PRELIMINARY EXAMINATION
GENERAL CERTIFICATE OF EDUCATION ORDINARY LEVEL

## MATHEMATICS                                          4048/01

Paper 1                                          **Wednesday 19 August 2020**

**2 hours**

Candidates answer on the Question Paper.

### READ THESE INSTRUCTIONS FIRST

Write your name, register 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 highlighters, glue or correction fluid or correction tape.

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.
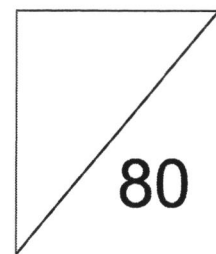
Calculators should be used where appropriate.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give 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.

/80

This document consists of **19** printed pages and **1** blank page

# Mathematical Formulae

**Compound interest**

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

**Mensuration**

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

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

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

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

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

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

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

**Trigonometry**

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

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

**Statistics**

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

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

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

$\dfrac{1}{5}$,  $\left(\dfrac{2}{5}\right)^2$,  0.033,  0.22

*Answer* …………..……………………………… [1]

___

2  **(a)** Expressing your answer as a power of 6, find  $6^5 \div 6^{-3} \times 6^3$ .

*Answer* ………………………………… [1]

**(b)** Simplify  $\dfrac{(3x^2)^3}{21x^4} \times 5x^{-2} + 7x^0$ .

*Answer* ………………………………… [2]

___

3  Solve  $a(a+1) = 6$ .

*Answer* ………………………………… [2]

**4** **(a)** Express 252 and 280 as the product of their prime factors.

*Answer* 252 = ………………………………

280 = …………………………… [2]

**(b)** The number 252$k$ is a perfect cube. Find the smallest positive integer value of $k$.

*Answer k =* ……………………………….. [1]

**(c)** Write down the greatest integer that will divide both 252 and 280 exactly.

*Answer* ……………………………………… [1]

5   **(a)** Solve the inequalities $-2 < \dfrac{2(7+5x)}{8} < 10$.

*Answer* ......................................... [2]

**(b)** Write down all the prime numbers that satisfy $-2 < \dfrac{2(7+5x)}{8} < 10$.

*Answer* ......................................... [1]

6   Given that $x^2 + y^2 = 17$ and $xy = 5$, find the value of $(3x-3y)^2 + 2(x-y)^2$.

*Answer* ......................................... [4]

7
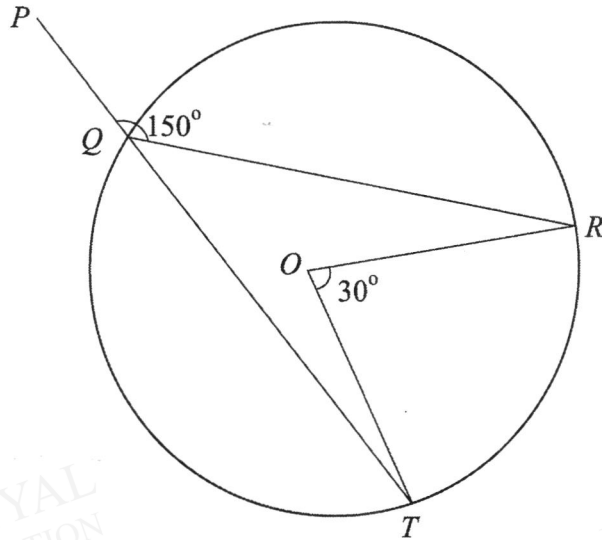


In the diagram, $Q$, $R$ and $T$ are points on a circle.

$PQT$ is a straight line, angle $PQR = 150°$ and angle $TOR = 30°$.

Determine, with reasons, if $O$ is the centre of the circle.

*Answer*    Point $O$ is ………………………………… of the circle because .......................

.................................................................................................................................

.................................................................................................................................

....................................................................................................................... [3]

8 (a) Simplify $\dfrac{a^2 + 2a + 1}{a^2 - 1}$.

Answer ....................................... [2]

(b) Factorise completely $m - n - 1 + mn$.

Answer ....................................... [2]

9 The times taken by an athlete to run 800 metres in three successive races were 2 minutes 1.8 seconds, 1 minute 59.1 seconds and 2 minutes 2.4 seconds.

In order to qualify for the next round, his average time for four races must be less than 2 minutes.

Calculate the time he took in his fourth race if he just qualified for the next round. Give you answer in minutes and seconds, correct to the nearest second.

Answer ................ min .............. s [3]

10 Mr Sim wishes to buy a dishwasher that costs $1589.
He decided to purchase the dishwasher using the instalment plan below with a repayment period of 15 months in equal monthly instalments.
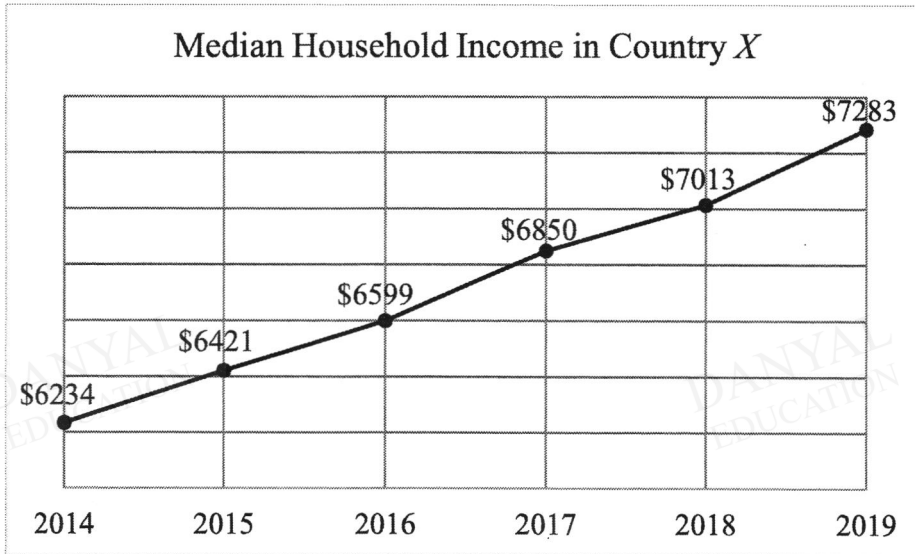
> ### Best Instalment Plan!
>
> NO Deposit!
>
> NO Admin Fee!
>
> Interest rate 19.99% per annum!

Calculate how much he has to pay each month.

Answer $.................................... [3]

11  The graph below shows the median household income in Country $X$ from 2014 to 2019.

Household income is the combined gross income of all the people occupying the same housing unit.



**(a)** Calculate the percentage increase in household income from 2015 to 2018.

*Answer* ……………………………….% [1]

**(b)** Ashwinder claims median household income per person can be a more accurate measure of wealth compared to median household income.

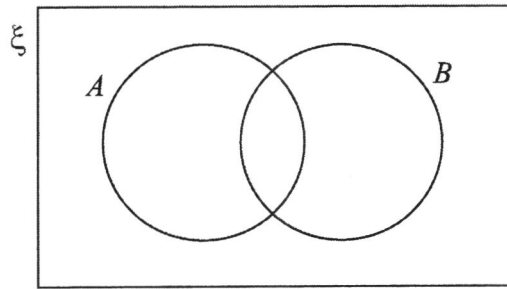Do you agree with Ashwinder? Explain your answer.

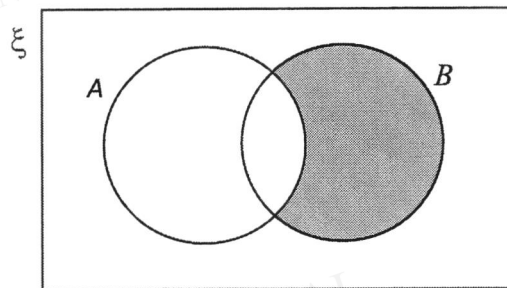*Answer* ……………………………………………………………………………………………..…..

………………………………………………………………………………………………………..……

…………………………………………………………………………………………………...…… [1]

**12 (a)** On the Venn diagram, shade the region which represents $A' \cup B$. [1]

**(b)** Write down the set represented by the following shaded region.

*Answer* ...................................... [1]

---

**13** The points $(-3,5)$ and $(2,20)$ lie on the curve given by the equation $y = 3x^2 + bx + c$.

Use an algebraic method to find the values of $b$ and $c$.

*Answer b =* ......................................

*c =* ...................................... [4]

**14 (a)** Rearrange the formula $f = \dfrac{1}{4\pi}\sqrt{\dfrac{k}{n}}$ to make $n$ the subject.

*Answer n = ...................................* [2]

**(b)** Hence find the value of $n$ if $f = \dfrac{5}{4\pi}$ and $k = 125$.

*Answer n = ...................................* [2]

**15** Four interior angles of a 7-sided polygon are $100^\circ$, and the others are $(x + 123)^\circ$, $(2x - 39)^\circ$ and $(282 - x)^\circ$. Find the largest interior angle.
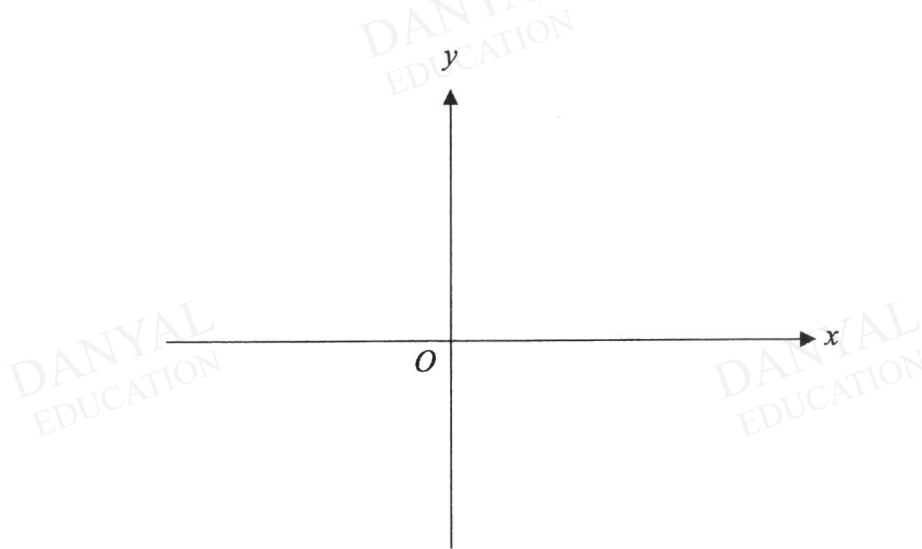
*Answer ...................................* [3]

16 (a) Use a graphical method to solve $1 + 2x^3 = \dfrac{1}{7^x}$.
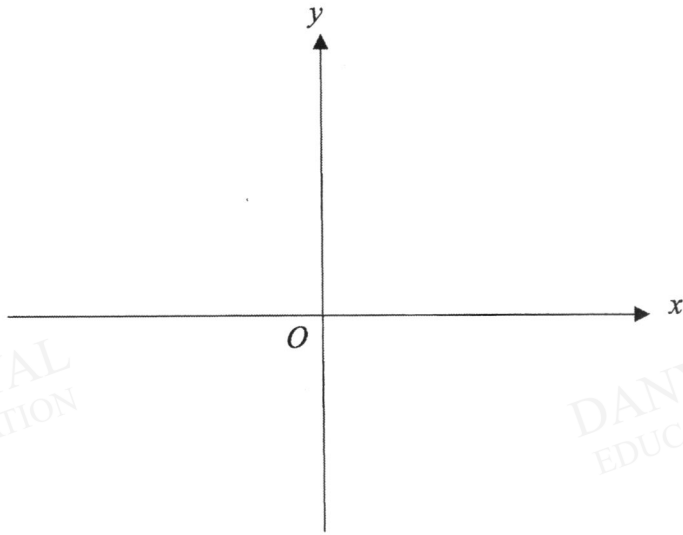


*Answer* ..................................... [3]

(b) (i) Sketch the graph of $y = x(4 - x)$ on the axes below.



[2]

(b) (ii) Hence find the maximum value of $15^{4x - x^2}$.

*Answer* ..................................... [1]

**17** A statue is made from 8400 cm$^3$ of metal.

**(a)** Given that the density of the metal is 6.5 g/cm$^3$, calculate the mass, in kg, of the statue.

*Answer* ...............................kg [2]

**(b)** The statue is 150 cm tall.
A similar model of the statue is made from 33 cm$^3$ of the same metal.
Calculate the height, in cm, of the model.

*Answer* ...............................cm [2]

**18** It is given that $y$ is inversely proportional to $x^2$. Find the percentage decrease in $y$ when $x$ is increased by 150%.

