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Full Name	Class Index No	Class



Anglo-Chinese School (Parker Road)

PRELIMINARY EXAMINATION 2023

SECONDARY FOUR EXPRESS

MATHEMATICS

4052

PAPER 1

2 HOURS 15 MINUTES

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
Write in dark blue or black pen.

Answer **all** questions.

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

Omission of essential working will result in loss of marks.

The use of an approved scientific calculator is expected, where appropriate.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

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

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

The total of the marks for this paper is 90.

For Examiner's Use

This question paper consists of **26** printed pages and **2** blank pages.

Mathematical Formulae*Compound interest*

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

1 Simplify $5a - 3(a - 2)$.

Answer _____ [1]

2 (a) Calculate $\frac{12.5^2}{5.48 - 2.47}$.

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 The sine of an angle is 0.6420.
Give two possible values for the angle.

Answer _____ ° or _____ ° [2]

-
- 4 (a) Express 168 as the product of its prime factors.

Answer _____ [1]

- (b) The number $168k$ is a perfect square.
Find the smallest positive integer value of k .

Answer $k =$ _____ [1]

- 5 (a) Factorise completely $3xy - 6ay - 5x + 10a$.

Answer _____ [2]

- (b) Solve $(2x+1)(x-3) = 0$.

Answer $x =$ _____ or $x =$ _____ [1]

- (c) (i) Solve the inequalities $9x - 1 < 11 + 3x \leq 7x + 21$.

Answer _____ [3]

- (ii) Represent the solution on the number line below.

Answer



- 6** A gardener wants to plant flowers in his garden and he wants to arrange them in rows. He has 60 red flowers, 72 yellow flowers and 84 blue flowers. He wants to make the same number of rows of each color.

(a) Find the largest number of rows he can make of each colour.

Answer _____ [2]

(b) Write down the number of red, yellow and blue flowers in each row.

Answer _____ red
_____ yellow
_____ blue [1]

- 7 **(a)** Express $y = x^2 - 8x + 18$ in the form $y = (x+a)^2 + b$.

Answer _____ [2]

- (b)** Write down the equation of the line of symmetry of the graph of $y = x^2 - 8x + 18$.

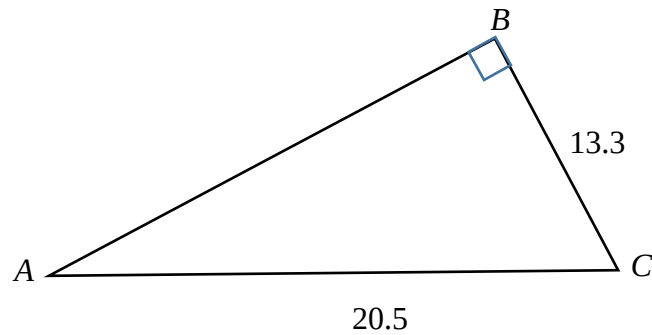
Answer _____ [1]

- (c)** Explain why the graph $y = x^2 - 8x + 18$ will not pass through the x-axis.

Answer _____

_____ [1]

8



In the triangle, $AC = 20.5$ cm, $BC = 13.3$ cm and angle $ABC = 90^\circ$.

- (a) Calculate AB .

Answer $AB =$ _____ cm [1]

- (b) (i) Explain why it is possible to draw a circle that passes through A , B and C .

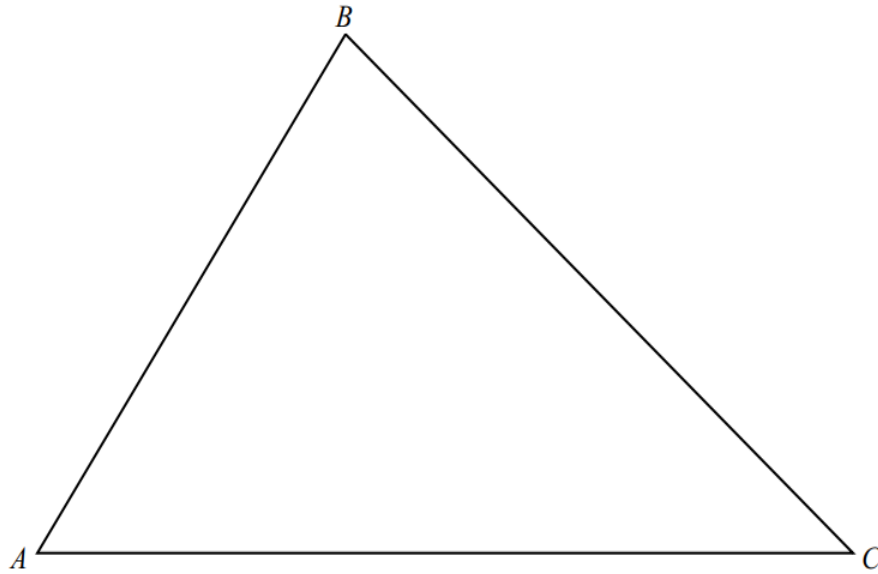
Answer

[1]

- (ii) State the radius of this circle.

