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**EXP/
N(A)**

PUNGGOL SECONDARY SCHOOL
SECONDARY 3
EXPRESS
PRELIMINARY EXAMINATION
QUESTION & ANSWER BOOKLET



NAME

CLASS

INDEX
NUMBER
Mathematics**4048****Paper 1****30 September 2021****2 hours****READ THESE INSTRUCTIONS FIRST**

Write your class, register number and name on all the work you hand in.

Write in dark blue or black ink.

You may use a soft pencil for any diagrams, graphs.

Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

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

If working is needed for any question it must be shown with the answer.

Omission of essential working will result in loss of marks.

The total of the marks for this paper is 80.

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.

For Examiner's use	
Total	/ 80

Parent's Signature

This paper consists of **18** printed pages and **0** blank page.

Setter(s) : Mrs Lee Wei Wei

Vetter : Ms Jillian Khong

*Mathematical Formulae**Compound Interest*

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

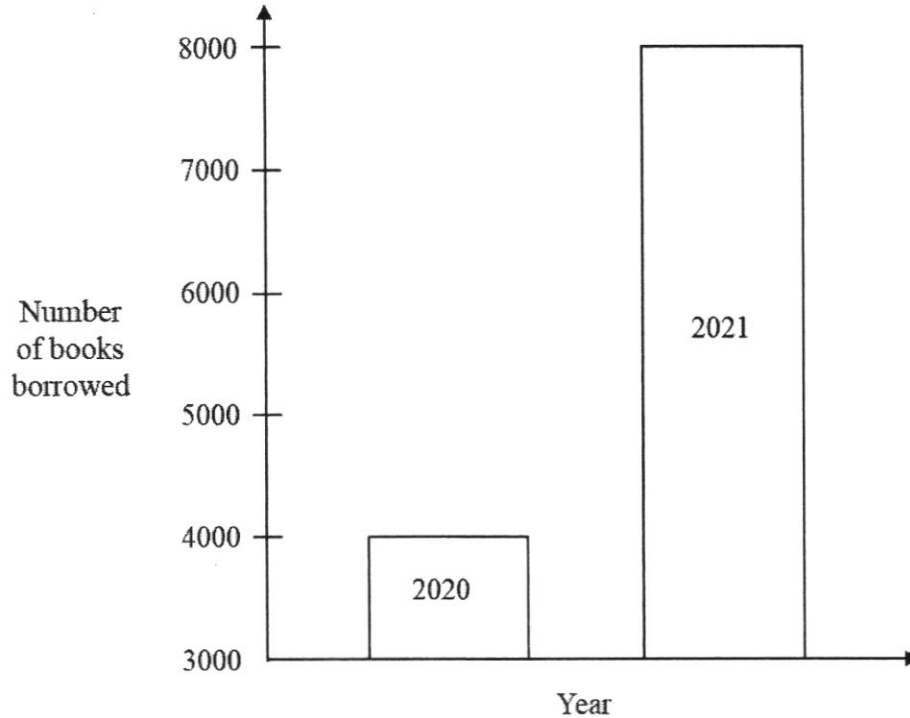
Statistics

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

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

Answer all the questions

- 1 The annual report of a library indicated that the number of books borrowed have doubled from 2020 to 2021. The annual report contained the bar chart shown below.



Explain how this bar chart may be misleading.

Answer

..... [1]

2 (a) Calculate $\frac{4.23^2 - 6.78}{\sqrt{109}}$.

Write down the first five digits of your answer.

Answer [1]

(b) Write your answer to **part (a)** correct to 2 significant figures.

Answer [1]

- 3 Given that $x = 4$ is a solution of the equation $2x^2 - 5x - 12 = 0$, find the other solution of the equation.

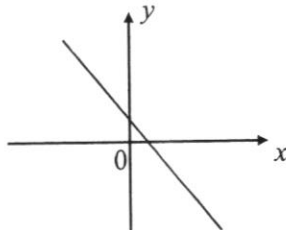
Answer $x = \dots\dots\dots$ [2]

4

$y = x - 2$	$y = -x^2 + 2$	$y = -2x$
$y = \frac{1}{x} + 2$	$y = 2 - x$	$y = 2^x$

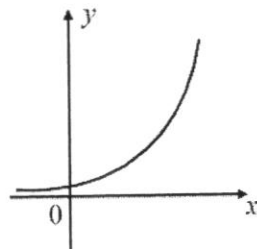
Write down a possible equation for each of the sketch graphs below.
 In each case select one of the equations from the box above.

(a)



Answer $\dots\dots\dots$ [1]

(b)



Answer $\dots\dots\dots$ [1]

5

- 5 The number of books that each of 15 students read in a year were recorded. This record is shown on the stem-and-leaf diagram.

1	0	1	3	9		
2	2	2	2	3	3	7
3	x	6				
4	0	1				
5	0					

Key: 3|1 means 31

- (a) Find the modal number of books read.

Answer [1]

- (b) Given that the mean number of books read is 26, find x .

Answer [2]

- 6 There are 7 red discs, 10 yellow discs and 8 blue discs in a bag. A disc is chosen at random from the bag.

- (a) Find the probability that the chosen disc is either red or yellow.

Answer [1]

- (b) Some green discs are added into the bag such that the probability of choosing a yellow disc is 0.2. Find the probability of choosing a green disc.

Answer [2]

- 7 (a) Express 168 as a product of prime factors.

Answer [1]

- (b) Given that $360 = 2^3 \times 3^2 \times 5$, find the HCF of 168 and 360.

Answer [1]

- (c) Find the smallest positive integer m such that $360m$ is a perfect cube.

Answer $m =$ [1]

- 8 It is given that $E = \frac{3a}{\sqrt{m}}$.

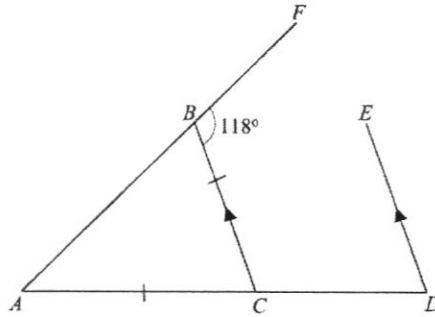
- (a) Find E when $m = 72$ and $a = -0.3$.

Answer $E =$ [1]

- (b) Express m in terms of E and a .

Answer [2]

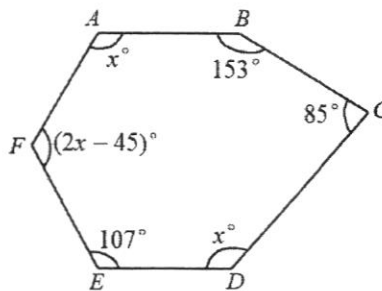
9



In the diagram, ABC is a triangle in which $AC = BC$.
 The point D is on AC produced and DE is parallel to CB . Angle $FBC = 118^\circ$.
 Find angle EDC . Show your working and give reasons.

Answer [3]

10

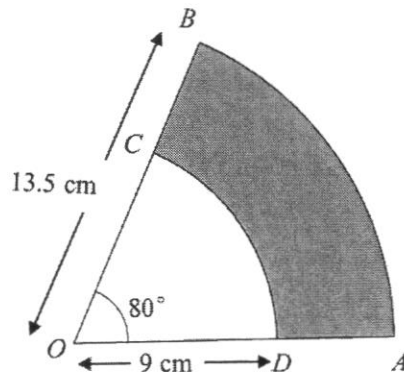


The diagram shows a hexagon $ABCDEF$.
 Angle $ABC = 153^\circ$, angle $BCD = 85^\circ$ and angle $DEF = 107^\circ$.
 It is also given that angle $FAB =$ angle $CDE = x^\circ$ and angle $EFA = (2x - 45)^\circ$.
 Find x .