*Answer* ................................. % [3]

**19**
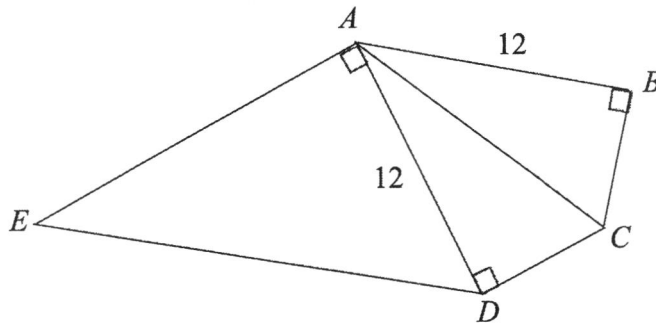


The diagram shows a pentagon $ABCDE$ made up of three triangles. $AD = AB = 12$ cm.
Angle $ABC$ = angle $ADC$ = angle $DAE = 90^{\circ}$.

**(a)** Show that triangle $ABC$ is congruent to triangle $ADC$.

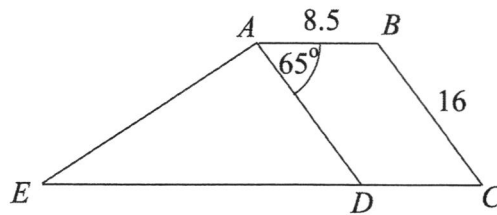Answer ......................................................................................................................

.............................................................................................................................

.............................................................................................................................

.......................................................................................................................... [2]

**(b)** Given that $AE = 7DC$, find the ratio  area of triangle $ADE$ : area of $ABCD$.

Answer ................. : ..................... [1]

**20**



*ABCD* is a parallelogram. *EDC* is a straight line.
*DA* bisects angle *EAB*.

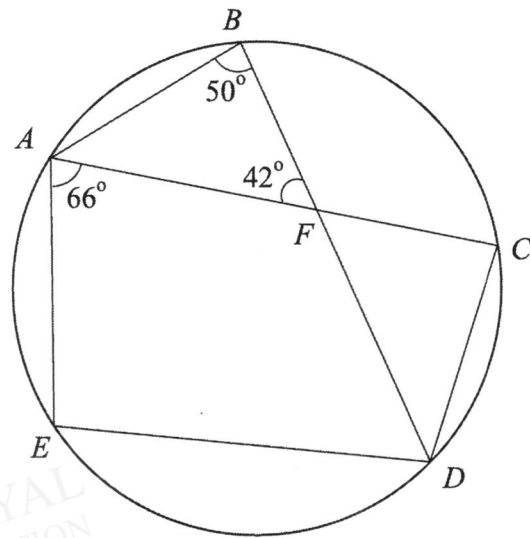*AB* = 8.5 cm, *BC* = 16 cm and angle *DAB* = 65°.

Calculate
**(a)** the area of the parallelogram,

*Answer* …………………………… cm² [1]

**(b)** the perimeter of the quadrilateral *ABCE*.

*Answer* ………………………… cm [3]

21



In the diagram, $A$, $B$, $C$, $D$ and $E$ are points on the circumference of a circle.

Angle $ABD = 50^\circ$, angle $EAC = 66^\circ$ and angle $AFB = 42^\circ$.

Find, giving reasons for each answer,

(a) angle $FDC$,

Answer ................................... [2]

(b) angle $AED$,

Answer ................................... [1]

(c) angle $EDF$.

Answer ................................... [1]

22 The stem-and-leaf diagram shows the distribution of distances, in km, covered by a taxi over 16 consecutive days.

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

Key: 2 | 7 means 27 km

**(a)** Write down the median of the distances.

*Answer* ................................................ km [1]

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

*Answer* ........................................ km [2]

**(c)** It was discovered that the distances had been incorrectly measured.

Each actual distance is 300 m more than what was recorded.

Explain how the median of the recorded distances is affected by this error.

*Answer* Due to this error, the median of the recorded distances is ................................

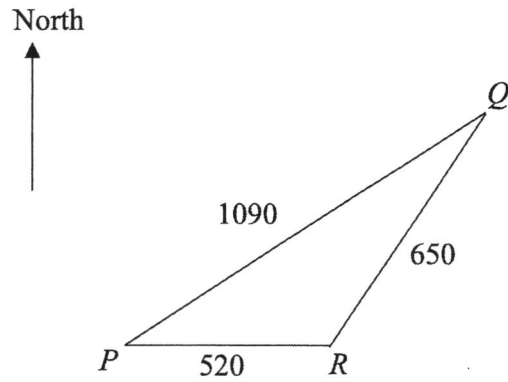................................................................ than the median of the actual distances.     [1]

23  A survey was conducted on the number of lipsticks 50 women own. The results were recorded in the following table.

| Number of Lipsticks | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Number of Women | 5 | $x$ | 12 | 12 | $y$ | 6 | 3 |

Given that the mean is 2.7, find the value of $x$ and of $y$.

*Answer x =* ……………, *y =* …………... [4]

24

North

Q

1090

650

P    520    R

$P$, $Q$ and $R$ are three points on level ground.

$R$ is 520 km east of $P$.

$PQ$ is 1090 km and $RQ$ is 650 km.

Calculate

**(a)** angle $PRQ$,

*Answer* .......................................... [2]

**(b)** the bearing of $Q$ from $R$.

*Answer* ........................................ [1]

Name: _____ (    )          Class:_____

## PRELIMINARY EXAMINATION
## GENERAL CERTIFICATE OF EDUCATION ORDINARY LEVEL

# MATHEMATICS                                          **4048/02**

Paper 2                                          **Friday 21 August 2020**

**2 hours 30 minutes**

Candidates answer on the Question Paper.

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**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 on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use 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.
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.

| Q1 | | Q4 | | Q7 | | Q10 | | Paper 1 | | / 80 |
|----|---|----|---|----|---|-----|---|---------|---|------|
| Q2 | | Q5 | | Q8 | | | | Paper 2 | | /100 |
| Q3 | | Q6 | | Q9 | | | | | | |
| | | | | | | | | **Total** | | **/ 100** |

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圣尼各拉女校
**CHIJ ST. NICHOLAS GIRLS' SCHOOL**
Girls of Grace ● Women of Strength ● Leaders with Heart

**[Turn Over**

## *Mathematical Formulae*

*Compound interest*

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

*Mensuration*

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

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

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

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

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

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

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

*Trigonometry*

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

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

*Statistics*

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

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

**1** **(a)** Write as a single fraction in its simplest form $\dfrac{x-2}{x^2+7x+10}+\dfrac{x-5}{3x+6}$.

*Answer* .......................................... [3]

**(b)** Simplify $\dfrac{16x^2-9y^2}{12x^2-9xy}$.

*Answer* .......................................... [2]

**(c)** Solve the equation $\dfrac{1}{(x+1)(x-2)}=\dfrac{2}{8-x}$.

*Answer x =* .......................................... [4]

**2** **(a) (i)** Paul sold a painting for $15680.
He made a profit of 12% in the sale.
How much did he pay for the painting?

*Answer* $ ...................................... [1]

**(ii)** Paul saved $15680 in a bank at 2.05% per year compound interest.
What was the value of his savings after 3 years?
Give your answer correct to the nearest dollar.

*Answer* $ ...................................... [2]

**(iii)** Which was greater, the profit he made on the painting or the interest he received in 3 years from the bank? Calculate the difference between the two.

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

.............................................................................. [3]

**(b)** Paul bought an apartment at the end of 2006.

The price of the apartment at the end of 2006 was 9% higher than at the end of 2005.
The price of the apartment at the end of 2007 was 6% higher than at the end of 2006.

**(i)** Express the price of the apartment at the end of 2007 as a percentage of the price at the end of 2005.

*Answer* ........................................ % [1]

**(ii)** Given that the increase in the price from 2006 to 2007 was $63000, calculate the increase in the price of the apartment from 2005 to 2006.

Give your answer correct to the nearest hundred dollars.

*Answer* $........................................ [3]

3   A Thai restaurant sells 3 different types of dinner sets. Each dinner set contains packets of 4 different types of food items: fried rice, stir fried vegetables, sambal toufu and mango sticky rice.

Matrix **T** shows the breakdown of the number of packets of each type of food item within the 3 different sets.

$$\begin{array}{cccc} & \text{Set} & \text{A} & \text{B} & \text{C} \\ \mathbf{T} = & \begin{pmatrix} 2 & 4 & 7 \\ 1 & 2 & 3 \\ 1 & 1 & 2 \\ 2 & 3 & 4 \end{pmatrix} & \begin{array}{l} \text{Fried Rice} \\ \text{Stir Fried Vegetables} \\ \text{Sambal Toufu} \\ \text{Mango Sticky Rice} \end{array} \end{array}$$

**(a)** On average, the restaurant sells 5 Set A, 3 Set B and 6 Set C per day.

Represent this as a $3 \times 1$ column matrix **R**.

*Answer* ........................................ [1]

**(b)** Evaluate the matrix **N** = 7**R**.

*Answer* ........................................ [1]

**(c)** Evaluate **M** = **TN**.

*Answer* ........................................ [2]

**(d)** State what each of the element(s) of **M** represent.

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

.......................................................................................................................[1]

**(e) (i)** If the restaurant sells Set A at $24, Set B at $43 and Set C at $70, calculate the total sales from the dinner sets.

*Answer* $ ....................................... [1]

**(ii)** Instead of buying the dinner sets where the combination of food items is fixed, the food items can also be bought individually (this is known as à la carte).

For à la carte purchase, a packet of fried rice costs $4, mixed vegetable $6.50, sambal toufu $5 and mango sticky rice $5. In order to boost business, the restaurant also extends a discount of 10% for all à la carte purchases.

Calculate the percentage loss in sales when the restaurant sells dinner sets instead of à la carte.

*Answer* ....................................... % [3]

**[Turn Over**

4  **(a)** The *n*th term of a sequence is given by $T_n = \dfrac{n(n+3)}{2}$ .

   **(i)** Use the formula to find $T_{16}$.

*Answer* $T_{16}$ = ……………………………… [1]

   **(ii)** Which term in the sequence has a value of 54?

*Answer* ………………………………… [2]

   **(iii)** Find, in its simplest form, the expression for $T_{n+1} + T_n$, leaving your answer in terms of *n*.

*Answer* ………………………………… [2]

   **(iv)** Explain why the sum of two consecutive terms of this sequence will never be a perfect square.

[2]

**(b)** The first four terms of a sequence are 6, 10, 14 and 18.

**(i)** Write down the 7$^{th}$ term in this sequence.

*Answer* ......................................... [1]

**(ii)** Find, an expression, in terms of *n*, for the *n*th term of this sequence.

*Answer* ......................................... [1]

5  A man was driving his truck from point $A$ to point $C$ in a remote part of a country. After he has travelled for 80 km, at a constant speed of $x$ km/h, he reached point $B$, where his truck broke down.

**(a)** Write down an expression, in terms of $x$, for the time in hours, taken for him to drive from $A$ to $B$.

*Answer* ……………………………… h [1]

He then walks the remaining 6 km from $B$ to $C$ at a constant speed of $(x - 60)$ km/h.

**(b)** Write down an expression, in terms of $x$, for the time in hours, taken for him to walk from $B$ to $C$.

*Answer* ……………………………… h [1]

**(c)** The man took 4 hours to travel from $A$ to $C$.
Write down an equation in $x$ and show that it reduces to $2x^2 - 163x + 2400 = 0$.

[3]

**(d)** Solve the equation $2x^2 - 163x + 2400 = 0$.

*Answer* $x =$ ……………………………… [3]

**(e)** Find how long it would have taken if the man was able to drive from $A$ to $C$ at the original constant speed.

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

*Answer* ………… h ……………… min [2]

12

**6 (a)**



The diagram shows an ornament made up of a hemispherical block of wood of diameter 32 cm, that has a smaller hemispherical block of diameter 16 cm, carved out of it.

**(i)** Calculate the surface area of the ornament, leaving your answer in terms of $\pi$.

Answer .......................................... cm$^2$ [3]

**(ii)** Calculate the volume of the ornament.

Answer .......................................... cm$^3$ [2]

CHIJ SNGS Preliminary Examinations 2020 - Mathematics 4048/02

**(b)**



The figure shows a semicircle with centre $O$.
$AB$ is the diameter and point $P$ is on the circumference of the circle.

Angle $OBP = 75°$ and $BP = 5$ cm.

**(i)** Show that $OA = 9.66$ cm, correct to three significant figures.

[2]

**(ii)** Calculate the area of the shaded region.

*Answer* .......................................... cm² [3]

**7**



The diagram shows a solid made up of a pyramid and a prism.
The base of the prism is a right-angled triangle.

*FC*, *AD* and *EB* are vertically above the base.

*FC* = 18 cm, *AD* = *EB* = 6 cm, *AB* = *DE* = 3.6 cm, *BC* = 4.8 cm and *AC* = 6 cm.