Answer _____ cm [1]

- 9 The diagram shows a triangle ABC .



- | | | |
|-----|--|-----|
| (a) | Construct the angle bisector of angle ACB . | [1] |
| (b) | Construct the perpendicular bisector of BC . | [1] |
| (c) | Shade the region closer to AC than to BC and closer to C than to B . | [1] |

- 10 Joe and Jack each have a savings account.
 The ratio Joe's savings : Jack's savings = $29 : 8$.
 They each spend \$15 from their savings.
 The new ratio Joe's savings : Jack's savings = $4 : 1$.
 Find how much money Joe now has in his account.

Answer \$ _____ [4]

11 Simplify $\frac{a^2 - 2ab - 3b^2}{4b^2 - 4a^2}$.

Answer _____ [3]

12 Solve $\frac{5}{3(x-1)} + \frac{3}{2(1-x)} + 4 = 0$.

Answer _____ [3]

13 Given that $a = 5 \times 10^{-3}$ and $b = 2 \times 10^2$, evaluate

(a) $\frac{2b}{a}$, giving your answer in standard form,

Answer _____ [1]

(b) $\frac{3}{a} - b$, giving your answer in ordinary notation.

Answer _____ [1]

- 14** On a particular week, a 40-seater bus ferries 10 adults and 30 children to their destination every morning from Monday to Friday.
It ferries 20 adults and 10 children every afternoon from Monday to Friday.

The information may be represented by the matrix $\mathbf{C} = \begin{pmatrix} 10 & 30 \\ 20 & 10 \end{pmatrix}$.

On Saturday morning, it ferries 25 adults and 15 children and in that afternoon, it ferries 10 adults and 30 children.

- (a)** Represent the number of passengers carried on Saturday in a 2x2 matrix $\mathbf{D}$.

Answer $\mathbf{D} =$ [1]

- (b)** Evaluate the matrix $\mathbf{E} = 5\mathbf{C} + \mathbf{D}$.

Answer $\mathbf{E} =$ [2]

- (c) State what the elements of **E** represent.

Answer _____

[1]

- (d) The fare for an adult is \$2.50 and the fare for a child is \$1.50.

- (i) Evaluate the matrix $\mathbf{F} = \mathbf{C} \begin{pmatrix} 250 \\ 150 \end{pmatrix}$.

Answer $\mathbf{F} =$

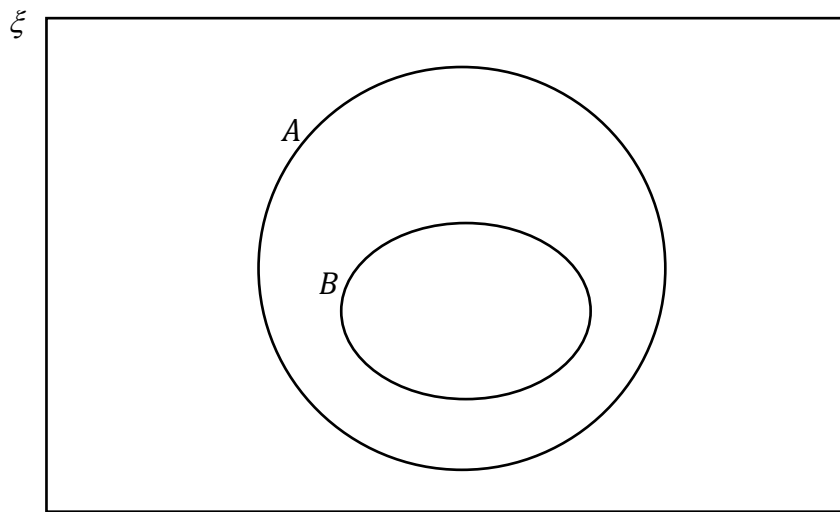
[1]

- (ii) State what the elements of **F** represent.

Answer _____

[1]

- 15 (a) On the Venn diagram shown in the answer space, shade the set $A \cap B'$.



[1]

- (b) $\xi = \{x : x \text{ is an integer, } 1 \leq x \leq p \text{ and } p < 50\}$

$$S = \{x : x \text{ is a multiple of 2}\}$$

$$T = \{x : x \text{ is a perfect square}\}$$

- (i) List the elements of $S \cap T$ such that there are only 3 elements in it.

Answer _____ [1]

- (ii) Find the largest p such that $S \cap T = \emptyset$.

Answer _____ [1]

- 16 $X(5, 5)$ and $Y(5, -5)$ are points on a cartesian plane. Find the equation of line L passing through $(1, -2)$ if it has the same gradient as the line passing through the points X and Y .

Answer _____ [2]

- 17 (a) Simplify $(x^6)^{\frac{2}{3}}$.

Answer _____ [1]

- (b) (i) Given that $\frac{1}{81} = 3^k$, find k .