Answer $x =$ $^\circ$ [3]

- 11 In the diagram below, OAB is a sector of a circle, center O , of radius 13.5 cm.
 ODC is a sector of a circle, center O , of radius 9 cm.
 ODA and OCB are straight lines. Angle $AOB = 80^\circ$.

Find the perimeter of the shaded region $ABCD$. Leave your answer in the form of $(p\pi + q)$ cm.



Answer cm [3]

- 12 y is inversely proportional to x^2 . It is given that $y = 7$ for a particular value of x . Find the percentage change in y when this value of x is increased by 100%.

Answer % [3]

13 (a) Simplify $7 + 4y - (3x - y)$.

Answer [2]

(b) Factorise $6ab + 3ac - 10b - 5c$ completely.

Answer [2]

14 (a) Express $x^2 - 7x + 6$ in the form $(x - a)^2 + b$.

Answer [1]

(b) Hence, solve $x^2 - 7x + 6 = 0$.

Answer $x =$ or [3]

15 (a) Express the following as powers of 3.

(i) $3^2 \div 3^{-6}$,

Answer [1]

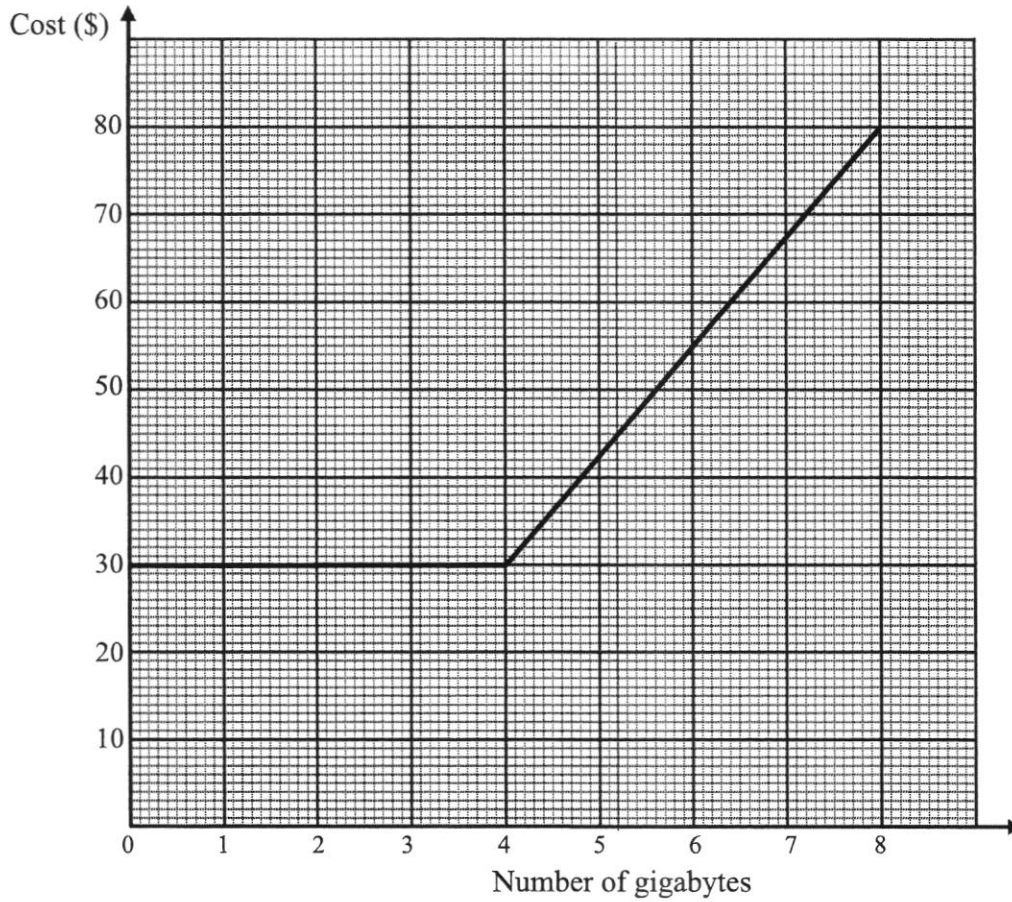
(ii) $\frac{1}{243}$.

Answer [1]

(b) Given that $5^{2x} \times 5^{-7} = 1$, find x .

Answer $x =$ [2]

- 16 The graph below shows the monthly charges of a mobile data plan by Starly Mobile. The charges consist of a flat subscription fee and additional data charges.



- (a) How much will it cost if 3.3 gigabytes of data has been used for that month?

Answer \$ [1]

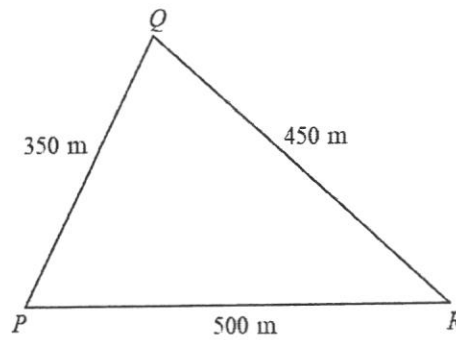
- (b) How much data has been used if the mobile charges is \$60 for that month?

Answer gb [1]

- (c) What is the cost per gigabyte of data once the monthly usage exceeds 4 gigabytes?

Answer \$ /gb [2]

- 17 The diagram shows a sketch of a field PQR .



- (a) Using a scale of 1 : 5000, make an accurate scale drawing of the field.

Answer

[2]

- (b) (i) Construct the perpendicular bisector of PR . [1]

- (ii) Construct the bisector of angle QPR . [1]

- (c) The town council decides to build an adventure park in the field.

The proposed site will be an area nearer to point P than point R and nearer to the line PR than PQ .

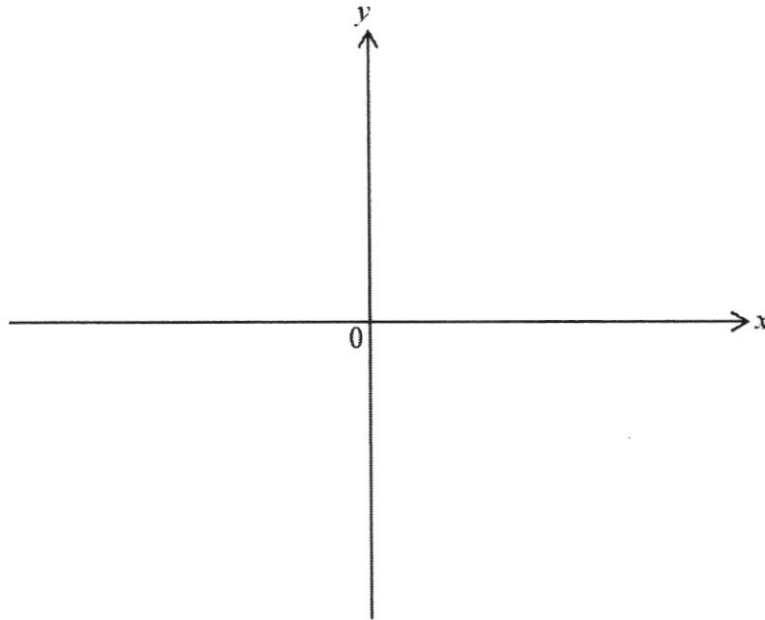
Shade the region where the adventure park is to be built.

[1]

- 18 (a) Sketch the graph of $y = (x - 2)(x - 7)$ on the axes below.
Indicate clearly the points where the graph crosses the axes.

Answer

[3]



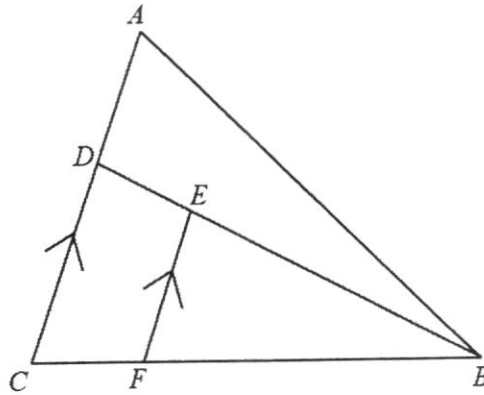
- (b) Write down the equation of the line of symmetry of the graph.