**(a)** Show that $FD^2 = 180$.

[2]

**(b)** Show that triangle *FED* is a right-angled triangle.

[3]

**(c)** Calculate the total surface area of the solid.

*Answer* ........................................ cm$^2$ [3]

**(d)** Find the ratio  volume of the prism : volume of the pyramid.

*Answer* ................. : ................... [2]

**8**  *X* is the point (1, 4) and *Y* is the point (6, 9).

Find

**(a)** the length of the line *XY*,

*Answer* ........................................ units [2]

**(b)** the equation of the line XY,

*Answer* ........................................ [3]

**(c)** the equation of the line *l*, which is parallel to *XY* and passes through the point *A* which has coordinates (2, 0),

*Answer* ........................................ [3]

**(d)** the coordinates of the point *Z* that lies on *XY* such that $XY = 4\,XZ$.

*Answer* Z(................ , ....................) [2]

**9** Nadirah observes that the queue at one of the school's canteen stall, Stall E, is always long. She decides to do a project to improve the situation.

**(a)** She finds information about the times, in seconds, spent by 100 students in the queue for Stall E. The cumulative frequency curve shows the distribution of the queuing times.



**Queuing Times for Stall E**
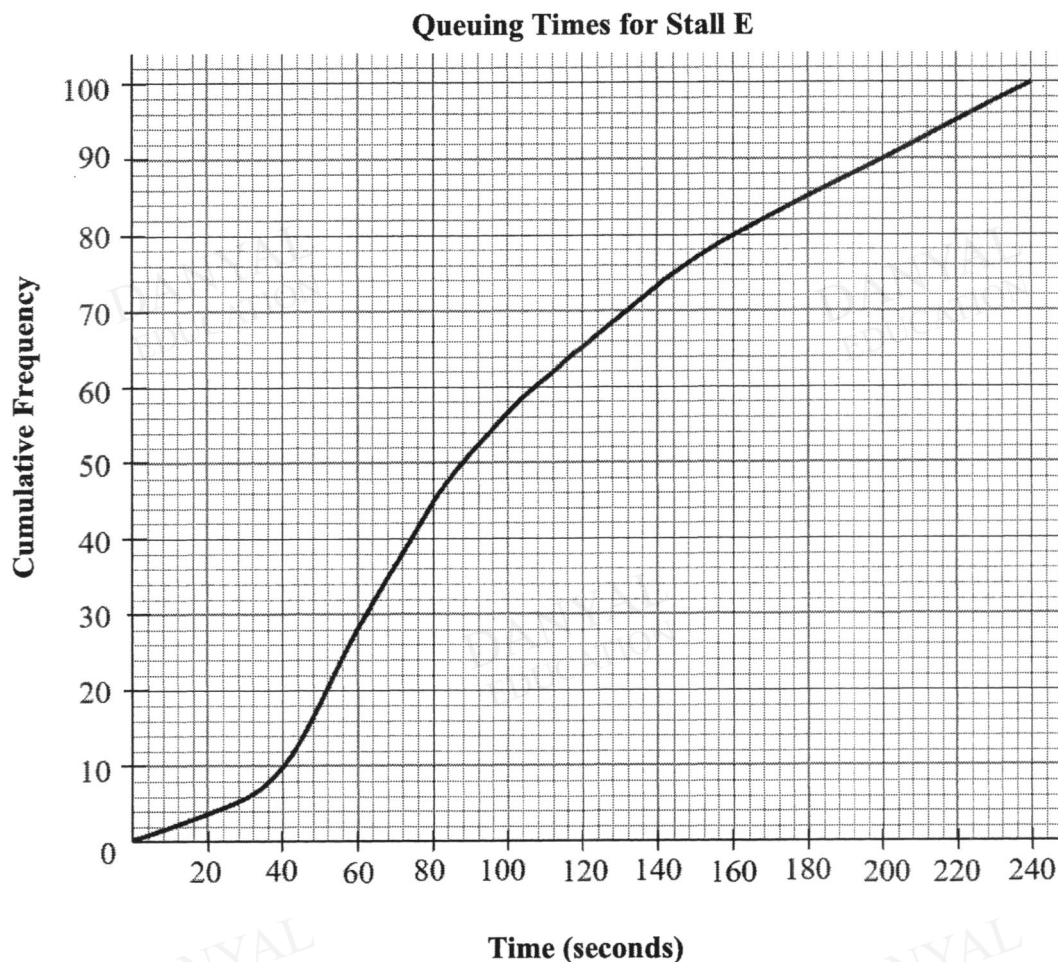
**(i)** Copy and complete the grouped frequency table for the queuing times for Stall E.

| Time ($t$ seconds) | $0 \leq t < 40$ | $40 \leq t < 80$ | $80 \leq t < 120$ | $120 \leq t < 160$ | $160 \leq t < 200$ | $200 \leq t < 240$ |
|---|---|---|---|---|---|---|
| Frequency | 10 | 35 | 20 | | | 10 |

[1]

**(ii)** Calculate an estimate of the mean queuing time of the 100 students.

*Answer* ....................................... s [1]

**(iii)** Calculate an estimate of the standard deviation.

*Answer* ....................................... s [1]

**(iv)** A student claims that 75% of students queuing at Stall E had to wait at least 144 seconds. Is this claim true? Explain your answer.

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

...............................................................................................................

......................................................................................................... [2]

A few weeks later, Nadirah recorded the queuing time of another 100 students. She observes that the longest queuing time is now 200 seconds and the median queuing time is smaller.

**(v)** State two possible ways the cumulative frequency curve for this set of data differs from the given curve.

1. ...............................................................................................................

2. ......................................................................................................... [2]

**(b)** The table shows the number of students queuing at Stall F during recess on a particular day. Each student queues only once.

|  | Sec 3 | Sec 4 | Sec 5 |
|---|---|---|---|
| Boy | 18 | 7 | 6 |
| Girl | 10 | 16 | 8 |

**(i)** One student in the queue is selected at random.
Find, as a fraction in its lowest term, the probability that the student is from Sec 4.

*Answer* ....................................... [1]

**(ii)** Two students in the queue are selected at random.
Find the probability that

**(a)** one of them is a boy and the other is a girl,

*Answer* ....................................... [2]

**(b)** both students are girls and one of them is from Sec 3.

*Answer* ....................................... [2]

**10** Mr Samad owns a bakery that specialises in pineapple tarts. Each pineapple tart is in the shape of a sphere of radius 15 mm with its bottom part removed as shown below.
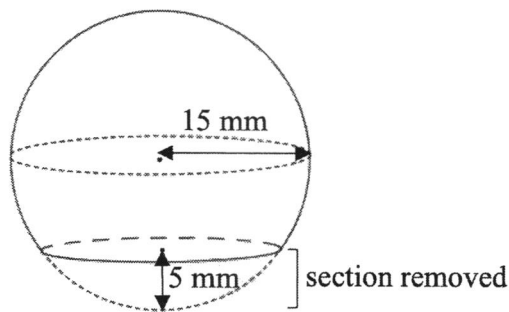


**(a)** Show that the height of a pineapple tart is 25 mm.

[1]

The pineapple tarts are arranged such that after each layer, a piece of baking paper, of negligible thickness, is placed to ensure the tarts stay in place. The side and top views of how the tarts are arranged are shown below.



Side View                                Top View
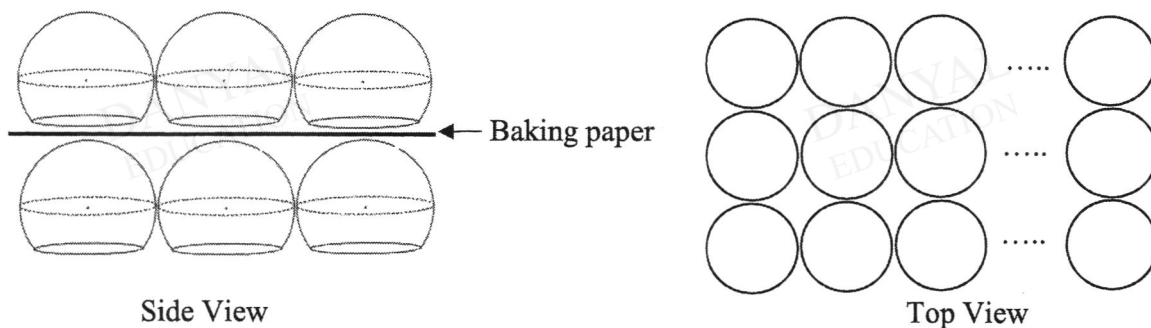
Mr Samad sells his pineapple tarts in rectangular containers that measure 21 cm in length, 9 cm in width and 5 cm in height.

**(b)** Calculate the number of pineapple tarts in a rectangular container.

*Answer* ..................................................... [2]

During festive seasons, the pineapple tarts are packed in cylindrical containers.

The top view of each layer of the pineapple tarts is shown below.
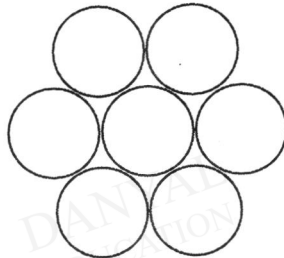


Top View of each Layer

**(c)** Calculate the diameter and the height of the cylindrical container such that it can fit the same number of pineapple tarts in **(b)**.

*Answer* diameter = ................................. cm

height = ............................... cm [2]

During one of the festive seasons, Mr Samad received a bulk order of 250 containers of pineapple tarts.

He decided to use a courier service to deliver the pineapple tarts. He has a choice of 2 courier services: GoVan and Singapost. Both courier services offer no weight limit and charge based on the size of goods. The cylindrical containers are packed in cardboard boxes based on the courier service's requirement.

To prevent the pineapple tarts from breaking, Mr Samad packs each cylindrical container upright as shown below.



The rates of the two courier services are as follow.

| GoVan | Singapost |
|---|---|
|  |  |
| 50 cm, 50 cm, 50 cm | 40 cm, 50 cm, 55 cm |
| **Max. 8 boxes per trip** | **Max. 8 boxes per trip** |
| Handling fee per box: $5 | Handling fee per box: $3.50 |
| Rate per trip: $25 base charge + $0.80/km | Rate per trip: $30 base charge + $0.50/km |

**(d)** Given that the trip distance is 23.7 km, which courier service should Mr Samad use? Support your answer with clear workings.
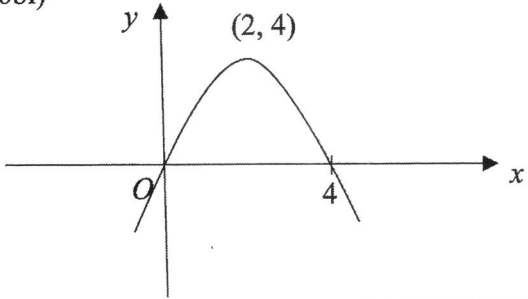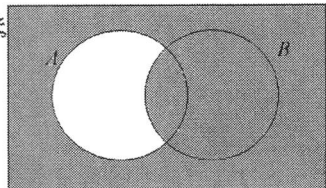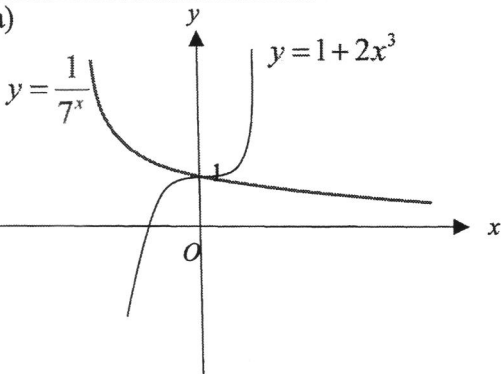
[6]

2020 Y4 Math EOY Paper 1 Answer Key

| | |
|---|---|
| 1) $0.22$, $\dfrac{1}{5}$, $\left(\dfrac{2}{5}\right)^2$, $0.033$ | 16bi)  |
| 2a) $6^{11}$ | |
| 2b) $13\dfrac{3}{7}$ | |
| 3) $a = -3$ or $2$ | |
| 4a) $252 = 2^2 \times 3^2 \times 7$, $280 = 2^3 \times 5 \times 7$ | |
| 4b) $k = 294$ | |
| 4c) $2^2 \times 7 = 28$ | 16bii) $50625$ |
| 5a) $-3 < x < 6.6$ | 17a) $54.6$ kg |
| 5b) $2, 3, 5$ | 17b) $23.7$ cm |
| 6) $77$ | 18) $84\%$ |
| 7) Point $O$ is not the centre of the circle. | $\angle ABC = \angle ADC = 90°$ (given) |
| 8a) $\dfrac{(a+1)}{(a-1)}$ | 19a) $AD = AB = 12$ cm (given) <br> $AC$ is a common side. |
| 8b) $(1+n)(m-1)$ | $\triangle ABC \equiv \triangle ADC$ $(RHS)$ |
| 9) 1 min 56 s | |
| 10) $\$132.40$ | 19b) $7 : 2$ |
| 11a) $9.22\%$ | 20a) $123$ cm$^2$ |
| 11b) Yes, I agree with him. A household income, when divided by the number of household members, is smaller for a larger household as compared to a smaller household. | 20b) $70.9$ cm |
| | 21a) $43$ km |
| 12a)  | 21b) $11$ km |
| | 21c) The median of the recorded distances is **300 m less** than the median of the actual distances due to this error. |
| 12b) $A' \cap B$ | 23) $x = 7$, $y = 5$ |
| 13) $b = 6$, $c = -4$ | 24a) $137.1°$ |
| 14a) $n = \dfrac{k}{16\pi^2 f^2}$ | 24b) $047.1°$ |
| 14b) $n = 5$ | |
| 15) $(282 - x)° = 215°$ | |
| 16a)  | |

Name: _____ (    )                    Class:_____

## MATHEMATICS    Students Solutions                        4048/01

Paper 1                                        **Wednesday 19 August 2020**

**2 hours**

Candidates answer on the Question Paper.