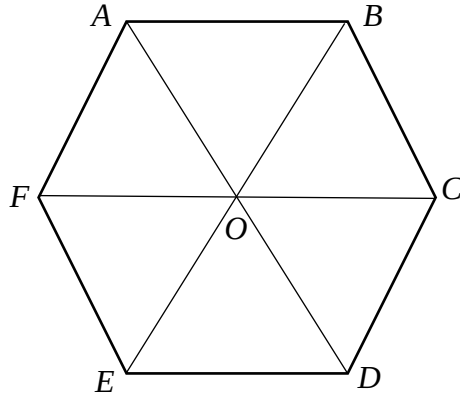
Answer $k =$ _____ [1]

(ii) $\frac{625^p}{5^q} = 125^r$

Find an expression for q in terms of p and r .

Answer $q =$ _____ [2]

18



$ABCDEF$ is a regular hexagon.
Show that triangle BOC and triangle EOF are congruent.
Give a reason for each statement.

Answer _____

_____ [3]

- 19 (a) (i) By factorisation, show that $1 + x + x(1+x) + x(1+x)^2 = (1+x)^3$.

Answer _____ [2]

- (ii) Given $1 + x + x(1+x) + x(1+x)^2 + x(1+x)^3 + x(1+x)^4 = (1+x)^n$,
State the value of n .

Answer $n =$ _____ [1]

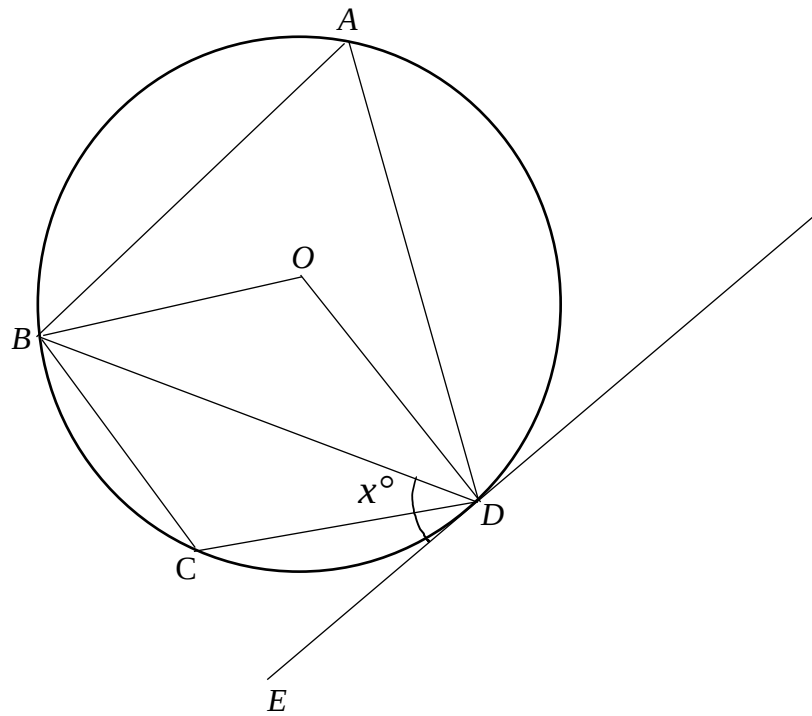
- (b) Hence, evaluate

$$2 + 2x + 2x(1+x) + 2x(1+x)^2 + 2x(1+x)^3 + 2x(1+x)^4 + \dots + 2x(1+x)^{99}$$

if $x = 3$.

Express your answer in index notation as a power of 2.

Answer _____ [4]



A, B, C and D are points on the circle, centre O .
 ED is a tangent to the circle and angle $EDB = x^\circ$.

Find, in terms of x , angle BCD .
 Give a reason for each step of your answer.

Answer _____ $^\circ$ [3]

- 21** The marks of 20 students for their Mid-Year Mathematics examination are listed in the tables below.

Mid-Year Mathematics Exam Marks				
51	72	66	61	65
58	64	80	83	48
47	54	45	75	50
51	91	40	77	59

- (a)** Find the mean mark.

Answer _____ [1]

- (b)** The passing mark for the examination is 50.

- (i)** Find the probability of selecting a student who passed the examination.

Answer _____ [1]

- (ii)** Two students are selected. Find the probability that one passed and the other failed the examination.

Answer _____ [2]

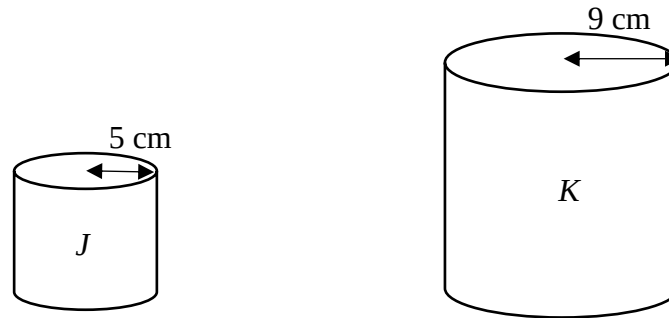
- (c) The same group of 20 students sat for their End-of-Year Mathematics examination and achieved a mean mark of 63.7.
The probability of selecting a student who passed the End-of-Year Mathematics examination was $\frac{9}{10}$.