Answer [1]

- (c) Write down the coordinates of the turning point.

Answer (..... ,) [1]

- 19 In the figure, AC and EF are parallel lines.
 F lies on the line BC such that $BF : BC = 4 : 5$. D lies on the line AC such that $AD : DC = 1 : 2$.



- (a) Show that triangles CDB and FEB are similar.

Answer

.....

.....

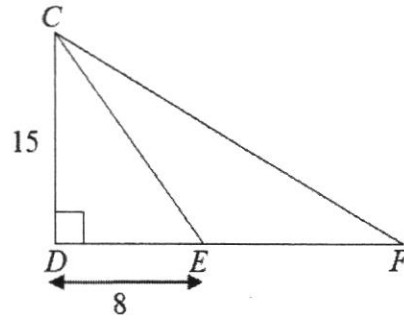
..... [2]

- (b) If the area of triangle FEB is 32 cm^2 , calculate the area of triangle ABC .

Answer [3]

15

20



In triangle CDF , CD is perpendicular to DF . $CD = 15$ cm and $DE = 8$ cm.

- (a) Calculate CE .

Answer cm [2]

- (b) Given that $\tan \angle CFD = \frac{3}{4}$, find the length of EF **without the use of a calculator**.

Answer cm [3]

21 The first four terms in a sequence of numbers are given below.

$$\begin{array}{rclcl}
 T_1 & = & 1 \times 5 \times (3^2 + 4) & = & 3^4 - 16 \\
 T_2 & = & 2 \times 6 \times (4^2 + 4) & = & 4^4 - 16 \\
 T_3 & = & 3 \times 7 \times (5^2 + 4) & = & 5^4 - 16 \\
 T_4 & = & 4 \times 8 \times (6^2 + 4) & = & 6^4 - 16 \\
 T_5 & = & p & = & 7^4 - 16 \\
 & & : & & : \\
 T_{10} & = & 10 \times 14 \times (12^2 + 4) & = & q \\
 & & : & & : \\
 T_n & = & r & = & (n+2)^4 - 16
 \end{array}$$

(a) Find p , q and r .

Answer $p = \dots\dots\dots$ [1]

Answer $q = \dots\dots\dots$ [1]

Answer $r = \dots\dots\dots$ [1]

(b) Using your answers to **part (a)** and given that $15^4 = 50625$,

(i) write 50609 as a product of three prime factors,

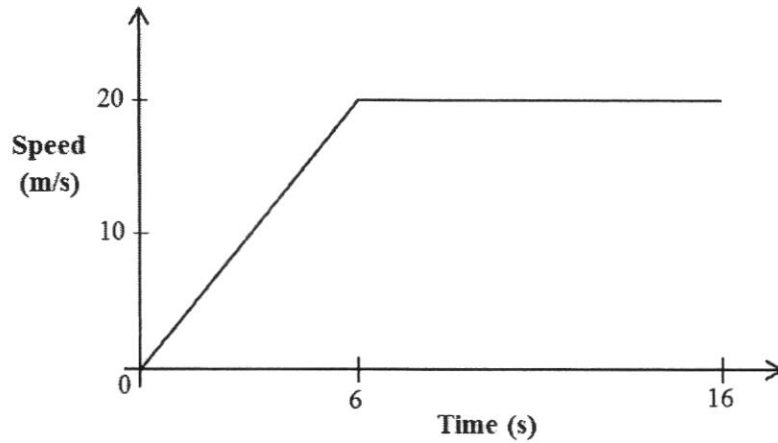
Answer $\dots\dots\dots$ [2]

(ii) state the term in the sequence that has a value of 50609.

Answer $\dots\dots\dots$ [1]

- 22 A car starts from rest and accelerates at a constant rate to a speed of 20 m/s in 6 seconds. It then travels at a constant speed of 20 m/s for the next 10 seconds.

The speed-time graph for the journey of the car is shown below.



- (a) Calculate the acceleration of the car for the first 6 seconds of the journey.

Answer m/s² [1]

- (b) Calculate the speed of the car when $t = 5$.

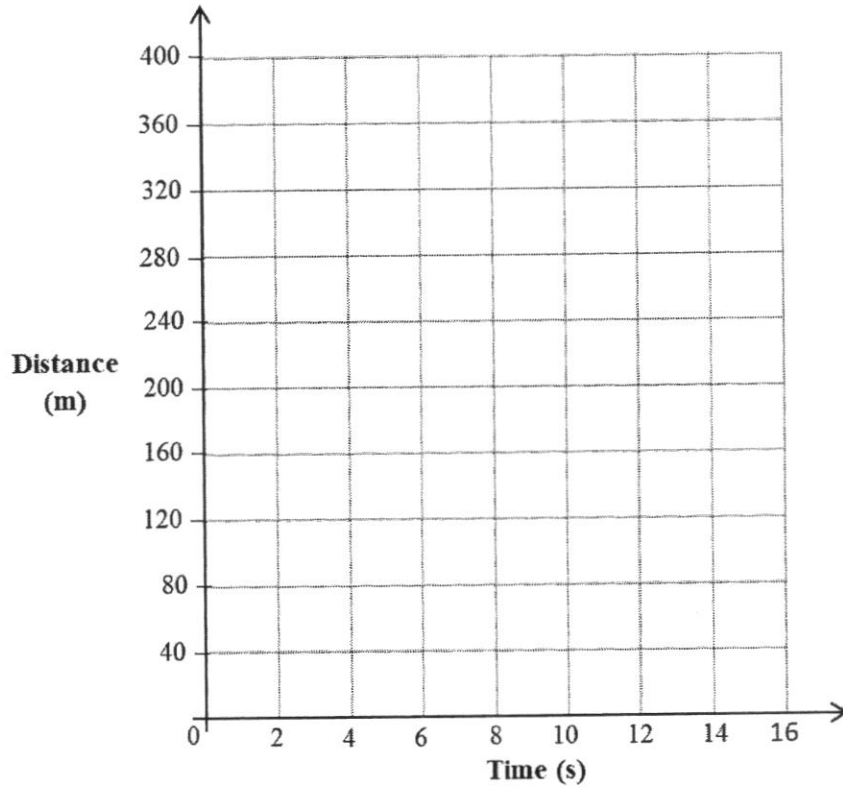
Answer m/s [2]

- (c) Find the total distance travelled in the 16 seconds.

Answer m [2]

(d) On the axes below, sketch the distance-time graph for the same journey.

Answer



[2]

----- End of Paper -----

EXP

PUNGGOL SECONDARY SCHOOL
SECONDARY 3
EXPRESS
END-OF-YEAR EXAMINATION



NAME

CLASS

INDEX
NUMBER
Mathematics**4048/02****Paper 2****1 October 2021****2 hours 30 minutes****READ THESE INSTRUCTIONS CAREFULLY**

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

Answer **all** the questions.

Write your answers in the spaces provided.

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

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.
The total number of marks for this paper is 100.

For Examiner's use	
Total	/100

Parent's Signature

This paper consists of **21** printed pages and **1** blank page.

Setter(s) : Mr Ong Kai Wei Mdm Ho Wei Ling	Vetter : Ms Jillian Khong
--	------------------------------

Mathematical Formulae*Compound Interest*

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

- 1 (a)** In 2019, the number of visitors to Gardens by the Bay is 1.37×10^7 .
- (i)** Calculate the mean number of visitors to Gardens by the Bay each month. Give your answer in millions, correct to 3 significant figures.