**READ THESE INSTRUCTIONS FIRST**

Write your name, register 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 highlighters, glue or correction fluid or correction tape.

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.

Calculators should be used where appropriate.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give 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.

80

This document consists of **19** printed pages and **1** blank page

圣尼各拉女校
**CHIJ ST. NICHOLAS GIRLS' SCHOOL**

**[Turn Over**

# Mathematical Formulae

*Compound interest*

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

*Mensuration*

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

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

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

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

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

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

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

*Trigonometry*

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

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

*Statistics*

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

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

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

$$\frac{1}{5}, \quad \left(\frac{2}{5}\right)^2, \quad 0.033, \quad 0.22$$

= **0.2, 0.16, 0.033, 0.22**

Answer ..... $0.22, \dfrac{1}{5}, \left(\dfrac{2}{5}\right)^2, 0.033$ ..... [1]

___

2  **(a)** Expressing your answer as a power of 6, find $6^5 \div 6^{-3} \times 6^3$.

$$6^5 \div 6^{-3} \times 6^3 = 6^{5-(-3)+3}$$
$$= 6^{11}$$

Answer ..... $6^{11}$ ..... [1]

**(b)** Simplify $\dfrac{(3x^2)^3}{21x^4} \times 5x^{-2} + 7x^0$.

$$\frac{(3x^2)^3}{21x^4} \times 5x^{-2} + 7x^0$$

$$= \frac{27x^6}{21x^4} \times \frac{5}{x^2} + 7$$

$$= 13\frac{3}{7}$$

Answer ..... [2]

___

3  Solve $a(a+1) = 6$.

$$a(a+1) = 6$$
$$a^2 + a - 6 = 0$$
$$(a+3)(a-2) = 0$$
$$a = -3 \text{ or } a = 2$$

Answer ..... [2]

**4** **(a)** Express 252 and 280 as the product of their prime factors.

$$252 = 2^2 \times 3^2 \times 7$$
$$280 = 2^3 \times 5 \times 7$$

*Answer* 252 = .......................................

280 = ............................... [2]

**(b)** The number 252*k* is a perfect cube. Find the smallest positive integer value of *k*.

$$252 \times k = 2^2 \times 3^2 \times 7 \times (2 \times 3 \times 7^2)$$
$$\therefore k = 294$$

*Answer* *k* = ................................. [1]

**(c)** Write down the greatest integer that will divide both 252 and 280 exactly.

$$2^2 \times 7 = 28$$

*Answer* .................................... [1]

**5 (a)** Solve the inequalities $-2 < \dfrac{2(7+5x)}{8} < 10$.

$$-2 < \frac{2(7+5x)}{8} < 10$$

$-16 < 14 + 10x \quad and \quad 14 + 10x < 80$

$-30 < 10x \qquad\qquad 10x < 66$

$-3 < x \qquad\qquad\quad x < 6.6$

$-3 < x < 6.6$

*Answer* ................................................ [2]

**(b)** Write down all the prime numbers that satisfy $-2 < \dfrac{2(7+5x)}{8} < 10$.

2, 3, 5

*Answer* ........................................... [1]

---

**6** Given that $x^2 + y^2 = 17$ and $xy = 5$, find the value of $(3x-3y)^2 + 2(x-y)^2$.

$(3x-3y)^2 + 2(x-y)^2$

$= 9x^2 - 18xy + 9y^2 + 2(x^2 - 2xy + y^2)$

$= 9(x^2 + y^2) - 18(xy) + 2(x^2 + y^2) - 4(xy)$

$= 9(17) - 18(5) + 2(17) - 4(5)$

$= 77$

*Answer* ........................................ [4]
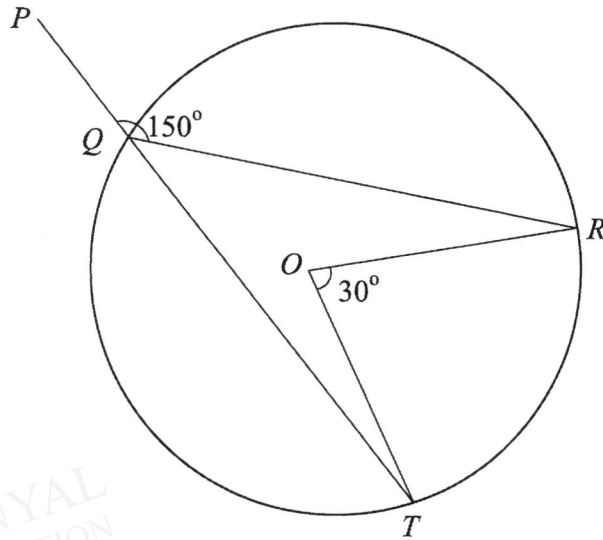
7



In the diagram, $Q$, $R$ and $T$ are points on a circle.

$PQT$ is a straight line, angle $PQR = 150°$ and angle $TOR = 30°$.

Determine, with reasons, if $O$ is the centre of the circle.

*Answer*     Point $O$ is ...| is not the centre |... of the circle because ....................

.......... | $\angle TQR = 180° - 150° = 30°$ (adjacent angles on a straight line)  | ......

.......... | $\angle TOR = 30° \neq 2(30°)$ Therefore angle at centre 2 times angle at
circumference does not hold. | ......

.................................................................................................................... [3]

**8** **(a)** Simplify $\dfrac{a^2+2a+1}{a^2-1}$.

$$\frac{a^2+2a+1}{a^2-1}$$

$$=\frac{(a+1)(a+1)}{(a+1)(a-1)}$$

$$=\frac{(a+1)}{(a-1)}$$

Answer ......................................... [2]

**(b)** Factorise completely $m-n-1+mn$.

$$m-n-1+mn$$

$$=m+mn-n-1$$

$$=m(1+n)-(n+1)$$

$$=(1+n)(m-1)$$

Answer ......................................... [2]

---

**9** The times taken by an athlete to run 800 metres in three successive races were
2 minutes 1.8 seconds, 1 minute 59.1 seconds and 2 minutes 2.4 seconds.

In order to qualify for the next round, his average time for four races must be less than
2 minutes.

Calculate the time he took in his fourth race if he just qualified for the next round.
Give you answer in minutes and seconds, correct to the nearest second.

2 min 1.8s = 2.03 min

1 min 59.1s = 1.985 min

2 min 2.4s = 2.04 min

$$\frac{2.03+1.985+2.04+x}{4}<2$$

$x<1.945$

Ans: 1 min 56.7s

= 1 min 56s (nearest sec)     **(round down)**

**OR** 2 min 1.8s = 121.8 s

1 min 59.1s = 119.1 s

2 min 2.4s = 122.4 s

$$\frac{121.8+119.1+122.4+x}{240}<2$$

$x<116.7$

Ans: 116.7 s = 1 min 56.7s

= 1 min 56s (nearest sec)

Answer ................. min .............. s [3]

10 Mr Sim wishes to buy a dishwasher that costs $1589.

He decided to purchase the dishwasher using the instalment plan below with a repayment period of 15 months in equal monthly instalments.

> **Best Instalment Plan!**
>
> **NO** Deposit!
>
> **NO** Admin Fee!
>
> Interest rate 19.99% per annum!

Calculate how much he has to pay each month.

$$\text{Interest} = \frac{1589 \times 19.99 \times \frac{15}{12}}{100}$$

$$= \$397.0513$$

Hire Purchase Price $= \$1589 + \$397.0513$

$$= \$1986.0513$$

Monthly instalment $= \$1986.0513 \div 15$

$$= \$132.4034$$

$$= \$132.40 \text{ (nearest cents)}$$

*Answer* $.................................... [3]

**11** The graph below shows the median household income in Country $X$ from 2014 to 2019.

Household income is the combined gross income of all the people occupying the same housing unit.



Median Household Income in Country $X$
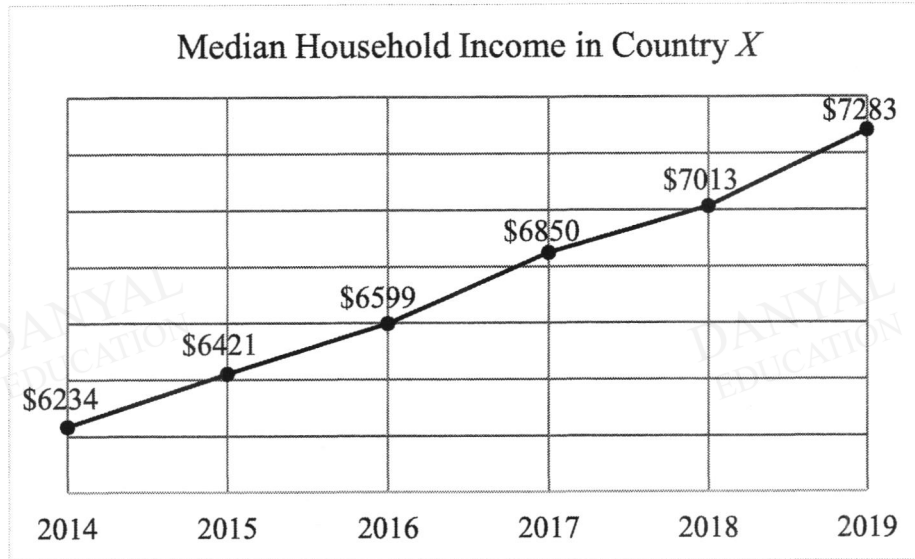
**(a)** Calculate the percentage increase in household income from 2015 to 2018.

$$\text{Percentage increase} = \frac{7013 - 6421}{6421} \times 100\%$$

$$= 9.2197\%$$

$$= 9.22\% \text{ (3 s.f.)}$$

*Answer* ....................................% [1]

**(b)** Ashwinder claims median household income per person can be a more accurate measure of wealth compared to median household income.

Do you agree with Ashwinder? Explain your answer.

*Answer*  Yes, I agree with him. A household income, when divided by the number     ….......
of household members, is smaller for a larger household as compared to a
….......... smaller household.                                                                                        …......

................................................................................................................................... [1]
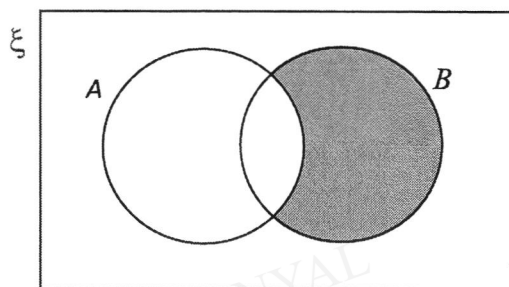
**12 (a)** On the Venn diagram, shade the region which represents $A' \cup B$. [1]
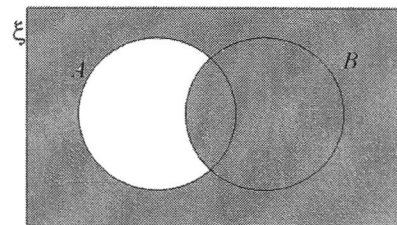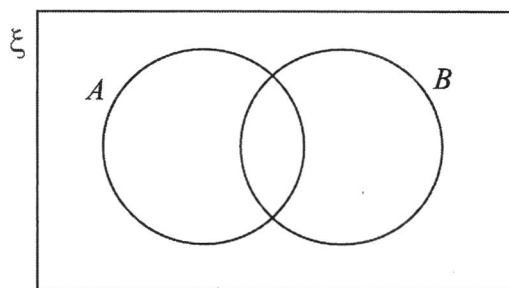


**(b)** Write down the set represented by the following shaded region.



$A' \cap B$

*Answer* ......................................... [1]

---

**13** The points $(-3, 5)$ and $(2, 20)$ lie on the curve given by the equation $y = 3x^2 + bx + c$.
Use an algebraic method to find the values of $b$ and $c$.

Sub $(-3, 5)$ *and* $(2, 20)$ into $y = 3x^2 + bx + c$

Equation 1:

$5 = 3(-3)^2 + b(-3) + c$
$3b - c = 22$

Equation 2:

$20 = 3(2)^2 + b(2) + c$
$2b + c = 8$

Equation 1 + Equation 2:

$5b = 30$
$b = 6$

$c = -4$

*Answer* $b =$ .....................................