Determine, based on your answers to **parts (a) and (b)**, if there is an improvement in the performance of the students in the End-of-Year Mathematics examination.

Answer _____

[2]

- 22 The diagram shows two geometrically similar solid cylinders. Cylinder J has radius 5 cm and cylinder K has radius 9 cm. These cylinders are made with the same material.



- (a) Find the ratio

- (i) volume of cylinder K : volume of cylinder J ,

Answer _____ : _____ [1]

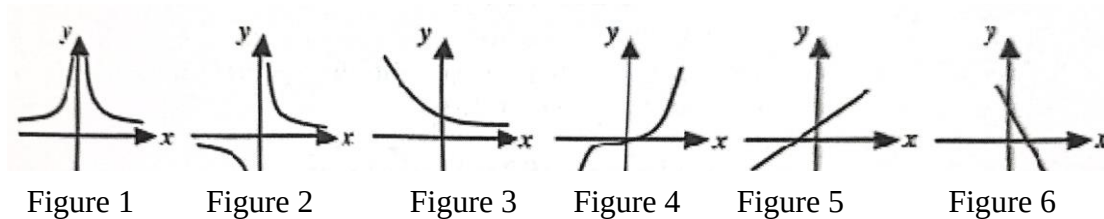
- (ii) total surface area of cylinder J : total surface area of cylinder K .

Answer _____ : _____ [1]

- (b) If the mass of J is 250 g, find the mass of K in kg.

Answer _____ kg [2]

23



Match the above figures to the following equations.

(a) $y = \frac{2}{x^2}$

Answer Figure_____ [1]

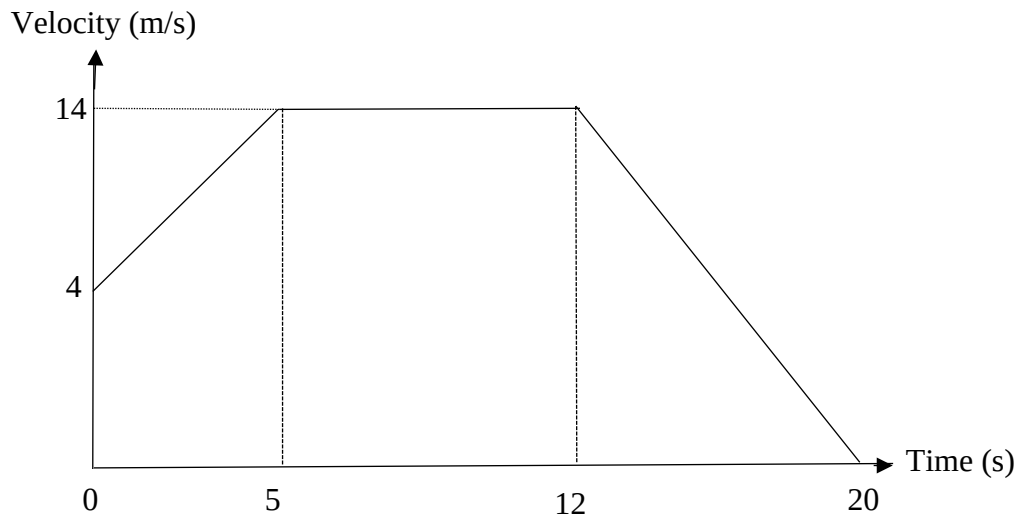
(b) $x + y - 2 = 0$

Answer Figure_____ [1]

(c) $y = e^{-x}$

Answer Figure_____ [1]

- 24 The diagram below shows the velocity-time graph of the first 20 seconds of the journey by an object.



Find

- (a) (i) its acceleration for the first 5 seconds of the journey,

Answer _____ m/s^2 [1]

- (ii) the velocity of the object at $t = 14\text{s}$,

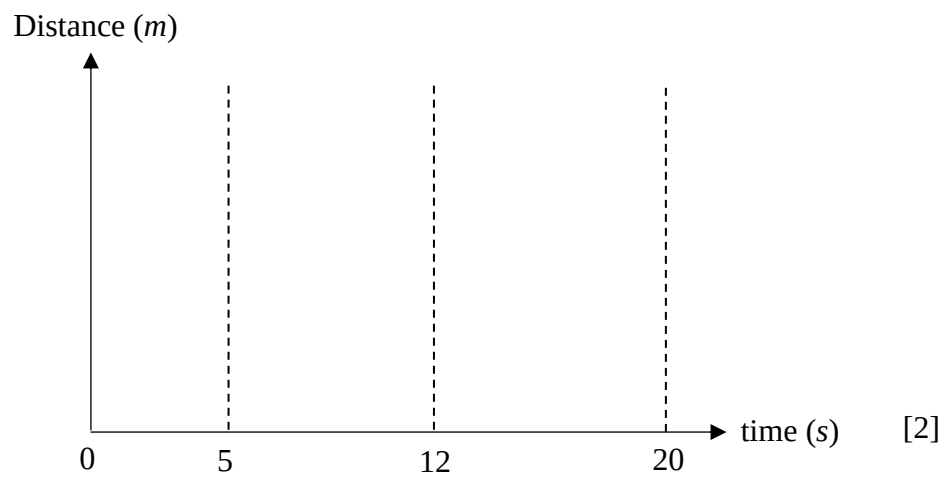
Answer _____ m/s [2]

- (iii) the total distance travelled for the journey.