Answermillion [2]

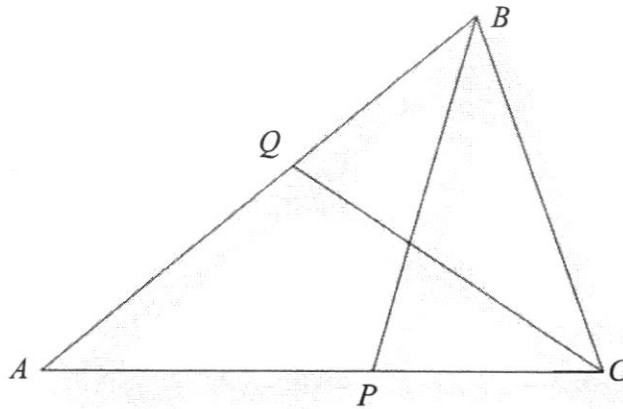
- (ii)** The number of visitors to Gardens by the Bay in December 2019 was 2.36 million. Express the number of visitors to Gardens by the Bay in December 2019 as a percentage of the total number of visitors to Gardens by the Bay for the entire year of 2019.

Answer% [2]

- (b)** In 2018, the total income generated from ticketing sales to Gardens by the Bay was \$65.089 million. In 2019, the total income generated increased by 4%. Calculate the total income generated from ticketing sales in 2019.

Answer \$..... [2]

- 2 (a) In the diagram, $AB = AC$, BP bisects $\angle ABC$ and CQ bisects $\angle ACB$. Prove that triangles ABP and ACQ are congruent.



Answer [3]

- (b) Two open troughs are geometrically similar.
The ratio of the areas of the bases is $25 : 9$
- (i) The area of the top of the bigger trough is 1250 cm^2 .
Find the area of the top of the smaller trough.

Answer cm^2 [2]

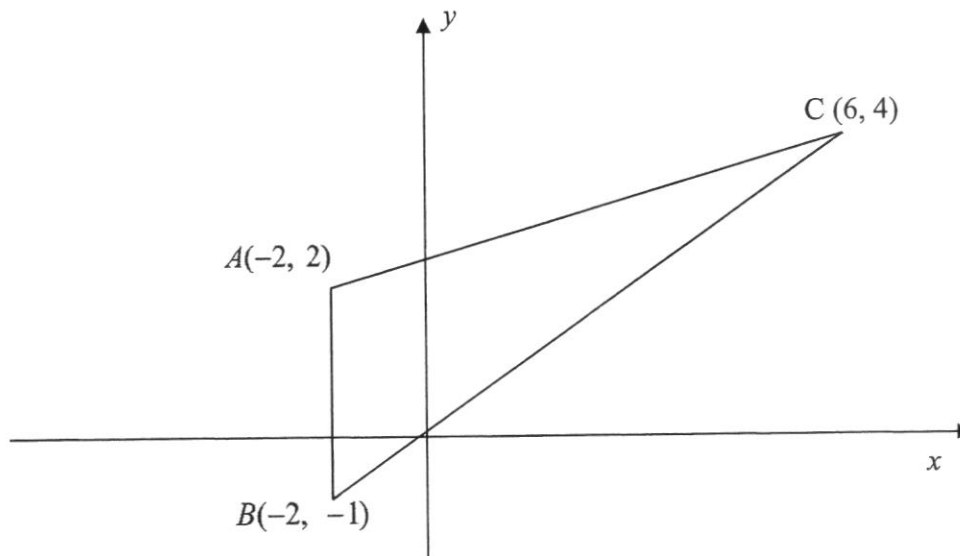
- (ii) Write down the depth of the bigger trough and the depth of the smaller trough as a ratio.

Answer : [1]

- (iii) Both troughs are filled to the brim with sand.
The mass of sand in the smaller trough is 67.5 kg.
Find the mass of sand in the larger trough.

Answerkg [2]

- 3 The diagram below shows a triangle with the vertices $A(-2, 2)$, $B(-2, -1)$ and $C(6, 4)$.



(a) Find the gradient of AC .

Answer [1]

(b) Find the length of BC .

Answerunits [1]

(c) Write down the equation of the line AB .

Answer [1]

(d) Find the equation of the line AC .

Answer [2]

(e) Find the area of triangle ABC .

Answerunits² [2]

(f) Find the coordinates of D if $ABCD$ is a parallelogram.

Answer (,) [1]

4 Mr Ong planned to buy \$150 worth of durians at \$ x per kg during the non-peak season.

(a) During the peak season, the price of durians decreased by \$5 per kg. Given that he could buy 5 kg more of durians during the peak season, form an equation in x and show that it can be reduced to $x^2 - 5x - 150 = 0$. [5]

- (b) Solve the equation $x^2 - 5x - 150 = 0$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (c) Find the number of kilograms of durians that Mr Ong could get for \$150 during the peak season.

Answer $\dots\dots\dots$ kg [1]

- 5 (a) On 30th of August 2021 the exchange rate between Singapore dollars (S\$) and Japanese yen (¥) was S\$1 = ¥80.50.
On the same day, the exchange rate between Singapore dollars (\$) and South Korean won (₩) was \$1 = ₩815.50.

- (i) Ali changed S\$450 into Japanese yen.
Calculate the amount of money he received in Japanese yen.

Answer ¥..... [1]

- (ii) James changed ¥40000 into South Korean won.
Calculate the amount of money he received in South Korean won.
Give your answer correct to the nearest integer.

Answer ₩..... [2]

- (b) Mdm Lee wanted to deposit a sum of money.
She was considering the following options.

Bank ABC
Compound interest
5% per annum compounded
monthly

Finance Company XYZ
Simple interest
5.5% per annum

She decided to deposit the sum of money with Finance Company XYZ.
After 3 years, she received an interest of \$ 3300.

- (i) Calculate the principal amount of money deposited with Finance Company XYZ.

Answer \$..... [2]

- (ii) Did Mdm Lee get a better deal with Finance Company XYZ?
Justify your answer with the aid of relevant calculations

Answer [3]

- (c) The cost price of a camera is \$900.
A shop owner intends to make a profit of 140% for selling the camera.
Find the amount of money, inclusive of 7% Goods and Services Tax, which a customer needs to pay this shop owner for the camera.

Answer \$..... [2]

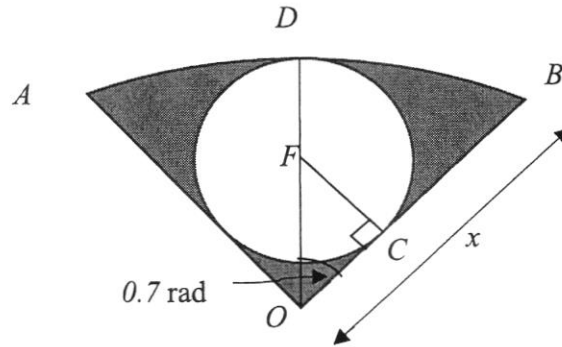
- 6 (a) (i) Convert 3.56 radians to degrees.

Answer ° [1]

- (ii) If $\sin x = 0.2$, write down the possible values of x for $0^\circ \leq x \leq 180^\circ$.

Answer° or° [2]

- (b) In the diagram, $OADB$ is a sector with radius x cm. Angle BOD is 0.7 radians and angle OCF is 90° . Point D lies on the arc AB such that OD is the angle bisector of angle AOB . Point F is the centre of the circle with radius 6 cm.



(i) Show that x is approximately 15.3 cm. [2]

(ii) Find angle OFC in radians.

Answerradians [1]

(iii) Find the shaded area.

Answercm² [2]

(iv) Find the perimeter of sector $AOBD$.

Answercm [2]

- 7 The variables x and y are connected by the equation $y = x + \frac{5}{x}$.