$c =$ ..................................... [4]

**14 (a)** Rearrange the formula $f = \dfrac{1}{4\pi}\sqrt{\dfrac{k}{n}}$ to make $n$ the subject.

$$f = \frac{1}{4\pi}\sqrt{\frac{k}{n}}$$

$$4\pi f = \sqrt{\frac{k}{n}}$$

$$16\pi^2 f^2 = \frac{k}{n}$$

$$n = \frac{k}{16\pi^2 f^2}$$

*Answer n =* ..................................... [2]

**(b)** Hence find the value of $n$ if $f = \dfrac{5}{4\pi}$ and $k = 125$.

$$n = \frac{125}{16\pi^2 \left(\dfrac{5}{4\pi}\right)^2}$$

$$n = \frac{125}{16\pi^2 \times \dfrac{25}{16\pi^2}}$$

$$n = 5$$

*Answer n =* ..................................... [2]

---

**15** Four interior angles of a 7-sided polygon are $100°$, and the others are $(x+123)°$, $(2x-39)°$ and $(282-x)°$. Find the largest interior angle.

Sum of interior angles
$$= (7-2)\times 180°$$
$$= 900°$$

$$4\times 100 + x + 123 + 2x - 39 + 282 - x = 900$$
$$2x = 134$$
$$x = 67$$
$$(x+123)° = 190°$$
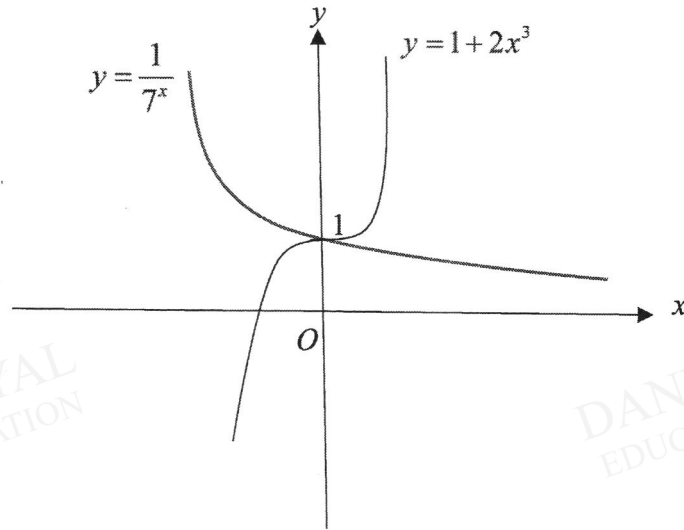$$(2x-39)° = 95°$$
$$\therefore (282-x)° = 215° \text{ is the largest int. angle}$$

*Answer* ..................................... [3]

**16 (a)** Use a graphical method to solve $1 + 2x^3 = \dfrac{1}{7^x}$.

$y = \dfrac{1}{7^x}$   $y = 1 + 2x^3$

$y$

1

$O$   $x$

$x = 0$

*Answer* ...................................... [3]

**(b) (i)** Sketch the graph of $y = x(4-x)$ on the axes below.

$y$

$(2, 4)$

$O$   4   $x$

[2]
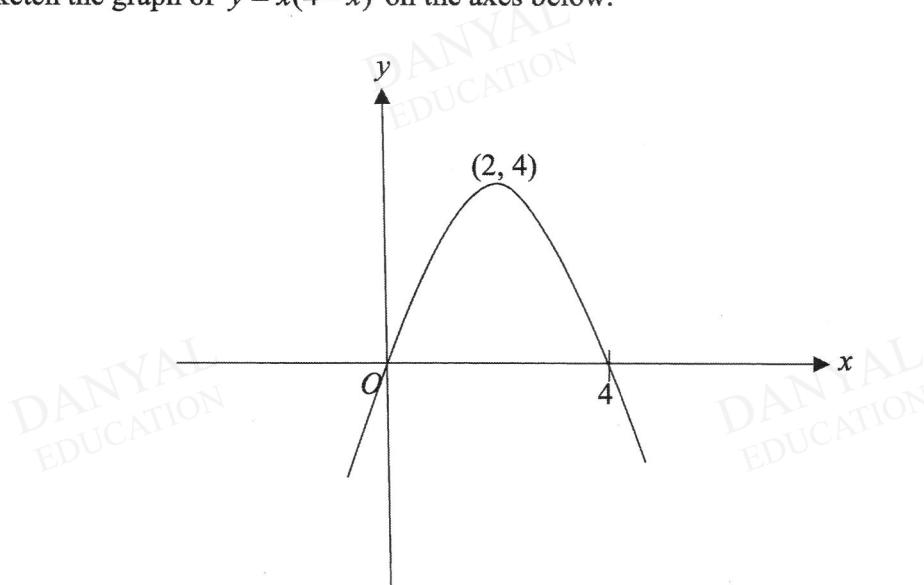
**(b) (ii)** Hence find the maximum value of $15^{4x-x^2}$.

Max pt. $(2, 4)$

maximum value of $15^{4x-x^2}$

$= 15^4$

$= 50625$

*Answer* ...................................... [1]

17 A statue is made from 8400 cm$^3$ of metal.

(a) Given that the density of the metal is 6.5 g/cm$^3$, calculate the mass, in kg, of the statue.

$$8400 \times 6.5 \text{ g}$$
$$= \frac{8400 \times 6.5}{1000} \text{kg}$$
$$= 54.6 \text{ kg}$$

*Answer* .................................kg [2]

(b) The statue is 150 cm tall.
A similar model of the statue is made from 33 cm$^3$ of the same metal.
Calculate the height, in cm, of the model.

$$\frac{h}{150} = \sqrt[3]{\frac{33}{8400}}$$
$$h = \sqrt[3]{\frac{33}{8400}} \times 150$$
$$h = 23.7 \text{ cm}$$

*Answer* .................................cm [2]

18 It is given that $y$ is inversely proportional to $x^2$. Find the percentage decrease in $y$ when $x$ is increased by 150%.

$$y = \frac{k}{x^2}$$

$$x_1 = 2.5x$$

$$y_1 = \frac{k}{x_1^2}$$

$$y_1 = \frac{k}{(2.5x)^2}$$

$$y_1 = \frac{k}{6.25x^2}$$

$$y_1 = \frac{y}{6.25}$$

$$y_1 = 0.16y$$

% decrease $= \dfrac{y - 0.16y}{y} \times 100\%$    **OR**    % change $= \dfrac{0.16y - y}{y} \times 100\%$    **OR**    % decrease $= \dfrac{\frac{k}{6.25x^2} - \frac{k}{x^2}}{\frac{k}{x^2}} \times 100\%$

$= 84\%$         $= -84\%$         $= 84\%$

Ans: 84         Ans: 84         Ans: 84

*Answer* .................................% [3]

19
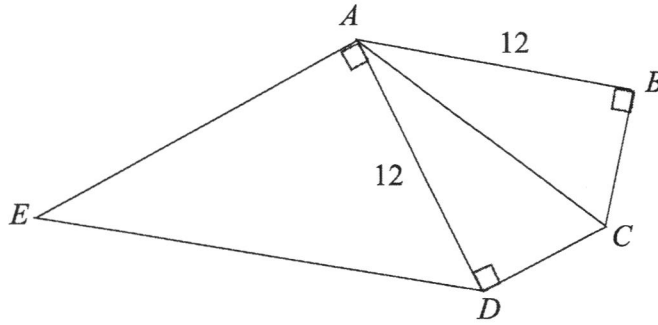


The diagram shows a pentagon *ABCDE* made up of three triangles. $AD = AB = 12$ cm.
Angle $ABC$ = angle $ADC$ = angle $DAE = 90°$.

**(a)** Show that triangle *ABC* is congruent to triangle *ADC*.

*Answer*

$\angle ABC = \angle ADC = 90°$ (given)

$AD = AB = 12$ cm (given)

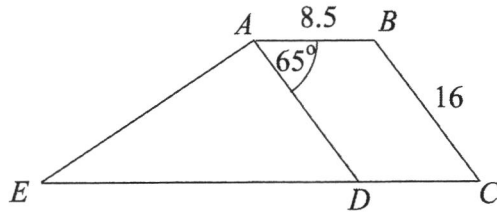$AC$ is a common side.

$\triangle ABC \equiv \triangle ADC$ $(RHS)$

............................................................

............................................................

............................................................

............................................................ [2]

**(b)** Given that $AE = 7DC$, find the ratio area of triangle *ADE* : area of *ABCD*.

area of $\triangle ABC$ = area of $\triangle ADC$

area of $ABCD = 2 \times$ area of $\triangle ADC$

$$\frac{\text{area of } \triangle ADE}{\text{area of } ABCD} = \frac{\frac{1}{2} \times 12 \times AE}{2 \times \frac{1}{2} \times 12 \times DC}$$

$$= \frac{7}{2}$$

Ans: 7 : 2

*Answer* .................. : .................... [1]

20



*ABCD* is a parallelogram. *EDC* is a straight line.
*DA* bisects angle *EAB*.

$AB = 8.5$ cm, $BC = 16$ cm and angle $DAB = 65°$.

Calculate
**(a)** the area of the parallelogram,

area of //ogram $= 8.5 \times 16 \sin 65°$
$= 123.25$
$= 123$ cm$^2$ (3sf)

*Answer* ……………..…………… cm$^2$ [1]

**(b)** the perimeter of the quadrilateral *ABCE*.

$\angle DAE = 65°$ (given DA bisects $\angle EAB$)
$\angle ADE = 65°$ (alternate angles, AB//EC)
$\angle AED = 50°$ (angle sum of $\Delta$)

**Method 1**

$\dfrac{ED}{\sin 65°} = \dfrac{16}{\sin 50°}$

$ED = \dfrac{16 \sin 65°}{\sin 50°}$

$\therefore ED = 18.929$

Perimeter of ABCE
$= 8.5 + 16 + 8.5 + 2 \times 18.929$
$= 70.9$ cm

**Method 2**

height between // lines $= 16 \sin 65° = 14.50$ cm

$\sin 50° = \dfrac{14.50}{EA}$ or $\cos 40° = \dfrac{14.50}{EA}$ or $\dfrac{8}{EA} = \cos 65°$
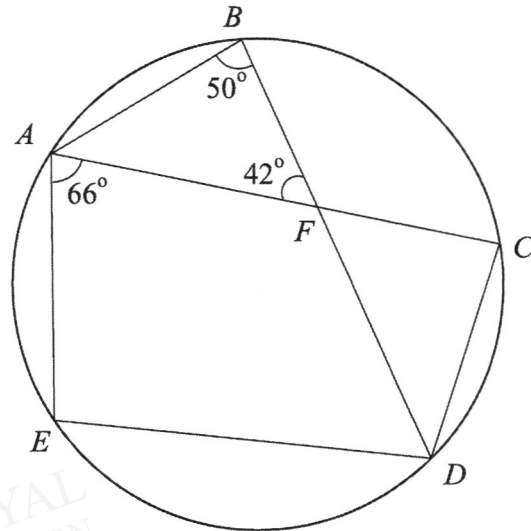
$EA = \dfrac{14.50}{\sin 50°}$ or $EA = \dfrac{14.50}{\cos 40°}$ $EA = \dfrac{8}{\cos 65°}$

$\therefore EA = 18.929$

Perimeter of ABCE $= 8.5 + 16 + 8.5 + 2 \times 18.929$
$= 70.9$ cm

*Answer* ………………………… cm [3]

**21**



In the diagram, $A$, $B$, $C$, $D$ and $E$ are points on the circumference of a circle.
Angle $ABD = 50°$, angle $EAC = 66°$ and angle $AFB = 42°$.

Find, giving reasons for each answer,

**(a)** angle $FDC$,

$\angle FAB = 180° - 50° - 42° = 88°$ (Angle sum of triangle)

$\angle FDC = 88°$ (Angles in the same segment)

*Answer* ................................... [2]

**(b)** angle $AED$,

$\angle AED = 180° - 50° = 130°$ (Opp. Angles of cyclic quad.)

**OR** $\angle CDE = 180° - 66° = 114°$ (Opp. Angles of cyclic quad.)

$\angle AED = 360° - 114° - 66° - 50° = 130°$ ($\angle$ sum of quad.)

*Answer* ................................... [1]

**(c)** angle $EDF$.

$\angle EDC = 180° - 66° = 114°$ (Opp. Angles of cyclic quad.)

$\angle EDF = 114° - 88° = 26°$

**OR** $\angle EDC = 180° - \angle EAB$ (Opp. Angles of cyclic quad.)

$= 180° - 66° - 88° = 26°$

*Answer* ................................... [1]

**22** The stem-and-leaf diagram shows the distribution of distances, in km, covered by a taxi over 16 consecutive days.

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

Key: 2 | 7 means 27 km

**(a)** Write down the median of the distances.

43

Answer ........................................ km [1]

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

27 29 34 **35 38** 39 41 42 44 45 46 **47 48** 48 49 68

47.5 – 36.5 = 11 km

Answer ........................................ km [2]

**(c)** It was discovered that the distances had been incorrectly measured.

Each actual distance is 300 m more than what was recorded.

Explain how the median of the recorded distances is affected by this error.

Answer Due to this error, the median of the recorded distances is ...............................

........................................................ than the median of the actual distances. [1]

23  A survey was conducted on the number of lipsticks 50 women own. The results were recorded
    in the following table.

| Number of Lipsticks | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Number of Women | 5 | $x$ | 12 | 12 | $y$ | 6 | 3 |

Given that the mean is 2.7, find the value of $x$ and of $y$.

