ [A1]

*Answer* $d_{copper}$ = _____ kg/m$^3$, $d_{tin}$ = _____ kg/m$^3$ [5]

~ End of Paper ~

## Marking Scheme

## Sec 4E5N/4N1-Maths P2-Prelim-2019

| | |
|---|---|
| 1 (a) (i) | $V=\frac{1}{3}(2)^2(3)+(-1)(5)$<br>$=-1$ |
| 1 (a) (ii) | $V=\frac{1}{3}ax^2+by$<br>$V-by=\frac{1}{3}ax^2$<br>$3(V-by)=ax^2$<br>$\frac{3(V-by)}{a}=x^2$<br>$x=\pm\sqrt{\frac{3(V-by)}{a}}$ |
| 1 (b) | $\frac{6ab+15b}{4a^2-25}=\frac{3b(2a+5)}{(2a+5)(2a-5)}$<br>$=\frac{3b}{2a-5}$ |
| 1 (c) | $2=\frac{3}{x+1}+\frac{1}{x(x+1)}$<br>$2=\frac{3x}{x(x+1)}+\frac{1}{x(x+1)}$<br>$2=\frac{3x+1}{x^2+x}$<br>$2x^2+2x=3x+1$<br>$2x^2-x-1=0$<br>$(2x+1)(x-1)=0$<br>$x=-0.5$ or $x=1$ |
| 1 (d) | $\frac{x}{3}+\frac{5}{6}<\frac{5x}{3}$<br>$\frac{2x+5}{6}<\frac{10x}{6}$<br>$2x+5<10x$<br>$5<8x$<br>$8x>5$<br>$x>\frac{5}{8}$ |





| | |
|---|---|
| | smallest prime number = 2 |
| 2 (a) | 3210 |
| 2 (b) | $\frac{3.11\times10^9}{365}=8520547.945$<br>$=8.52\times10^6$ (3 s.f.) |
| 2 (c) | $\frac{3.21\times10^9}{3.21\times10^9+2.98\times10^9+3.11\times10^9}\times100$<br>$=34.5\%$ (3 s.f.) |
| 2 (d) | $\frac{3.65\times10^9-3.11\times10^9}{3.65\times10^9}\times100$<br>$=14.8\%$ (3 s.f.) |
| 2 (e) | $\frac{125}{100}\times3.11\times10^9$<br>= 4 billions (nearest billion)<br>or 4 000 000 000 (nearest billion)<br>or $4\times10^9$ (nearest billion) |
| 3 | Refer to graph paper |

| | |
|---|---|
| 4 (a) | Triangle $DXY$ |
| 4 (b) | $\angle ACW = \angle ZCY$ (vert. opp. angles)<br>$\angle WAC = \angle YZC$ ($WA // ZY$, alt. angles)<br>By AA similarity, triangle $WAC$ is similar to triangle $YZC$. |
| 4 (c) (i) | $\frac{\text{area of triangle } DBC}{\text{area of triangle } DXY} = \left(\frac{8}{24}\right)^2$<br>$= \frac{1}{9}$<br>Area of triangle $DXY = 48 \times 9$<br>$= 432 \text{ cm}^2$ |
| 4 (c) (ii) | By similarity,<br>$\frac{WA}{YZ} = \frac{AC}{ZC}$<br>$\frac{WA}{12} = \frac{14}{10}$<br>$WA = \frac{14}{10} \times 12$<br>$= 16.8$<br>$\frac{WX}{ZY} = \frac{16.8+12}{12}$<br>$= \frac{12}{5}$<br>$WX : ZY = 12 : 5$ |
| 4 (c) (iii) | $\frac{\text{area of } ACXY}{\text{area of triangle } CZY} = \frac{\frac{1}{2}(6+8+24)(\text{ht})}{\frac{1}{2}(10)(\text{ht})}$<br>$= \frac{19}{5}$ |
| 5(a)(i) | $\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$<br>$= \begin{pmatrix} 3 \\ -8 \end{pmatrix}$ |
| (ii) | $\sqrt{3^2+8^2}$<br>$= 8.54$ units (3 s.f.) |