Answer _____ m [2]

- (b) Complete the distance-time graph for the same journey in the answer space below.

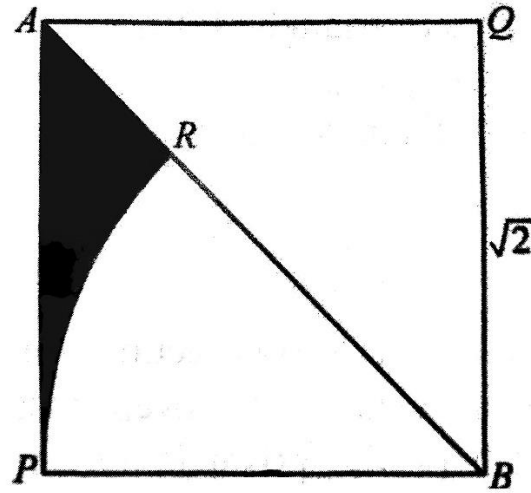
Answer



- 25 In the diagram, $AQBP$ is a square of side $\sqrt{2}$ cm.

BPR is a sector, centre B .

Show that the area of the shaded region APR is $\left(1 - \frac{\pi}{4}\right) \text{ cm}^2$.



Answer

[3]

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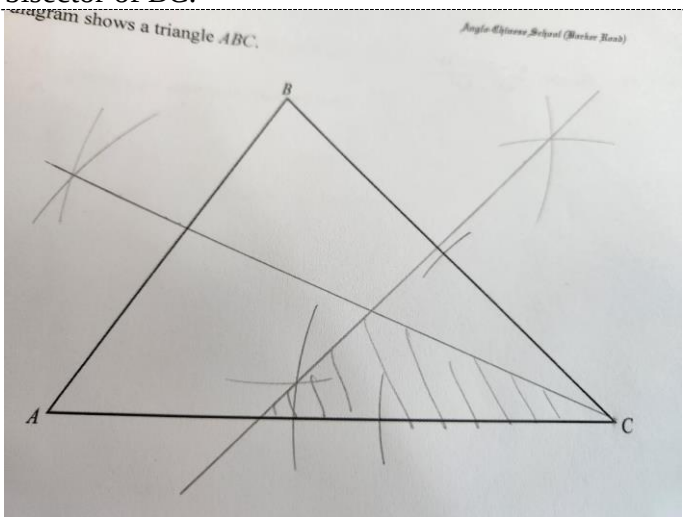
Marking Scheme
Secondary 4 Exp
Mathematics 4052/1

Anglo-Chinese School
(Barker Road)

1		$2a + 6$			
2	(a)	51.910			
	(b)	52			
3		$39.9^\circ, 140.1^\circ$			
4	(a)	$2^3 \times 3 \times 7$			
	(b)	42			
5	(a)	$3y(x-2a) - 5(x-2a)$ $= (3y-5)(x-2a)$			
	(b)	$x = -\frac{1}{2}$ or $x = 3$			
	(c)(i)	$9x - 1 < 11 + 3x$ $9x - 3x < 12$ $6x < 12$ $x < 2$ $11 + 3x \leq 7x + 21$ $3x - 7x \leq 21 - 11$ $-4x \leq 10$ $x \geq -2\frac{1}{2}$ $-2\frac{1}{2} \leq x < 2$			
	(ii)				
6	(a)	$60 = 2^2 \times 3 \times 5$ $72 = 2^3 \times 3^2$ $84 = 2^2 \times 3 \times 7$ HCF = $2^2 \times 3$ $= 12$			

Marking Scheme
Secondary 4 Exp
Mathematics 4052/1

Anglo-Chinese School
(Barker Road)

	(b)	$R = \frac{60}{12} = 5$ $Y = \frac{72}{12} = 6$ $B = \frac{84}{12} = 7$			
7	(a)	$(x-4)^2 - 16 + 18$ $= (x-4)^2 + 2$			
	(b)	$x = 4$			
	(c)	Since the minimum value = 2 which is above the x axis, the graph will not pass through the x -axis.			
8	(a)	$AB = \sqrt{20.5^2 - 13.3^2}$ $= 15.6\text{cm}$			
	(b)(i)	Angle $ABC = 90^\circ$. Since angle in a semi-circle is 90° , it is possible to draw a circle through A , B and C with AC as the diameter.			
	(ii)	Radius = 10.25cm			
9	(a)	Evidence of construction marks for angle bisector at angle C .			
	(b)	Evidence of construction marks for perpendicular bisector of BC .			
	(c)				