$5 + x + 12 + 12 + y + 6 + 3 = 50$

$\quad x + y = 12 \; ---(1)$

$\quad \dfrac{0(5) + 1(x) + 2(12) + 3(12) + 4(y) + 5(6) + 6(3)}{50} = 2.7$

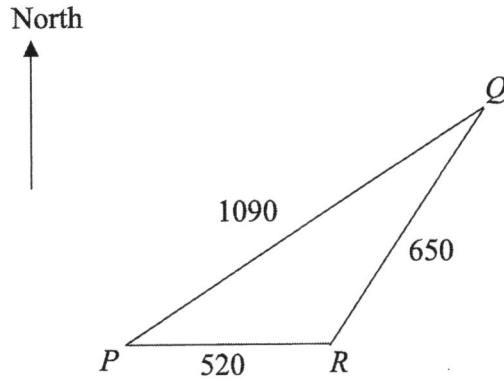$\quad x + 4y + 108 = 135$

$\quad x + 4y = 27 \; ---(2)$

$\quad (2) - (1), \; 4y - y = 27 - 12$

$\qquad\qquad y = \dfrac{15}{3}$

$\qquad\qquad y = 5$

Sub $y = 5$ into (1), $x = 12 - 5 = 7$

*Answer x =* …………….*, y =* …………... [4]

**24**

North



$P$, $Q$ and $R$ are three points on level ground.

$R$ is 520 km east of $P$.

$PQ$ is 1090 km and $RQ$ is 650 km.

Calculate

**(a)** angle $PRQ$,

$$\cos \angle PRQ = \frac{1090^2 - 650^2 - 520^2}{-2(650)(520)}$$
$$\therefore \angle PRQ = \cos^{-1}(-0.7325)$$
$$= 137.1°$$

*Answer* ............................................. [2]

**(b)** the bearing of $Q$ from $R$.

$137.1° - 90°$
$= 47.1°$
Bearing of Q from R is 047.1°

*Answer* ..................................... [1]

2020 Y4 Math EOY Paper 2 Answer Key

| | |
|---|---|
| 1a) $\dfrac{x^2+3x-31}{3(x+2)(x+5)}$ | 9aiv) The claim is false.<br>25% of students had to wait at least 144 seconds.<br>**OR** 75% of students had to wait for less than 144 seconds. |
| 1b) $\dfrac{4x+3y}{3x}$ | |
| 1c) $x = 2.71$ or $-2.21$ | |
| 2ai) $14000 | 9v) The curve is **less wide or narrower or steeper.**<br>The **median is shifted to the left.** |
| 2aii) $16664 | |
| 2aiii) Profit from sale is greater by $696. | |
| 2bi) 115.54% | 9bi) $\dfrac{23}{65}$ |
| 2bii) $86700 | |
| 3a) $\begin{pmatrix} 5 \\ 3 \\ 6 \end{pmatrix}$   3b) $\begin{pmatrix} 35 \\ 21 \\ 42 \end{pmatrix}$   3c) $\begin{pmatrix} 448 \\ 203 \\ 140 \\ 301 \end{pmatrix}$ | 9biia) $\dfrac{31}{65}\times\dfrac{34}{64}\times 2 = \dfrac{527}{1040}$ |
| | 9biib) $\dfrac{24}{65}\times\dfrac{10}{64}\times 2 = \dfrac{3}{26}$ |
| 3d) Each element of M shows **the total number of packets** of each of **the 4 different types of food items that were sold in one week (or 7 days)** respectively. | |
| 3ei) $4683 (weekly)    or    $669 (daily) | 10b) 42 |
| 3eii) 2.13% | 10c) Diameter = 9 cm<br>Height = 15 cm |
| 4ai) 152 | |
| 4aii) $9^{\text{th}}$ term | 10d) <u>GoVan</u><br>No. of containers per box |
| 4aiii) $n^2+4n+2$ | $= (50\div 9)\times(50\div 9)\times(50\div 15) \approx 5\times 5\times 3 = 75$ |
| 4aiv) Since the expression cannot be expressed as a perfect square, it is not possible for the sum to be a perfect square. (with workings) | |
| 4bi 30 | No. of boxes required $= 250\div 75 = 3\dfrac{1}{3} \approx 4$ |
| 4bii) $4n+2$ | |
| 5a) $\dfrac{80}{x}$    5b) $\dfrac{6}{x-60}$ | Cost = handling fee + base charge + charge per km $= (4\times 5)+25+(0.8\times 23.7) = \$63.96$ |
| 5d) $x = 62.2$ or $19.3$ | |
| 5e) 1h 20min | <u>Singapost</u> |
| 6ai) $832\pi$ cm$^2$ | No. of containers per box |
| 6aii) 7510 cm$^3$ | $= (55\div 9)\times(50\div 9)\times(40\div 15) \approx 6\times 5\times 2 = 60$ |
| 6bii) 98.8 cm$^2$ | |
| 7c) 183 cm$^2$ | |
| 7d) 3 : 2 | No. of boxes required $= 250\div 60 = 4\dfrac{1}{6} \approx 5$ |
| 8a) 7.07 units | |
| 8b) $y = x + 3$ | |
| 8c) $y = x - 2$ | Cost = handling fee + base charge + charge per km $= (5\times 3.5)+30+(0.5\times 23.7) = \$59.35$ |
| 8d) $(2\dfrac{1}{4}, 5\dfrac{1}{4})$ | |
| 9ai) 15, 10 | |
| 9aii) 104 s | Mr Samad should use Singapost as it is cheaper. |
| 9aiii) 59.2 s | |

Name: _____ (   )     Class:_____

## PRELIMINARY EXAMINATION
## GENERAL CERTIFICATE OF EDUCATION ORDINARY LEVEL

**MATHEMATICS**     **Students Solutions**     **4048/02**

Paper 2                                       **Friday 21 August 2020**

**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 on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use 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 number of marks for this paper is 100.

| Q1 | | Q4 | | Q7 | | Q10 | | Paper 1 | / 80 |
|----|----|----|----|----|----|-----|----|---------|------|
| Q2 | | Q5 | | Q8 | | | | Paper 2 | /100 |
| Q3 | | Q6 | | Q9 | | | | | |
| | | | | | | | | **Total** | **/ 100** |

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

## 圣尼各拉女校
**CHIJ ST. NICHOLAS GIRLS' SCHOOL**

Girls of Grace • Women of Strength • Leaders with Heart

**[Turn Over**

## Mathematical Formulae

*Compound interest*

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

*Mensuration*

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

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

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

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

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

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

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

*Trigonometry*

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

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

*Statistics*

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

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

1  (a) Write as a single fraction in its simplest form $\dfrac{x-2}{x^2+7x+10}+\dfrac{x-5}{3x+6}$.

$$\dfrac{x-2}{x^2+7x+10}+\dfrac{x-5}{3x+6}$$

$$=\dfrac{x-2}{(x+2)(x+5)}+\dfrac{x-5}{3(x+2)}$$

$$=\dfrac{3(x-2)+(x-5)(x+5)}{3(x+2)(x+5)}$$

$$=\dfrac{3x-6+x^2-25}{3(x+2)(x+5)}$$

$$=\dfrac{x^2+3x-31}{3(x+2)(x+5)}$$

*Answer* ......................................... [3]

(b) Simplify $\dfrac{16x^2-9y^2}{12x^2-9xy}$.

$$\dfrac{16x^2-9y^2}{12x^2-9xy}$$

$$=\dfrac{(4x+3y)(4x-3y)}{3x(4x-3y)}$$

$$=\dfrac{4x+3y}{3x}$$

*Answer* ......................................... [2]

(c) Solve the equation $\dfrac{1}{(x+1)(x-2)}=\dfrac{2}{8-x}$.

$$\dfrac{1}{(x+1)(x-2)}=\dfrac{2}{8-x}$$

$$8-x=2(x+1)(x-2)$$

$$2x^2-x-12=0$$

$$x=\dfrac{-(-1)\pm\sqrt{(-1)^2-4(2)(-12)}}{2(2)}$$

$$x=\dfrac{1\pm\sqrt{97}}{4}$$

$$x=2.71\,(3s.f.)\ or\ -2.21\,(3s.f.)$$

*Answer* $x=$ ......................................... [4]

**[Turn Over**

2  (a) (i)  Paul sold a painting for $15680.
He made a profit of 12% in the sale.
How much did he pay for the painting?

(a)(i)  $\dfrac{100}{112} \times 15680$

= $14000

*Answer* $ ................................................ [1]

(ii)  Paul saved $15680 in a bank at 2.05% per year compound interest.
What was the value of his savings after 3 years?
Give your answer correct to the nearest dollar.

(ii)  $15680\left(1 + \dfrac{2.05}{100}\right)^3$

= $16664

*Answer* $ ..................................... [2]

(iii)  Which was greater, the profit he made on the painting or the interest he received in 3 years
from the bank? Calculate the difference between the two.

(iii)  Profit from sale = $\dfrac{12}{112} \times 15680$

= $1680

Interest from bank = $16664 - $15680

= $984

$1680 > $984

$1680 - 984 = 696$

*Answer* .......∴ profit from sale is greater by $696. (or $$695.78)......

.................................................................................................... [3]

**(b)** Paul bought an apartment at the end of 2006.

The price of the apartment at the end of 2006 was 9% higher than at the end of 2005.
The price of the apartment at the end of 2007 was 6% higher than at the end of 2006.

**(i)** Express the price of the apartment at the end of 2007 as a percentage of the price at the end of 2005.

$$\frac{109}{100} \times \frac{(106)}{100} \times 100\% = 115.54\%$$

*Answer* ....................................... % [1]

**(ii)** Given that the increase in the price from 2006 to 2007 was $63000, calculate the increase in the price of the apartment from 2005 to 2006.

Express your answer correct to the nearest hundred dollars.

Price at the end of 2006

$$= \frac{100}{6} \times \$63000$$

$$= \$1050000$$

Increase from 2005 to 2006

$$= \frac{9}{109} \times \$1050000$$

$$= \$86697.24$$

$$= \$86700 \text{ (nearest hundred)}$$

*Answer* $...................................... [3]

**3** A Thai restaurant sells 3 different types of dinner sets. Each dinner set contains packets of 4 different types of food items: fried rice, stir fried vegetables, sambal toufu and mango sticky rice.

Matrix **T** shows the breakdown of the number of packets of each type of food item within the 3 different sets.

$$\text{Set} \quad \begin{matrix} A & B & C \end{matrix}$$
$$\mathbf{T} = \begin{pmatrix} 2 & 4 & 7 \\ 1 & 2 & 3 \\ 1 & 1 & 2 \\ 2 & 3 & 4 \end{pmatrix} \begin{matrix} \text{Fried Rice} \\ \text{Stir Fried Vegetables} \\ \text{Sambal Toufu} \\ \text{Mango Sticky Rice} \end{matrix}$$

**(a)** On average, the restaurant sells 5 Set A, 3 Set B and 6 Set C per day.

Represent this as a $3 \times 1$ column matrix **R**.

$$\begin{pmatrix} 5 \\ 3 \\ 6 \end{pmatrix}$$

*Answer* .......................................... [1]

**(b)** Evaluate the matrix $\mathbf{N} = 7\mathbf{R}$.

$$7\begin{pmatrix} 5 \\ 3 \\ 6 \end{pmatrix} = \begin{pmatrix} 35 \\ 21 \\ 42 \end{pmatrix}$$

*Answer* .......................................... [1]

**(c)** Evaluate $\mathbf{M} = \mathbf{TN}$.

$$\begin{pmatrix} 2 & 4 & 7 \\ 1 & 2 & 3 \\ 1 & 1 & 2 \\ 2 & 3 & 4 \end{pmatrix}\begin{pmatrix} 35 \\ 21 \\ 42 \end{pmatrix} = \begin{pmatrix} 448 \\ 203 \\ 140 \\ 301 \end{pmatrix}$$

*Answer* .......................................... [2]

**(d)** State what each of the element(s) of **M** represent.

*Answer* ..Each.element.of.M.shows. **the.total.number.of.packets** of.each.of. **the.4.different.**

**types of food items that were sold in one week (or 7 days)** respectively.
...................................................................................................................[1]

**(e) (i)** If the restaurant sells Set A at \$24, Set B at \$43 and Set C at \$70, calculate the total sales from the dinner sets.

**4 possible methods**

| Matrix Method | Non-Matrix Method |
|---|---|
| **Weekly** $$(24 \quad 43 \quad 70)\begin{pmatrix} 35 \\ 21 \\ 42 \end{pmatrix} = (4683)$$ Ans: \$4683 | **Weekly** Total for set $= 24(35) + 43(21) + 70(42)$ $= \$4683$ |
| **Daily** $$(24 \quad 43 \quad 70)\begin{pmatrix} 5 \\ 3 \\ 6 \end{pmatrix} = (669)$$ Ans: \$669 | **Daily** Total for set $= 24(5) + 43(3) + 70(6)$ $= \$669$ |

*Answer* \$ ......................................... [1]

**(ii)** Instead of buying the dinner sets where the combination of food items is fixed, the food items can also be bought individually (this is known as à la carte).