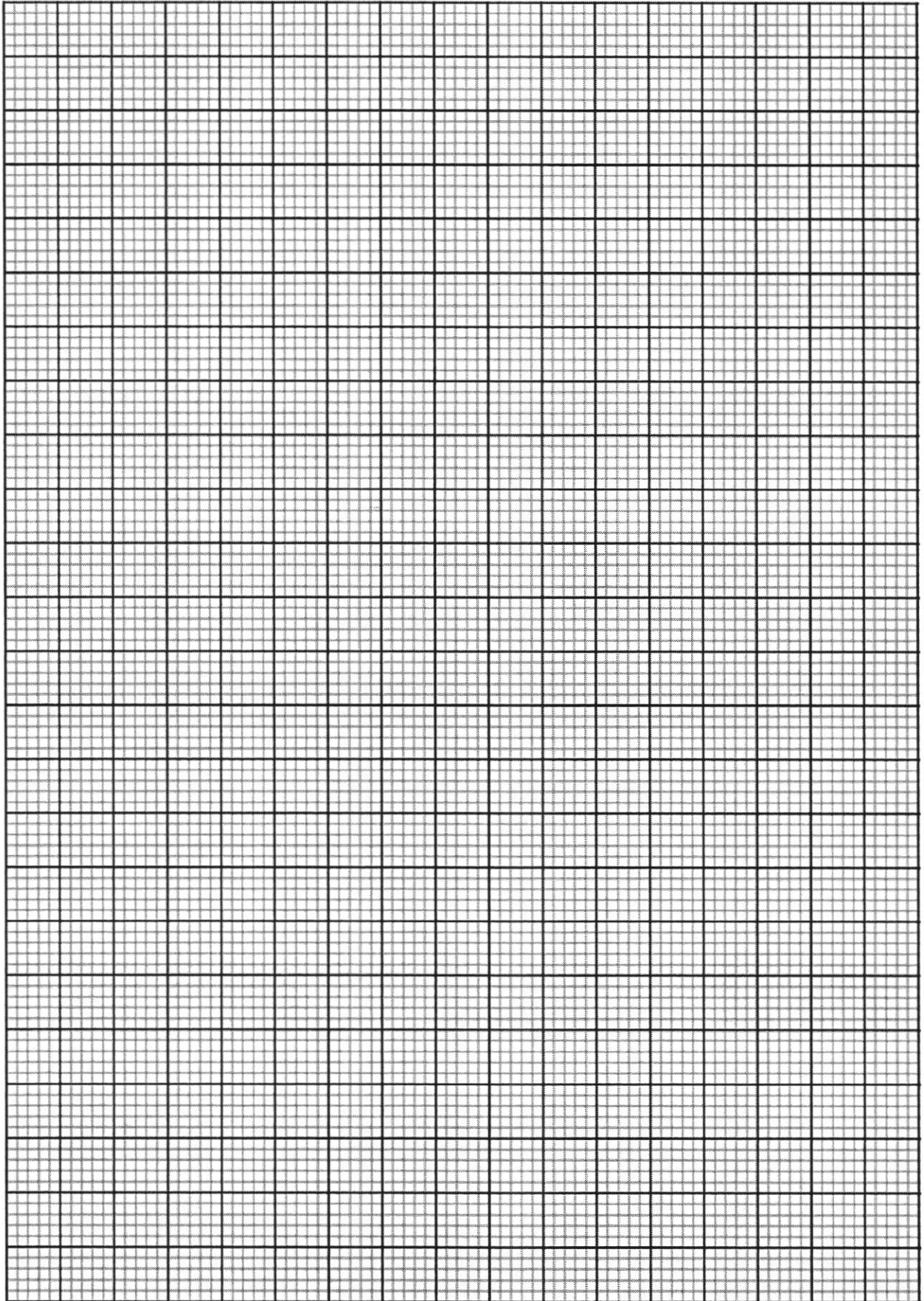
The table below gives some values of x and the corresponding values of y .

x	1	1.5	2	2.5	3	4	5	6	8
y	6	4.8	4.5	4.5	a	5.3	6	6.8	8.6

- (a) Calculate the value of a , giving your answer to 1 decimal place.

Answer $a = \dots\dots\dots$ [1]

- (b) Using a scale of 2 cm to represent 1 unit on the x -axis and 2 cm to represent 1 unit on the y -axis, draw the graph of $y = x + \frac{5}{x}$ on the graph paper provided on the next page for the range $1 \leq x \leq 8$. [3]



- (c) Use your graph to find the solutions of the equation $\frac{5}{x} = 5 - x$ in the range $1 \leq x \leq 8$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (d) (i) On the grid in part (b), draw the line $2y = 12 - x$ for $0 \leq x \leq 8$. [2]
- (ii) Write down the x -coordinates of the points where this line intersects the curve.

Answer $x = \dots\dots\dots$ and $\dots\dots\dots$ [2]

- (e) By drawing a suitable tangent to your curve, find the coordinates of the point at which the gradient of the tangent is equal to $-\frac{1}{2}$.

Answer (,) [2]

8 (a) Solve the inequality $\frac{2x+1}{3} \leq \frac{7-3x}{2}$.

Answer [2]

(b) Simplify $\frac{7x^2}{x^2-2x} \div \frac{x^2+2x}{x^2-4}$.

Answer [2]

(c) Solve these simultaneous equations.

$$7x + 2y = 15$$

$$6x - 3y = 16$$

Answer $x = \dots\dots\dots, y = \dots\dots\dots$ [3]

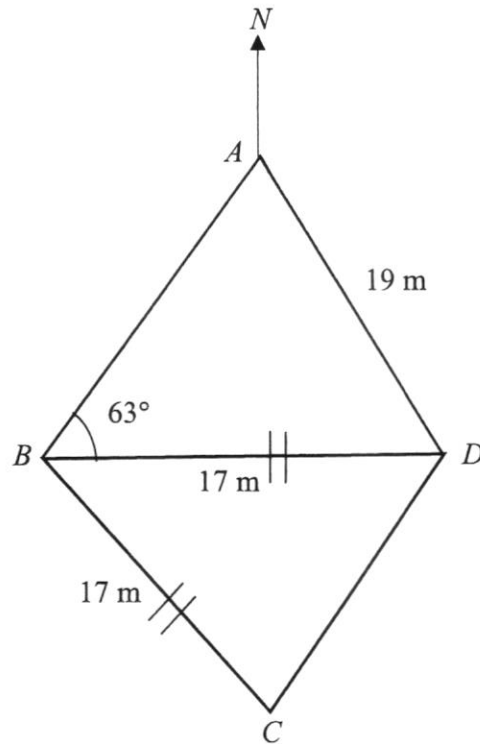
- (d) Express as a single fraction in its simplest form $\frac{2x^2 - x - 15}{(x-3)^2} - \frac{4}{x-3}$.

Answer [3]

- (e) Simplify $\left(\frac{625a^{-6}}{\sqrt{81}x^4}\right)^{\frac{1}{2}}$, giving your answer in positive index form.

Answer [3]

- 9 In the diagram below, A , B , C and D lie on a flat ground. B is due west of D and the bearing of C from B is 145° . $BC = BD = 17$ m and $AD = 19$ m. Angle $ABD = 63^\circ$.



- (a) Find the length of CD .

Answerm [3]

- (b) Calculate the value of angle BAD .

Answer $^\circ$ [2]

- (c) A vertical pole AT with a height of 3.5 m is placed at A .
Calculate the angle of depression of D from T .

Answer° [2]

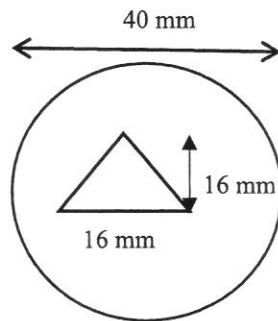
- (d) A lady walks along BD .
- (i) Calculate the distance from D such that the angle of elevation of T from the lady is the greatest.

Answerm [3]

- (ii) Hence, calculate the greatest angle of elevation.

Answer° [3]

- 10** The diagram shows the cross-section of a gold pendant. The pendant takes the form of a circular disc of diameter 40 mm and thickness 3 mm. A triangular hole of height and base, both 16 mm is drilled through the disc.