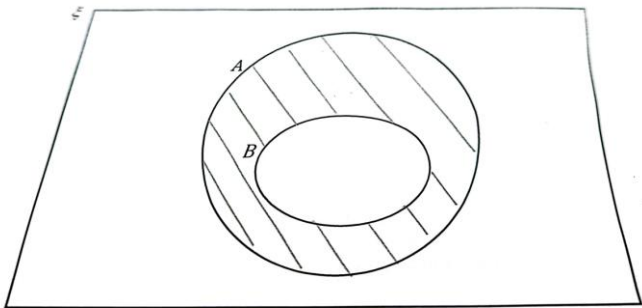
Marking Scheme
Secondary 4 Exp
Mathematics 4052/1

Anglo-Chinese School
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10		$\frac{29}{37}x - 15 = 4\left(\frac{8}{37}x - 15\right)$ $x = 555$ $\frac{29}{37} \times 555 = 435$ $435 - 15 = 420$ Alternatively $4:1=28:7$ $1u --- \$15$ $29 \times 15 = 435$ $435 - 15 = 420$			
11		$\frac{(a+b)(a-3b)}{4(b-a)(b+a)}$ $= \frac{a-3b}{4(b-a)}$			
12		$\frac{5}{3(x-1)} + \frac{3}{2(1-x)} + 4 = 0$ $\frac{5}{3(x-1)} - \frac{3}{2(x-1)} + 4 = 0$ $\frac{10-9}{6(x-1)} = -4$ $x = \frac{23}{24}$			
13	(a)	8×10^4			
	(b)	400			
14	(a)	$\begin{pmatrix} 25 & 15 \\ 10 & 30 \end{pmatrix}$			
	(b)	$5C = \begin{pmatrix} 50 & 150 \\ 100 & 50 \end{pmatrix}$ $E = \begin{pmatrix} 75 & 165 \\ 110 & 80 \end{pmatrix}$			

Marking Scheme
Secondary 4 Exp
Mathematics 4052/1

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	(c)	E represents the number of adults and children ferried in the morning and afternoon from Monday to Saturday .			
	d(i)	$F = \begin{pmatrix} 7000 \\ 6500 \end{pmatrix}$			
	(ii)	F represents the amount of money collected in cents on a weekday morning and afternoon .			
15	(a)				
	(b)(i)	4,16,36			
	(ii)	3			
16		Grad of XY is undefined and so the line is parallel to y-axis. $x = 1$			
17	(a)(i)	x^4			
	(b)(i)	$3^{-4} = 3^k$ $k = -4$			
	(ii)	$5^{4p-q} = 5^{3r}$ $4p - q = 3r$ $q = 4p - 3r$			
18		In triangle BOC and EOF, - Angle BOC = angle EOF = 60° (angle at the point, ABCD is a regular hexagon) - BC=EF (ABCD is a regular hexagon, all sides equal) - Angle BCO = angle EFO = 60° (equilateral triangle) - By ASA congruency test, triangle BOC is congruent to triangle EOF.			

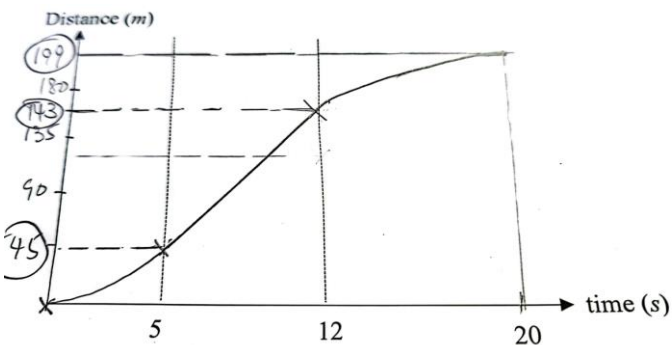
Marking Scheme
Secondary 4 Exp
Mathematics 4052/1

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19	(a)(i)	$(1+x)(1+x+x+x^2)$ $= (1+x)(1+x)^2$ $= (1+x)^3$			
	(ii)	$n = 5$			
	(b)	$2[(1+x)^{100}]$ $= 2(4)^{100}$ $= 2(2^{200})$ $= 2^{201}$			
20		Angle $OBD = 90^\circ - x$ (angle between the tangent and radius of a circle is a right angle). Angle $BOD = 180^\circ - 2(90^\circ - x) = 2x$ (base angles of an isosceles triangle, $OB = OD$, radii of the circle) $\text{Angle } BCD = \frac{360^\circ - 2x}{2}$ (angle at the centre is twice the angle at the circumference) $= 180^\circ - x$			
21	(a)(i)	61.85			
	(b)(i)	$\frac{4}{5}$			
	(b)(ii)	$\left(\frac{4}{5}\right)\left(\frac{1}{5}\right) + \left(\frac{1}{5}\right)\left(\frac{4}{5}\right)$ $= \frac{8}{25}$			
	(c)	There is improvement in the performance of students as the mean mark of the students in the final year examination 63.7 marks is higher than the mean mark of the mid-year examination of 61.85 marks. More students passed the final year examination.			
22	(a)(i)	$\frac{V_K}{V_J} = \left(\frac{9}{5}\right)^3 = 729:125$			
	(ii)	$\frac{S_J}{S_K} = \left(\frac{5}{9}\right)^2 = 25:81$			
	(b)	$K = \frac{729}{125} \times 250$ $= 1.458\text{kg}$			