For à la carte purchase, a packet of fried rice costs \$4, mixed vegetable \$6.50, sambal toufu \$5 and mango sticky rice \$5. In order to boost business, the restaurant also extends a discount of 10% for all à la carte purchases.

Calculate the percentage loss in sales when the restaurant sells dinner sets instead of à la carte.

**(Ans. next page)**

*Answer* ......................................... % [3]

**8**

**6 possible methods**

| Matrix Method | Non-Matrix Method |
|---|---|
| **Weekly** $$(4 \quad 6.50 \quad 5 \quad 5)\begin{pmatrix} 448 \\ 203 \\ 140 \\ 301 \end{pmatrix} = (5316.5)$$ $5316.5 \times 0.9 = \$4784.85$ $\dfrac{4784.85 - 4683}{4784.85} \times 100\% = 2.1285\%$ $= 2.13\%$ | **Weekly** Total sales for à la carte $= 4(448) + 6.5(203) + 5(140) + 5(301)$ $= \$5316.50$ $\$5316.5 \times 0.9 = \$4784.85$ $\dfrac{4784.85 - 4683}{4784.85} \times 100\% = 2.1285\%$ $= 2.13\%$ |
| **Daily** $$\begin{pmatrix} 2 & 4 & 7 \\ 1 & 2 & 3 \\ 1 & 1 & 2 \\ 2 & 3 & 4 \end{pmatrix}\begin{pmatrix} 5 \\ 3 \\ 6 \end{pmatrix} = \begin{pmatrix} 64 \\ 29 \\ 20 \\ 43 \end{pmatrix}$$ $$(4 \quad 6.50 \quad 5 \quad 5)\begin{pmatrix} 64 \\ 29 \\ 20 \\ 43 \end{pmatrix} = (759.5)$$ $\$759.5 \times 0.9 = \$683.55$ $\dfrac{683.55 - 669}{683.55} \times 100\%$ $= 2.1285$ $= 2.13\%$ | **Daily** No. of fried rice $= 2(5) + 4(3) + 7(5)$ $= 64$ No. of stir fried veg.$= 1(5) + 2(3) + 3(6)$ $= 29$ No. of sambal toufu $= 1(5) + 1(3) + 2(6)$ $= 20$ No. of mango sticky rice $= 2(5) + 3(3) + 4(6)$ $= 43$ Total sales for à la carte $= 4(64) + 6.5(29) + 5(20) + 5(43)$ $= \$759.50$ $\$759.5 \times 0.9 = \$683.55$ $\dfrac{683.55 - 669}{683.55} \times 100\%$ $= 2.1285$ $= 2.13\%$ |
| **Daily then weekly (LAST STEP)** $\dfrac{7(683.55 - 669)}{7(683.55)} \times 100\%$ $= \dfrac{4784.85 - 4683}{4784.85} \times 100\%$ $= 2.1285\%$ $= 2.13\%$ | **Daily then weekly (LAST STEP)** $\dfrac{7(683.55 - 669)}{7(683.55)} \times 100\%$ $= \dfrac{4784.85 - 4683}{4784.85} \times 100\%$ $= 2.1285\%$ $= 2.13\%$ |

**4** **(a)** The *n*th term of a sequence is given by $T_n = \dfrac{n(n+3)}{2}$.

**(i)** Use the formula to find $T_{16}$.

$$T_{16} = \frac{16(16+3)}{2} = 152$$

*Answer* $T_{16}$ = ..................................... [1]

**(ii)** Which term in the sequence has a value of 54?

$$\frac{n(n+3)}{2} = 54$$

$$n^2 + 3n = 108$$

$$n^2 + 3n - 108 = 0$$

$$(n+12)(n-9) = 0$$

$$n = -12\,(\text{N.A}) \quad \text{or} \quad n = 9$$

$\therefore$ 9$^{\text{th}}$ term          *Answer* ..................................... [2]

**(iii)** Find, in its simplest form, the expression for $T_{n+1} + T_n$, leaving your answer in terms of *n*.

$$\frac{(n+1)(n+4)}{2} + \frac{n(n+3)}{2}$$

$$= \frac{n^2 + 5n + 4}{2} + \frac{n^2 + 3n}{2}$$

$$= \frac{2n^2 + 8n + 4}{2}$$

$$= n^2 + 4n + 2$$

*Answer* ..................................... [2]

**(iv)** Explain why the sum of two consecutive terms of this sequence will never be a perfect square.

$$= n^2 + 4n + 2$$

$$= n^2 + 4n + 2^2 - 2^2 + 2$$

$$= (n+2)^2 - 2$$

Since the expression cannot be expressed as a perfect square, it is not possible for the sum to be a perfect square.

[2]

**[Turn Over**

**(b)** The first four terms of a sequence are 6, 10, 14 and 18.

    **(i)** Write down the 7$^{th}$ term in this sequence.

$$30$$

*Answer* ........................................ [1]

    **(ii)** Find, an expression, in terms of $n$, for the $n$th term of this sequence.

$$4n + 2$$

*Answer* ........................................ [1]

5 A man was driving his truck from point $A$ to point $C$ in a remote part of a country. After he has travelled for 80 km, at a constant speed of $x$ km/h, he reached point $B$, where his truck broke down.

(a) Write down an expression, in terms of $x$, for the time in hours, taken for him to drive from $A$ to $B$.

(a) $\dfrac{80}{x}$

*Answer* .......................................... h [1]

He then walks the remaining 6 km from $B$ to $C$ at a constant speed of $(x - 60)$ km/h.

(b) Write down an expression, in terms of $x$, for the time in hours, taken for him to walk from $B$ to $C$.

(b) $\dfrac{6}{(x-60)}$

*Answer* .......................................... h [1]

(c) The man took 4 hours to travel from $A$ to $C$.

Write down an equation in $x$ and show that it reduces to $2x^2 - 163x + 2400 = 0$.

(c) $\dfrac{80}{x} + \dfrac{6}{(x-60)} = 4$

$80(x-60) + 6x = 4(x^2 - 60x)$

$4x^2 - 326x + 4800 = 0$

$2x^2 - 163x + 2400 = 0$ (shown)

[3]

(d) Solve the equation $2x^2 - 163x + 2400 = 0$.

(d) $2x^2 - 163x + 2400 = 0$

$x = \dfrac{163 \pm \sqrt{7369}}{4}$

$= 62.2 \text{ or } 19.3$

*Answer* $x = $ .......................................... [3]

**[Turn Over**

**(e)** Find how long it would have taken if the man was able to drive from $A$ to $C$ at the original constant speed.

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

$x = 19.3$ (N.A. because $x - 60 < 0$ so $x > 60$)

$\dfrac{86}{62.21} h$

$= 1.382$ h

$= 1$ h $20$ min

*Answer* ............ h .................... min [2]

6 (a)



The diagram shows an ornament made up of a hemispherical block of wood of diameter 32 cm, that has a smaller hemispherical block of diameter 16 cm, carved out of it.

**(i)** Calculate the surface area of the ornament, leaving your answer in terms of $\pi$.

(a) (i) Surface area
$$= 2\pi(16)^2 + 2\pi(8)^2 + \pi(16)^2 - \pi(8)^2$$
$$= 832\pi \text{ cm}^2$$

*Answer* ……………………………… cm² [3]

**(ii)** Calculate the volume of the ornament.

(a) (ii) Volume
$$= \frac{2}{3}\pi(16^3 - 8^3)$$
$$= 7506.31$$
$$= 7510 \text{ cm}^3$$

*Answer* ……………………………… cm³ [2]

**(b)**



The figure shows a semicircle with centre $O$.
$AB$ is the diameter and point $P$ is on the circumference of the circle.

Angle $OBP = 75^\circ$ and $BP = 5$ cm.

**(i)** Show that $OA = 9.66$ cm, correct to three significant figures.

Method 1

$\triangle OPB$ is an isosceles triangle.

$\cos 75^\circ = \dfrac{2.5}{OB}$

$OA = OB = \dfrac{2.5}{\cos 75^\circ}$

$OA = 9.659$

$= 9.66$ (3sf)

Method 2

angle $APB = 90^\circ$ (rt $\angle$ in semicircle)

$\cos 75^\circ = \dfrac{5}{AB}$

$AB = \dfrac{5}{\cos 75^\circ}$

$AB = 19.318$

$OA = \frac{1}{2} AB$

$OA = 9.659$

$OA = 9.66$ (3sf)

Method 3

angle $BOP = 180^\circ - 2(75^\circ)$

$\qquad = 30^\circ (\angle$ sum of isos $\triangle)$

$OB = \dfrac{5}{\sin 30^\circ} \times \sin 75^\circ$

$OB = 9.659$

$OB = OA = 9.66$ (3sf)

[2]

**(ii)** Calculate the area of the shaded region.

$\angle AOP = 150^\circ$

Either $75^\circ \times 2$ (ext $\angle$ of $\triangle$)

or $180^\circ - (180^\circ - 75^\circ \times 2)$
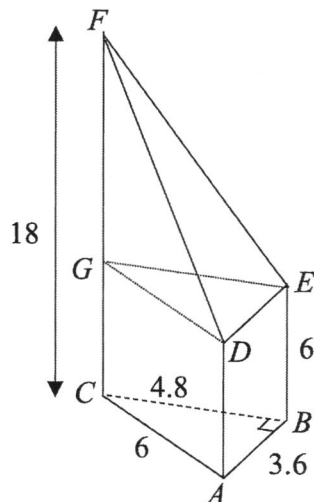
or $180^\circ - (90^\circ - 75^\circ) \times 2$

Shaded area

$= \dfrac{1}{2}(9.659)^2 \left( \dfrac{150}{360} \times 2\pi - \sin 150^\circ \right)$

or $= \dfrac{1}{2}\pi(9.659)^2 - \dfrac{1}{2}(9.659)^2 \sin 150^\circ - \dfrac{1}{2}(9.659)^2 \left( \dfrac{30}{360} \times 2\pi \right)$

$= 98.8$ cm$^2$

*Answer* ........................................ cm$^2$ [3]

7



The diagram shows a solid made up of a pyramid and a prism.
The base of the prism is a right-angled triangle.

$FC$, $AD$ and $EB$ are vertically above the base.

$FC = 18$ cm, $AD = EB = 6$ cm, $AB = DE = 3.6$ cm, $BC = 4.8$ cm and $AC = 6$ cm.

**(a)** Show that $FD^2 = 180$.

$$FG = 18 - 6$$
$$\quad = 12$$
$$FD^2 = 12^2 + 6^2$$
$$\quad = 144 + 36$$
$$\quad = 180 \text{ (shown)}$$

[2]

**(b)** Show that triangle $FED$ is a right-angled triangle.

$FD^2 = 180$
$DE^2 = 3.6^2 = 12.96$
$FE^2 = 12^2 + 4.8^2$
$FE^2 = 167.04$
Since $DE^2 + FE^2 = 12.96 + 169.04$
$\qquad = 180 = FD^2$,
by the converse of Pythagoras' Thm, $\triangle FED$ is a right-angled triangle.