- (a)** Find the cross-sectional area of the pendant. Leave your answer in mm^2 .

Answer mm^2 [2]

- (b)** Find the volume of the pendant, in cm^3 .

Answer cm^3 [2]

- (c) An object with a mass greater than or less than 2.2 oz is not made of pure gold. Pure gold will have an **exact** mass of 2.2 oz. The manufacturer now claims that this pendant is made of pure gold. Verify his claim by using the information given below.

Density of pure gold = 19.30 g/cm^3

1 ounce (oz) = 28.35g

Answer[3]

- (d) The manufacturer decides to melt down the original pendant to form several identical spheres. The radius of each sphere is to be 5.1 mm. Calculate the maximum number of spheres that he can make out of the melted pendant.

Answer [3]

-----End of Paper -----

Punggol Secondary School 2021 Sec 3Exp End-of-Examination
 Mathematics Paper 1
 Marking Scheme

1	<p>The report is misleading because the ratio of the heights of the bar chart is not 1:2.</p> <p>or</p> <p>The bar for 2021 shows an increase in height that is more than doubled that of 2020.</p> <p>or</p> <p>The vertical axis does not start with zero and therefore the difference in heights of the columns is exaggerated.</p>	B1	Accept any other reasonable answer.
2a	$\frac{4.23^2 - 6.78}{\sqrt{109}} = 1.0644$	B1	
2b	1.1	B1	
3	$2x^2 - 5x - 12 = 0$ $(x - 4)(2x + 3) = 0$ $x = 4$ or -1.5 <i>the other solution is $x = -1.5$</i>	M1 A1	M1-Factorisation
4a	$y = 2 - x$	B1	
4b	$y = 2^x$	B1	
5a	Mode = 22	B1	
5b	$mean = 26$ $\frac{359 + (30 + x)}{15} = 26$ $359 + (30 + x) = 390$ $x = 390 - 359 - 30$ $x = 1$	M1 A1	<p>M1- accurate use of mean given to calculate total of 15 students.</p> <p>A1 – do not award for answer ‘31’</p>
6a	$\frac{7+10}{25} = \frac{17}{25}$ or 0.68	B1	
6b	<p>Let x be the new total</p> $\frac{10}{x} = 0.2$ $x = 50$ <p>P(green disc)</p> $= \frac{50 - 25}{50} = 0.5$	M1 A1	M1 – accurate new total

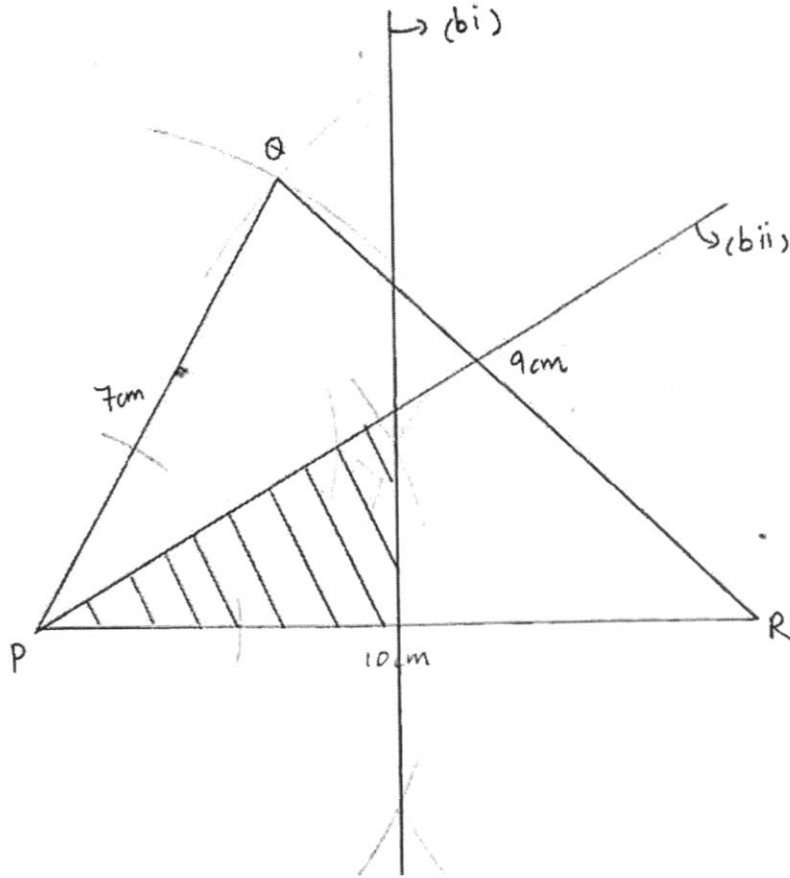
7a	$168 = 2^3 \times 3 \times 7$	B1	
7b	$168 = 2^3 \times 3 \times 7$ $360 = 2^3 \times 3^2 \times 5$ $HCF = 2^3 \times 3 = 24$	B1	
7c	$m = 3 \times 5^2 = 75$	B1	
8a	$E = \frac{3(-0.3)}{\sqrt{72}}$ $= -0.1060660172$ $= -0.106$ (3sf)	B1	
8b	$E = \frac{3a}{\sqrt{m}}$ $\sqrt{m} = \frac{3a}{E}$ $m = \left(\frac{3a}{E}\right)^2$ $m = \frac{9a^2}{E^2}$	M1 A1	M1-accurate expansion
9	$\angle ABC = 180 - 118 = 62$ (adj \angle s on a str line) $\angle BCA = 180 - 2(62) = 56$ (\angle sum of Δ) $\angle EDC = \angle BCA = 56$ (corresponding \angle s, $DE \parallel CB$)	M1 M1 A1	Deduct 1 mark if any reason not given/ or wrong reason
10	sum of interior angles = $(6 - 2) \times 180 = 720$ $x + 153 + 85 + x + 107 + (2x - 45) = 720$ $4x + 300 = 720$ $x = \frac{720 - 300}{4}$ $x = 105$	M1 M1 A1	M1-sum of int angles M1-accurate equation
11	Arc = $\frac{80}{360} \times 2 \times \pi \times 13.5 = 6\pi$ Arc = $\frac{80}{360} \times 2 \times \pi \times 9 = 4\pi$ Perimeter = $6\pi + 4\pi + 2(13.5 - 9)$ $= 10\pi + 9$	M1 M1 A1	

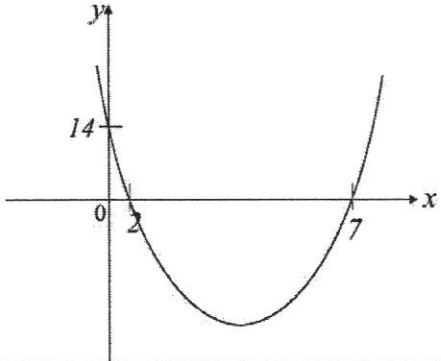
12	$y = \frac{k}{x^2}$ $7 = \frac{k}{x^2}$ $\text{new } y = \frac{k}{(2x)^2}$ $= \frac{k}{4x^2}$ $= \frac{1}{4}(7)$ $= 1.75$ $\% \text{ change} = \frac{1.75 - 7}{7} \times 100\% = -75\%$ <hr/> <p>Or</p> $y = \frac{k}{x^2}$ $\text{new } y = \frac{k}{(2x)^2}$ $= \frac{k}{4x^2}$ $\% \text{ change} = \frac{\frac{1}{4}\left(\frac{k}{x^2}\right) - \frac{k}{x^2}}{\frac{k}{x^2}} \times 100\%$ $= \frac{\frac{k}{x^2}\left(\frac{1}{4} - 1\right)}{\frac{k}{x^2}} \times 100\%$ $= -75\%$	<p>M1 - 2x</p> <p>M1- new $y = \frac{k}{4x^2}$</p> <p>A1</p>	
13a	$7 + 4y - (3x - y)$ $= 7 + 4y - 3x + y$ $= 7 - 3x + 5y$	<p>M1</p> <p>A1</p>	<p>M1-accurate expansion</p>
13b	$6ab + 3ac - 10b - 5c$ $= 3a(2b + c) - 5(2b + c)$ $= (2b + c)(3a - 5)$	<p>M1</p> <p>A1</p>	
14a	$x^2 - 7x + 6$ $= x^2 - 7x + \left(-\frac{7}{2}\right)^2 - \left(-\frac{7}{2}\right)^2 + 6$	<p>B1</p>	