Marking Scheme
Secondary 4 Exp
Mathematics 4052/1

Anglo-Chinese School
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23	(a)	1			
	(b)	6			
	(c)	3			
24	(a)(i)	2 m/s ²			
	(ii)	$\frac{7}{4} \times 6 = 10.5$ m/s			
	(iii)	45+98+24.5 = 167.5 m			
	(b)				
25		Area of $\frac{1}{2}$ square = 1 cm² Area of sector $\frac{1}{2} \times \sqrt{2} \times \sqrt{2} = 1$ $\frac{45}{360} \times \pi \times (\sqrt{2})^2$ $= \frac{\pi}{4}$ Area of shaded region = $1 - \frac{\pi}{4}$ cm²			

Full Name	Class Index No	Class



Anglo-Chinese School (Parker Road)

PRELIMINARY EXAMINATIONS SECONDARY FOUR EXPRESS

MATHEMATICS 4052 PAPER 2

2 HOURS 15 MINUTES

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

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

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

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

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

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) It is given that $s = ut + \frac{1}{2}at^2$.

(i) Find s when $u = 0$, $a = 0.5$ and $t = 13$.

Answer $s =$ _____ [1]

(ii) Rearrange the formula to make a the subject.

Answer $a =$ _____ [2]

(b) Solve $\frac{9}{x-4} = 2x-1$.

Answer $x =$ _____ or $x =$ _____ [2]

- (c) Solve these simultaneous equations.

$$4x - 3y = 18$$

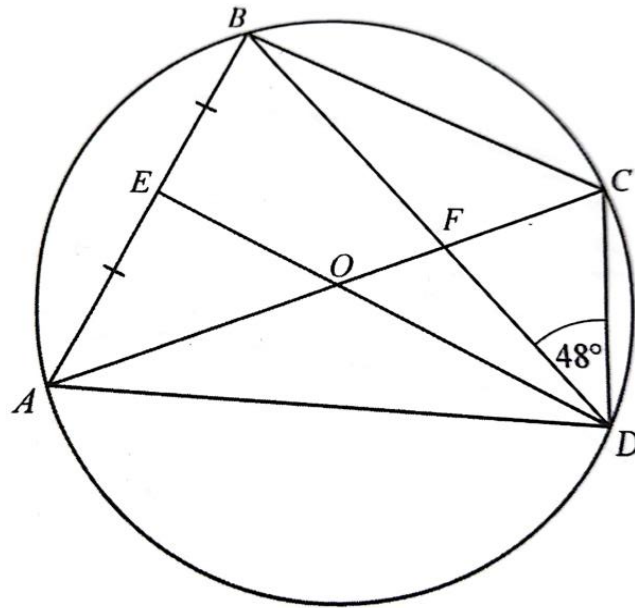
$$6x + 2y = 1$$

You must show your working.

Answer $x =$ _____

Answer $y =$ _____ [3]

2



The diagram shows a circle $ABCD$, centre O .

E is the midpoint of the chord AB . ED passes through O .

F is the point of intersection of BD and diameter AC .

Angle $BDC = 48^\circ$.

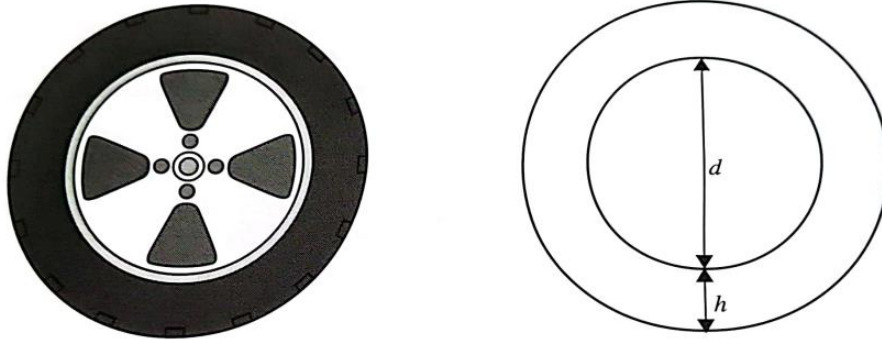
- (a) (i) Show that triangle CFD is similar to triangle BFA .
Give a reason for each statement you make.

[2]

- (ii) $AE = 5$ cm.
Find the area of triangle ABC .