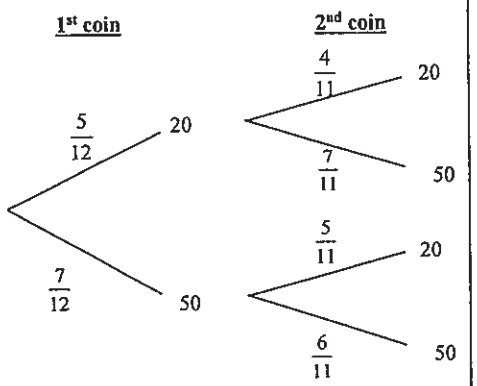
| | |
|---|---|
| (iii) | $\overrightarrow{OC} = \overrightarrow{OA} + \overrightarrow{AC}$<br>$= \begin{pmatrix} -1 \\ 5 \end{pmatrix} + 3\overrightarrow{AB}$<br>$= \begin{pmatrix} -1 \\ 5 \end{pmatrix} + 3\begin{pmatrix} 3 \\ -8 \end{pmatrix}$<br>$= \begin{pmatrix} 8 \\ -19 \end{pmatrix}$<br>C (8, -19) |
| (b)(i) | Gradient of $PQ = \frac{12}{-8} = -\frac{3}{2}$<br>$y = -\frac{3}{2}x + c$<br>$-2 = -\frac{3}{2}(4) + c$<br>$c = 4$<br>$y = -\frac{3}{2}x + 4$ |
| (ii) | $3x + 2y = 11$<br>$y = -\frac{3}{2}x + 5.5$<br>Both lines have the same gradient so they are parallel and will not intersect |
| 6(a)(i) | Reflex $AOC = 4.6$ rad (angle at centre = 2X angle at circum)<br>Angle $AOC = 2\pi - 4.6 = 1.684$<br>$AO = \frac{5}{\sin 0.842}$<br>$= 6.703$ m<br>(shown) |
| (ii) | Arc ABC $= 6.703 \times 1.684$<br>$= 11.3$ m |
| (b) | Cross sectional area =<br>$\frac{1}{2} \times (6.703)^2 \times 1.684 - \frac{1}{2}(6.703)^2 \sin 1.684$<br>$= 15.5099$<br>$= 15.5 \text{ m}^2$ |

| | |
|---|---|
| | Volume $= 15.5099 \times 100$<br>$= 1551\ m^3$<br><br>The rain will overflow from the drain as the rain flowing is more than the capacity of the drain |
| 7(a)(i) | 34°<br>(ext angle of triangle / angle at centre = 2 X angle at circum) |
| (ii) | 56°<br>(angle sum of isos triangle) |
| (iii) | $= \frac{180+68}{2}$<br>$= 124°$<br>(angle at centre = 2 X angle at circum) |
| (iv) | $= 180-34-124$<br>$= 22°$<br>(int angle, $OA$ parallel to $BC$) |
| (b) | Both triangles have common height<br>$= \frac{1}{3}(30)$<br>$= 10\ cm^2$ |
| (c) | Area of semicircle $= 30 + 36.375 = 66.375$<br>$\frac{1}{2}\pi r^2 = 66.375$<br>$r = 6.50$ cm |
| 8(a) | $\frac{1500}{x}$ |
| (b) | $\frac{1500}{x+3}$ |
| (c) | $\frac{1500}{x} - \frac{1500}{x+3} = 28$<br>$4500 = 28x(x+3)$<br>$28x^2 + 84x - 4500 = 0$<br>$7x^2 + 21x - 1125 = 0$<br>(shown) |





| | |
|---|---|
| (d) | $x = \frac{-21 \pm \sqrt{21^2 - 4(-1125)(7)}}{2(7)}$<br>$= 11.266$ *or* $-14.266$ |
| (e) | $t = \frac{1500}{11.266}$<br>$= 133$ mins<br>$= 2$ h 13 mins |
| 9(a)(i) | $BC^2 = 68^2 + 45^2 - 2(68)(45)\cos 118$<br>$BC = 97.582$<br>$= 97.6m$<br>(3 s.f.) |
| (ii) | $= \frac{1}{2}(68)(45)\sin 118$<br>$= 1350m^2$<br>(3 s.f.) |
| (b) | $\frac{1}{2}(97.582)h = 1350.9$<br>$h = 27.7m$<br>(3 s.f.) |
| (c)(i) | $h = 45\tan 16$<br>$= 12.9m$<br>(3 s.f.) |
| (ii) | $\tan\theta = \frac{12.904}{27.688}$<br>$\theta = 25.0°$<br>(1 d.p.) |
| 10(a)(i) | $= \frac{45\times13 + 55\times16 + 65\times8 + 75\times3}{40}$<br>$= 55.25$ kg |
| (ii) | $\sqrt{\frac{125400}{40} - 55.25^2}$<br>$= 9.08$ kg<br>(3 s.f.) |
| (b) | Class 4B is heavier than 4A as the mean is higher.<br>Class 4A weight is more consistent as the S.D. is smaller. |
| (c)(i) | |

| | |
|---|---|
| |   |
| ii(a) | $\frac{5}{12}\times\frac{4}{11}$<br>$=\frac{5}{33}$ |
| (b) | $\frac{5}{12}\times\frac{7}{11}+\frac{5}{11}\times\frac{7}{12}$<br>$=\frac{35}{66}$ |