	$= (x - \frac{7}{2})^2 - \frac{25}{4}$ or $(x - 3.5)^2 - 6.25$		
14b	$x^2 - 7x + 6 = 0$ $(x - 3.5)^2 - 6.25 = 0$ $(x - 3.5)^2 = 6.25$ $x - 3.5 = \pm\sqrt{6.25}$ $x = 3.5 \pm \sqrt{6.25}$ $x = 6$ or 1	M1-take square root with +/- A1/A1	

15ai	$3^2 \div 3^{-6}$ $= 3^{2-(-6)}$ $= 3^8$	B1	
15aii	$\frac{1}{243} = \frac{1}{3^5} = 3^{-5}$	B1	
15b	$5^{2x} \times 5^{-7} = 1$ $5^{2x} \times 5^{-7} = 5^0$ $2x - 7 = 0$ $x = 3.5$	M1 A1	M1 - writing $1=5^0$
16a	\$30	B1	
16b	6.4gb	B1	
16c	$\frac{80 - 30}{8 - 4}$ $= \frac{50}{4}$ $= \$12.50 \text{ per gb}$	M1 A1	

- 17a B1 – at least 2 lines constructed accurately
 Or
 B1 – triangle PQR drawn to scale, without construction arcs
 B2 – triangle PQR constructed accurately



18a		<p>B1 – accurate shape</p> <p>B1 – accurate x intercepts</p> <p>B1 – accurate y intercept</p>	
18b	$x = 4.5$	B1	
18c	$(4.5, -6.25)$	B1	
19a	<p>$\angle CDB = \angle FEB$ (corresponding \angles, $DC \parallel EF$)</p> <p>$\angle DCB = \angle EFB$ (corresponding \angles, $DC \parallel EF$)</p> <p>$\angle DBC = \angle EBF$ (common angle)</p> <p>The 3 pairs of corresponding angles are equal. Therefore, $\triangle CDB$ and $\triangle FEB$ are similar.</p>	<p>M1</p> <p>A1</p>	<p>Able to conclude and state the case for similarity</p>
19b	$\frac{\text{Area of } \triangle CDB}{\text{Area of } \triangle FEB} = \left(\frac{5}{4}\right)^2 = \frac{25}{16}$ $\frac{\text{Area of } \triangle CBD}{32} = \frac{25}{16}$ $\text{Area of } \triangle CBD = \frac{25}{16} \times 32 = 50\text{cm}^2$ $\frac{\text{Area of } \triangle ABC}{\text{Area of } \triangle CDB} = \frac{3}{2}$ $\frac{\text{Area of } \triangle ABC}{50} = \frac{3}{2}$ $\text{Area of } \triangle ABC = \frac{3}{2} \times 50 = 75\text{cm}^2$	<p>M1</p> <p>M1</p> <p>A1</p>	<p>Able to find the area of $\triangle CDB$ using similar triangles</p>

20a	$CE^2 = 15^2 + 8^2$ $CE = \sqrt{15^2 + 8^2}$ $CE = 17\text{cm}$	M1 A1	
20b	$\tan CFD = \frac{3}{4}$ $\frac{15}{8 + EF} = \frac{3}{4}$ $3(8 + EF) = 4(15)$ $24 + 3EF = 60$ $3EF = 36$ $EF = 12\text{ cm}$	M1 M1 A1	M1 – accurate trigo ratio M1-cross multiply A1->3EF=26
21a	$p = 5 \times 9 \times (7^2 + 4)$ $q = 12^4 - 16$ $r = n \times (n + 4) \times ((n + 2)^2 + 4)$	B1 B1 B1	
21bi	$50609 = 50625 - 16$ $50609 = 15^4 - 16$ $= 13 \times 17 \times (15^2 + 4)$ $= 13 \times 17 \times 229$	M1 A1	
21bii	13 th term / T ₁₃	B1	

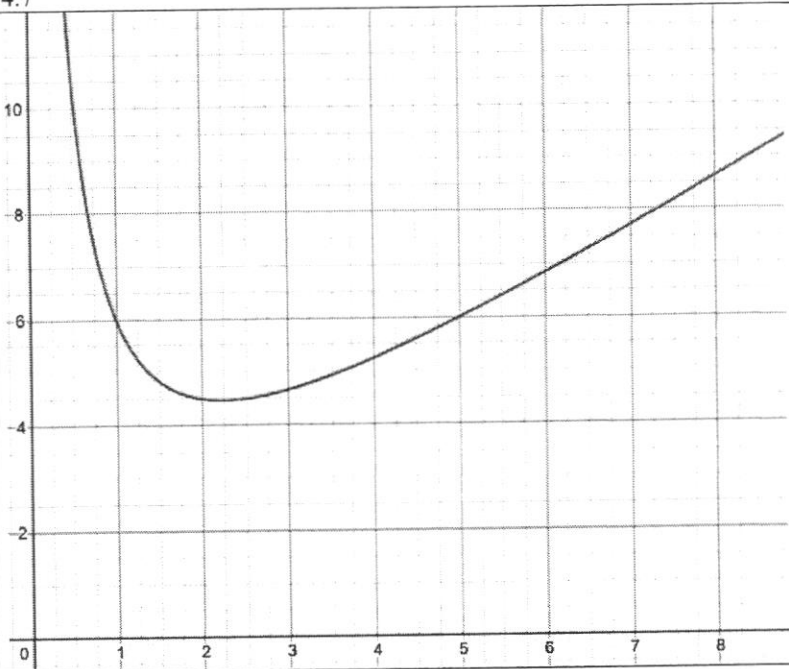
22a	<i>acceleration</i> $= \frac{20}{6}$ $= 3\frac{1}{3}$ $= 3.33m / s^2$	B1	
22b	$\frac{v}{5} = \frac{20}{6}$ $6v = 100$ $v = 16.667$ $v = 16.7 m / s$	M1 A1	
22c	Total distance $= \frac{1}{2} \times (10 + 16) \times 20$ $= 260m$	M1 A1	
22d		B1/B1	B1- straight line B1-curve

3E SA2 2021 Paper 2 Marking Scheme

No	Solution	Marks	
1(a)(i)	Mean number of visitors $\frac{1.37 \times 10^7}{12}$ $= 11\,41666.667$ $= 1.14 \text{ million (3 sf)}$	M1 A1	
(a)(ii)	$\frac{2.36 \times 10^6}{1.37 \times 10^7} \times 100\%$ $= 17.22627$ $= 17.2\% \text{ or } 17\frac{31}{137}\%$	M1 A1	
1(b)	$65.089 \times 10^6 \times \frac{104}{100} = \$67\,692\,560$	M1A1	
2(a)	$\angle ABC = \angle ACB$ (Base \angle s of isosceles Δ) $\frac{1}{2} \angle ABC = \frac{1}{2} \angle ACB$ $\therefore \angle ABP = \angle ACQ$ $AB = AC$ (Given) $\angle BAP = \angle CAQ$ (common) Triangles ABP and ACQ are congruent.(ASA)	M1 M1 M1	
2b(i)	$\frac{A_1}{A_2} = \frac{9}{25}$ $\frac{A}{1250} = \frac{9}{25}$ $A = \frac{9}{25} \times 1250$ $= 450 \text{ cm}^2$	M1 A1	
2b(ii)	$\frac{A_1}{A_2} = \left(\frac{d_1}{d_2}\right)^2$ $\frac{d_1}{d_2} = \sqrt{\frac{25}{9}} \quad \text{accept} \quad \frac{d_1}{d_2} = \sqrt{\frac{9}{25}}$ $= \frac{5}{3} \quad \quad \quad = \frac{3}{5}$	B1	