[3]

**(c)** Calculate the total surface area of the solid.

Total SA
$$= \tfrac{1}{2}(18+6)(6) + \tfrac{1}{2}(18+6)(4.8)$$
$$+ \tfrac{1}{2} \times 3.6 \times 4.8 + 6 \times 3.6$$
$$+ \tfrac{1}{2} \times 3.6 \times \sqrt{167.04}$$
$$= 183 \text{ cm}^2$$

*Answer* ………………………………… cm$^2$ [3]

**(d)** Find the ratio  volume of the prism : volume of the pyramid.

volume of prism = base area $\times 6$

$= 51.84$ cm$^3$

volume of pyramid = $\tfrac{1}{3} \times$ base area $\times 12$

$= 34.56$ cm$^3$

Ratio $= 6 : \tfrac{1}{3} \times 12$

$= 6 : 4$

$= 3 : 2$

*Answer* ……………… : ………………… [2]

**8** $X$ is the point $(1, 4)$ and $Y$ is the point $(6, 9)$.

Find

**(a)** the length of the line $XY$,

$$\sqrt{(9-4)^2+(6-1)^2}$$

$$=7.07(3s.f)$$

Answer ........................................ units [2]

**(b)** the equation of the line XY,

$$m=\frac{9-4}{6-1}=1$$

$$\frac{y-4}{x-1}=1$$

$$y-4=x-1$$

$$y=x+3$$

Answer ........................................ [3]

**(c)** the equation of the line $l$, which is parallel to $XY$ and passes through the point $A$ which has coordinates $(2, 0)$,

$$m=1$$

Sub $(2, 0)$ into $y=x+c$,

$$0=2+c$$

$$c=-2$$

$$y=x-2$$

Answer ........................................ [3]

**(d)** the coordinates of the point $Z$ that lies on $XY$ such that $XY=4\,XZ$.

$$x-coordinate=1+(\frac{6-1}{4})=2\frac{1}{4}$$

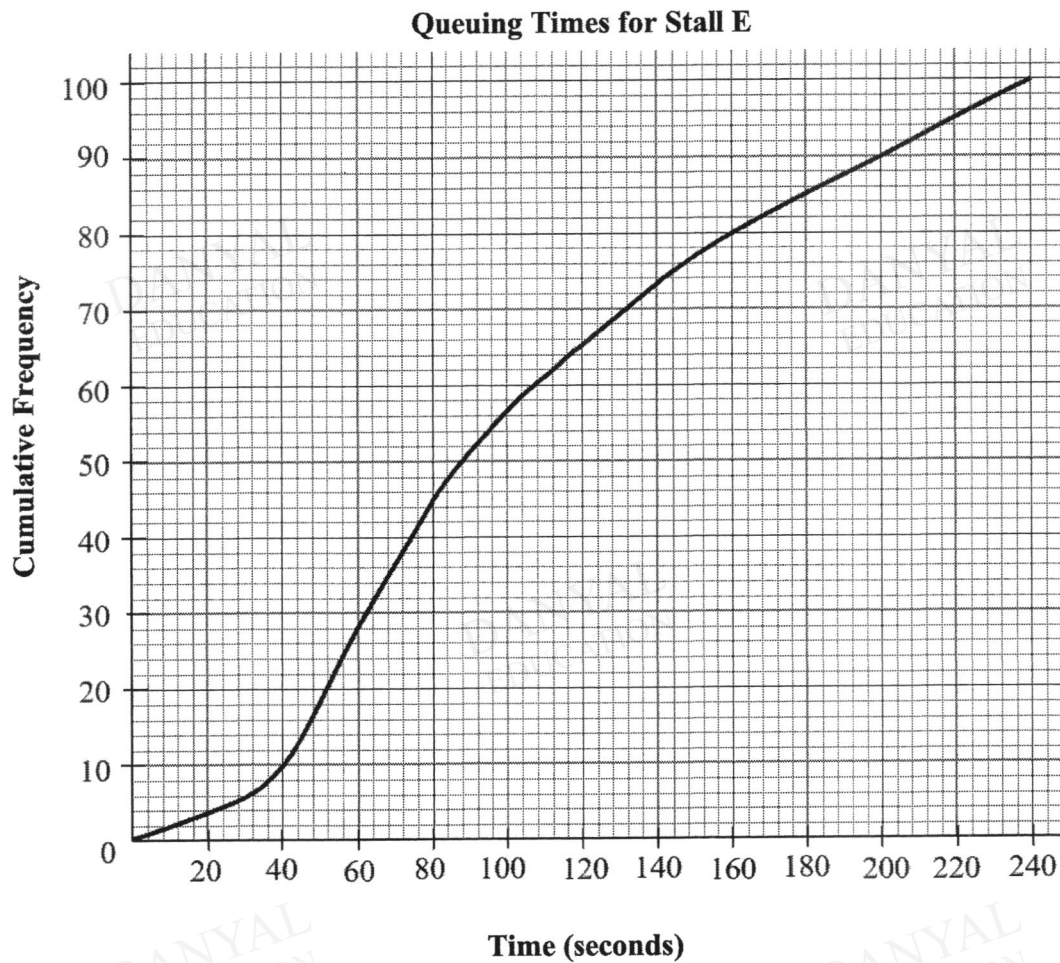$$y-coordinate=4+(\frac{9-4}{4})=5\frac{1}{4}$$

$$(2\frac{1}{4},5\frac{1}{4})$$

Answer Z(.................. , ..................) [2]

9    Nadirah observes that the queue at one of the school's canteen stall, Stall E, is always long.
     She decides to do a project to improve the situation.

(a) She finds information about the times, in seconds, spent by 100 students in the queue for
    Stall E. The cumulative frequency curve shows the distribution of the queuing times.

**Queuing Times for Stall E**



(i)  Copy and complete the grouped frequency table for the queuing times for Stall E.

| Time (t seconds) | $0 \leq t < 40$ | $40 \leq t < 80$ | $80 \leq t < 120$ | $120 \leq t < 160$ | $160 \leq t < 200$ | $200 \leq t < 240$ |
|---|---|---|---|---|---|---|
| Frequency | 10 | 35 | 20 | **15** | **10** | 10 |

[1]

**(ii)** Calculate an estimate of the mean queuing time of the 100 students.

$$\bar{x} = \frac{10400}{100}$$

$$= 104 \text{ s}$$

*Answer* ........................................ s [1]

**(iii)** Calculate an estimate of the standard deviation.

$$\sigma = \sqrt{\frac{1432000}{100} - 104^2}$$

$$= 59.194$$

$$= 59.2 \text{ s}$$

*Answer* ........................................ s [1]

**(iv)** A student claims that 75% of students queuing at Stall E had to wait at least 144 seconds. Is this claim true? Explain your answer.

*Answer* ...The claim is false/untrue/incorrect.................................................

25% of students had to wait at least 144 seconds.

**OR** 75% of students had to wait for less than 144 seconds.

................................................................................................... [2]

A few weeks later, Nadirah recorded the queuing time of another 100 students. She observes that the longest queuing time is now 200 seconds and the median queuing time is smaller.

**(v)** State two possible ways the cumulative frequency curve for this set of data differs from the given curve.

1.   The curve is **less wide or narrower or steeper.**

2.   The **median is shifted to the left.** [2]

**(b)** The table shows the number of students queuing at Stall F during recess on a particular day. Each student queues only once.

|  | Sec 3 | Sec 4 | Sec 5 |
|---|---|---|---|
| Boy | 18 | 7 | 6 |
| Girl | 10 | 16 | 8 |

**(i)** One student in the queue is selected at random.
Find, as a fraction in its lowest term, the probability that the student is from Sec 4.

$$\frac{23}{65}$$

*Answer* ..................................... [1]

**(ii)** Two students in the queue are selected at random.
Find the probability that

**(a)** one of them is a boy and the other is a girl,

$$\frac{31}{65} \times \frac{34}{64} \times 2 = \frac{527}{1040}$$

*Answer* ..................................... [2]

**(b)** both students are girls and one of them is from Sec 3.

$$\frac{24}{65} \times \frac{10}{64} \times 2 = \frac{3}{26}$$

*Answer* ..................................... [2]

**10** Mr Samad owns a bakery that specialises in pineapple tarts. Each pineapple tart is in the shape of a sphere of radius 15 mm with its bottom part removed as shown below.
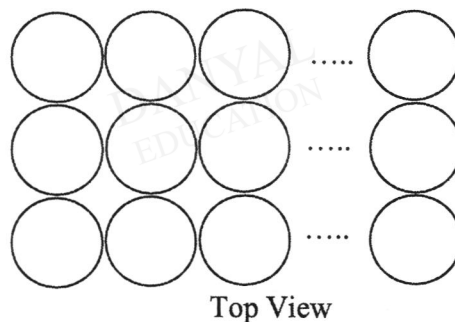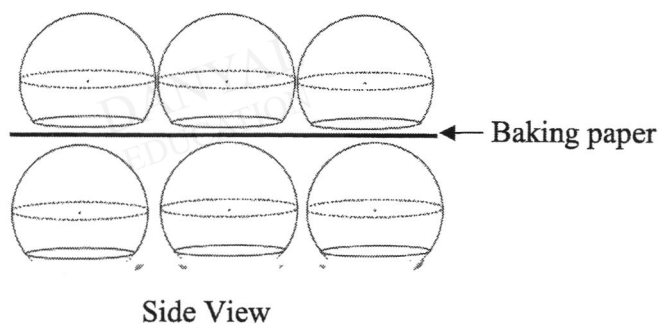


**(a)** Show that the height of a pineapple tart is 25 mm.

Height of pineapple tart = 30 − 5          **or**          15 + 10
$\qquad\qquad\qquad\qquad$ = 25 mm (shown)

[1]

The pineapple tarts are arranged such that after each layer, a piece of baking paper, of negligible thickness, is placed to ensure the tarts stay in place. The side and top views of how the tarts are arranged are shown below.



Side View

Top View

Mr Samad sells his pineapple tarts in rectangular containers that measure 21 cm in length, 9 cm in width and 5 cm in height.

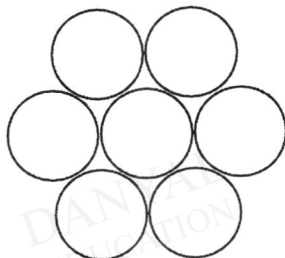**(b)** Calculate the number of pineapple tarts in a rectangular container.

$$\text{No. of pineapple tarts} = (21 \div 3) \times (9 \div 3) \times (5 \div 2.5)$$
$$= 7 \times 3 \times 2$$
$$= 42$$

*Answer* ..................................... [2]

During festive seasons, the pineapple tarts are packed in cylindrical containers.

The top view of each layer of the pineapple tarts is shown below.



Top View of each Layer

**(c)** Calculate the diameter and the height of the cylindrical container such that it can fit the same number of pineapple tarts in **(b)**.

Diameter $= 9$ cm

$$\text{Height} = \frac{42}{7} \times 2.5$$
$$= 15 \text{ cm}$$
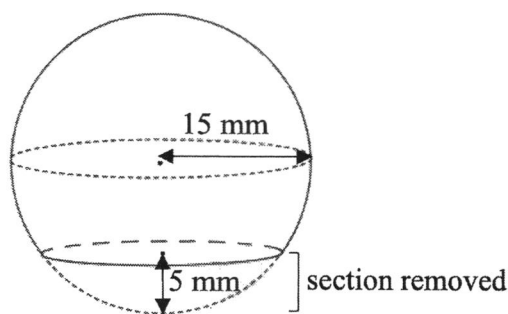
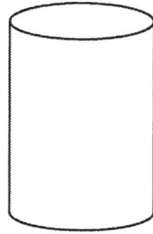*Answer* diameter = ..................................... cm

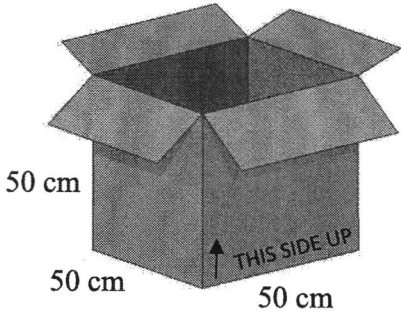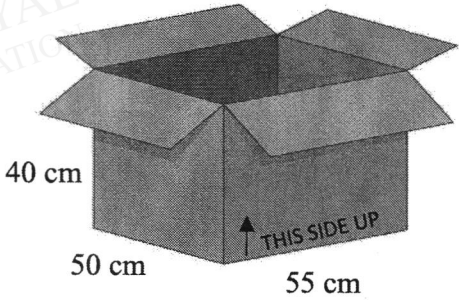height = ..................................... cm [2]

During one of the festive seasons, Mr Samad received a bulk order of 250 containers of pineapple tarts.

He decided to use a courier service to deliver the pineapple tarts. He has a choice of 2 courier services: GoVan and Singapost. Both courier services offer no weight limit and charge based on the size of goods. The cylindrical containers are packed in cardboard boxes based on the courier service's requirement.

To prevent the pineapple tarts from breaking, Mr Samad packs each cylindrical container upright as shown below.



The rates of the two courier services are as follow.

| GoVan | Singapost |
| --- | --- |
|  50 cm, 50 cm, 50 cm, THIS SIDE UP **Max. 8 boxes per trip** |  40 cm, 50 cm, 55 cm, THIS SIDE UP **Max. 8 boxes per trip** |
| Handling fee per box: $5 | Handling fee per box: $3.50 |
| Rate per trip: $25 base charge + $0.80/km | Rate per trip: $30 base charge + $0.50/km |

**[Turn Over**

**(d)** Given that the trip distance is 23.7 km, which courier service should Mr Samad use? Support your answer with clear workings.

| GoVan | Singapost |
|---|---|
| No. of containers per box | No. of containers per box |
| $= (50 \div 9) \times (50 \div 9) \times (50 \div 15)$ | $= (55 \div 9) \times (50 \div 9) \times (40 \div 15)$ |
| $\approx 5 \times 5 \times 3$ | $\approx 6 \times 5 \times 2$ |
| $= 75$ | $= 60$ |
| No. of boxes required $= 250 \div 75$ | No. of boxes required $= 250 \div 60$ |
| $\qquad\qquad = 3\dfrac{1}{3}$ | $\qquad\qquad = 4\dfrac{1}{6}$ |
| $\qquad\qquad \approx 4$ | $\qquad\qquad \approx 5$ |
| Cost $=$ handling fee $+$ base charge $+$ charge per km | Cost $=$ handling fee $+$ base charge $+$ charge per km |
| $\qquad = (4 \times 5) + 25 + (0.8 \times 23.7)$ | $\qquad = (5 \times 3.5) + 30 + (0.5 \times 23.7)$ |
| $\qquad = \$63.96$ | $\qquad = \$59.35$ |

Mr Samad should use Singapost as it is cheaper.

[6]