2b(iii)	$\frac{M_1}{M_2} = \frac{V_1}{V_2} = \left(\frac{5}{3}\right)^3$ $\frac{M_1}{67.5} = \frac{125}{27}$ $M_1 = \frac{125}{27} \times 67.5$ $= 312.5\text{kg}$	M1 A1	
3(a)	$\frac{2}{8} = \frac{1}{4}$	B1	
3(b)	$\sqrt{(-2-6)^2 + (-1-4)^2}$ $= 9.43$	B1	
3(c)	$x = -2$	B1	
3(d)	$m = \frac{1}{4}$ $4 = \frac{1}{4}(6) + c$ $c = 2.5$ $y = \frac{1}{4}x + 2.5$	M1 A1	
3(e)	$\frac{1}{2} \times 3 \times 8$ $= 12$	M1 A1	
3(f)	(6, 7)	B1	
4(a)	$\frac{150}{x} \text{ kg}$ $\frac{150}{x-5} \text{ kg}$ $\frac{150}{x-5} - \frac{150}{x} = 5$ $150x - 150(x-5) = 5x(x-5)$ $750 = 5x^2 - 25x$ $5x^2 - 25x - 750 = 0$ $x^2 - 5x - 150 = 0$	B1 B1 M1 M1 Divide by 5 throughout M1	
4(b)	$x^2 - 5x - 150 = 0$ $(x-15)(x+10) = 0$ $x = 15 \text{ or } -10$	M1 A1,A1	
4(c)	When $x = 15$,		

	$\frac{150}{15-5} = 15 \text{ kg}$	B1	
5(a)(i)	¥36225	B1	
5(a)(ii)	$40000 \div 80.50 \times 815.50$ $= \text{¥}405217$	M1 A1	
5(b)(i)	$I = \frac{PRT}{100}$ $3300 = \frac{P(5.5)(3)}{100}$ $P = 20000$	M1 A1	
5(b)(ii)	Bank ABC $A = P \left(1 + \frac{r}{100} \right)^n$ $A = 20000 \left(1 + \frac{5 \div 12}{100} \right)^{36}$ $A = 23229.44$ Finance Company XYZ Total \$23300 John received a better interest with Finance Company XYZ.	M1 A1 B1	
5(c)	Selling price with 140% profit $= \$900 \times 2.4$ $= \$2160$ Amount customer paid with 7% GST $= \$2160 \times 1.07$ $= \$2311.20$	M1 A1	
6a(i)	204.0°	B1	
6a(ii)	11.5° 168.5°	B1, B1	
6b(i)	$\sin 0.7 = \frac{6}{OF}$ $OF = 9.313$ $x = 9.313 + 6 = 15.3$ (Shown)	M1 A1	
6b(ii)	$\angle OFC = \pi - \frac{\pi}{2} - 0.7 = 0.8708 = 0.871$	B1	
6b(iii)	$\frac{1}{2} \times 15.3136^2 \times 1.4 - \pi(6)^2$ $= 51.05758$ $= 51.1$	M1 A1	

6b(iv)	$15.3136 \times 1.4 + 15.3136 + 15.3136$ $= 52.0663 = 52.1$	M1 A1	
7(a)	4.7	B1	
78(b)		Correct Scale – B1 Correct Plots – B1 Smooth Curve – B1	
7(c)	Draw the line $y = 5$ $x = 1.4, 3.6$ (Accept +/- 0.1)	B1 B2	
7(d)	(i) Straight line drawn – B1 Passes through (0, 6) and (8, 2) – B1	B2	
	(ii) $x = 1.2, 2.8$ (Accept +/- 0.1)	B2	
7(e)	Draw tangent Coordinates (1.8, 4.5) – Accept +/- 0.2	B1 B1	
8(a)	$\frac{2x+1}{3} \leq \frac{7-3x}{2}$ $2(2x+1) \leq 3(7-3x)$ $13x \leq 19$ $x \leq \frac{19}{13}$ $x \leq 1\frac{6}{13}$	M1 A1	
8(b)	$\frac{7x^2}{x^2-2x} \div \frac{x^2+2x}{x^2-4}$ $= \frac{7x^2}{x^2-2x} \times \frac{x^2-4}{x^2+2x}$ $= \frac{7x^2}{x(x-2)} \times \frac{(x-2)(x+2)}{x(x+2)}$ $= 7$	M1 A1	
8(c)	Show either elimination or substitution method	M1	

	$x = 2\frac{1}{3}, y = -\frac{2}{3}$	A1A1	
8(d)	$\frac{2x^2 - x - 15}{(x-3)^2} - \frac{4}{x-3}$ $= \frac{(2x+5)(x-3)}{(x-3)^2} - \frac{4}{(x-3)}$ $= \frac{(2x+5) - 4}{(x-3)}$ $= \frac{2x+1}{x-3}$	M1 M1 A1	
3(e)	$\left(\frac{625a^{-6}}{\sqrt{81x^4}}\right)^{\frac{1}{2}}$ $= \left(\frac{5^4 a^{-6}}{3^2 x^4}\right)^{\frac{1}{2}}$ $= \frac{5^2 a^{-3}}{3x^2}$ $= \frac{25}{3x^2 a^3}$	M1 M1 A1	
9(a)	$\angle DBC = 145^\circ - 90^\circ = 55^\circ$ $CD^2 = 17^2 + 17^2 - 2(17)(17)\cos 55^\circ$ $CD = 15.69$ $CD = 15.7 \text{ m}$	M1 M1 A1	
9(b)	$\frac{\sin \angle BAD}{17} = \frac{\sin 63^\circ}{19}$ $\sin \angle BAD = \frac{17 \sin 63^\circ}{19}$ $\angle BAD = 52.8651 = 52.9^\circ \text{ (1dp)}$	M1 A1	
9(c)	$\tan \theta = \frac{3.5}{19}$ $\theta = \tan^{-1}\left(\frac{3.5}{19}\right)$ $\theta = 10.43^\circ$ $\theta = 10.4^\circ$	M1 A1	
9(d)(i)	$\angle BDA = 180 - 63 - 52.8651 = 64.1349^\circ$ $\cos 64.14^\circ = \frac{x}{19}$ $x = 8.2888 = 8.29$	M1 M1 A1	

9(d)(ii)	$M = \sqrt{19^2 - 8.287^2} = 17.09$ $\tan \theta = \frac{3.5}{17.09}$ $\theta = 11.57$ Angle of elevation = 11.6°	M1 M1 A1	
10(a)	$\text{area of cross section} = \pi(20)^2 - \left(\frac{1}{2} \times 16 \times 16\right)$ $= 1128$ $= 1130 \text{ mm}^2$	M1 A1	
10(b)	$\text{volume} = (1128 \div 100) \times 0.3$ $= 3.3859$ $= 3.39 \text{ cm}^3$	M1 A1	
10(c)	$\text{mass of pendant (in g)} = 19.30 \times 3.384$ $= 65.31\text{g}$ $\text{mass in (oz)} = \frac{65.31}{28.35}$ $= 2.303$ $= 2.30 \text{ oz}$ Since mass of pendant not equal to 2.2 oz, his claim is not true.	M1 A1 B1	
10(d)	$\text{volume of 1 sphere} = \frac{4}{3} \pi (0.51)^3$ $= 0.5556 \text{ cm}^3$ $\frac{\text{volume of pendant}}{\text{volume of sphere}} = \frac{3.384}{0.5556}$ $= 6.09$ $= 6 \text{ spheres}$ He can make 6 spheres.	M1 M1 A1	