Answer _____ cm^2 [4]

- (b) An odometer keeps track of the distance travelled by a vehicle by keeping track of the revolutions of a car tyre. The diagram below shows a car tyre and a simplified graphical representation of it.



In real life, this tyre has the following technical information on its sides:

215/60 R16

R16 indicates the rim has diameter $d = 16$ inches.

215/60 means the tyre has a width of 215 mm, and the thickness h is 60% of the width.

Taking 1 inch = 2.54 cm,

- (i) Find the circumference of the tyre in metres.

Answer _____ m [2]

- (ii) If the odometer registers 50 complete revolutions, calculate the distance travelled by the vehicle.

Answer _____ m [1]

- 3 The number of micro-organisms, y , in a test tube after t days is shown in the table below. The relationship between y and t can be modelled by the equation $y = 10(2^t)$.

- (a) Find the value of q .

t	0	1	2	3	4	5	6
y	10	20	40	80	q	320	640

Answer $q =$ _____ [1]

- (b) On the grid opposite, draw the graph of $y = 10(2^t)$ for $0 \leq t \leq 6$. [3]

- (c) (i) By drawing a tangent, find the gradient of the curve when $t = 3$.

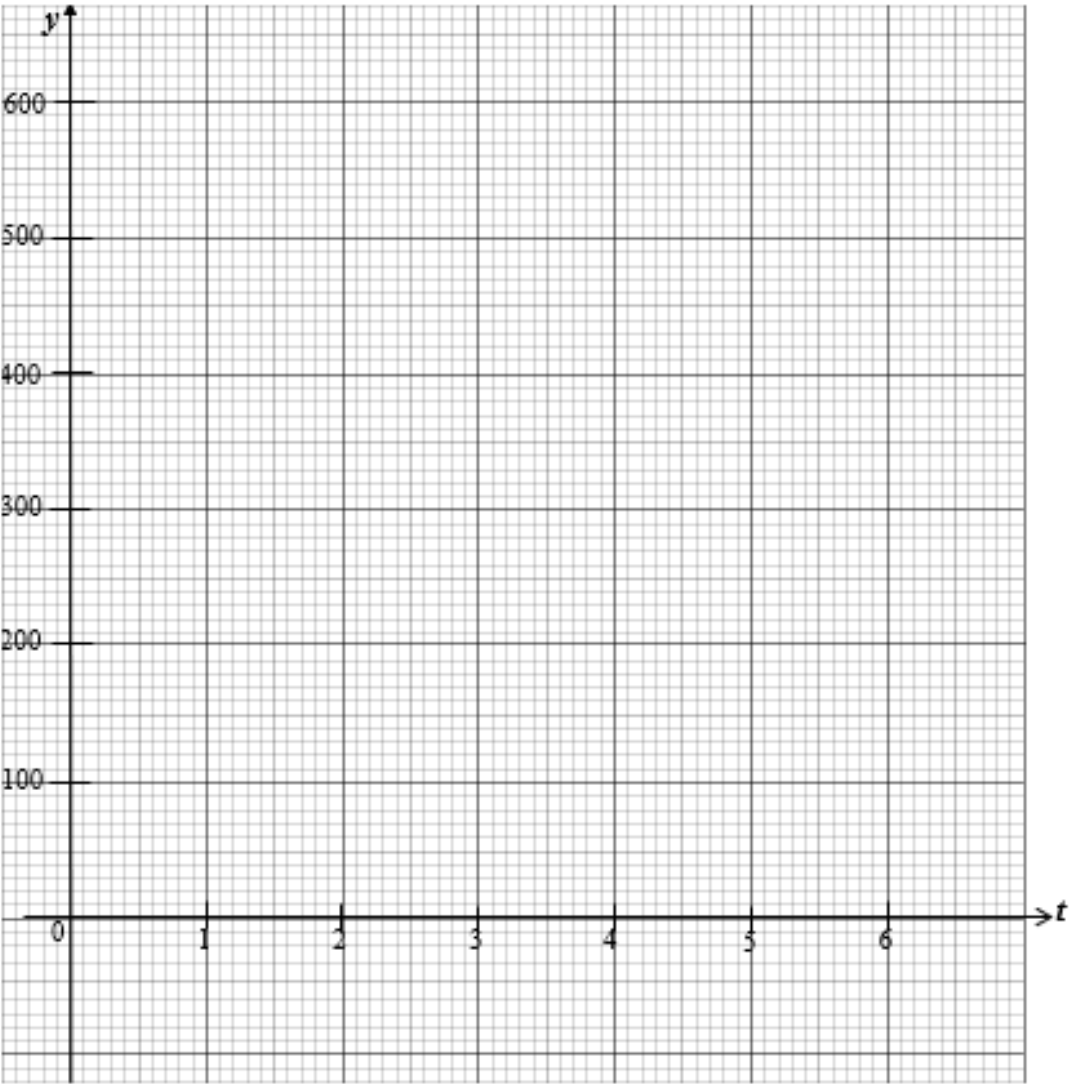
Answer _____ [2]

- (ii) What does this gradient represent?

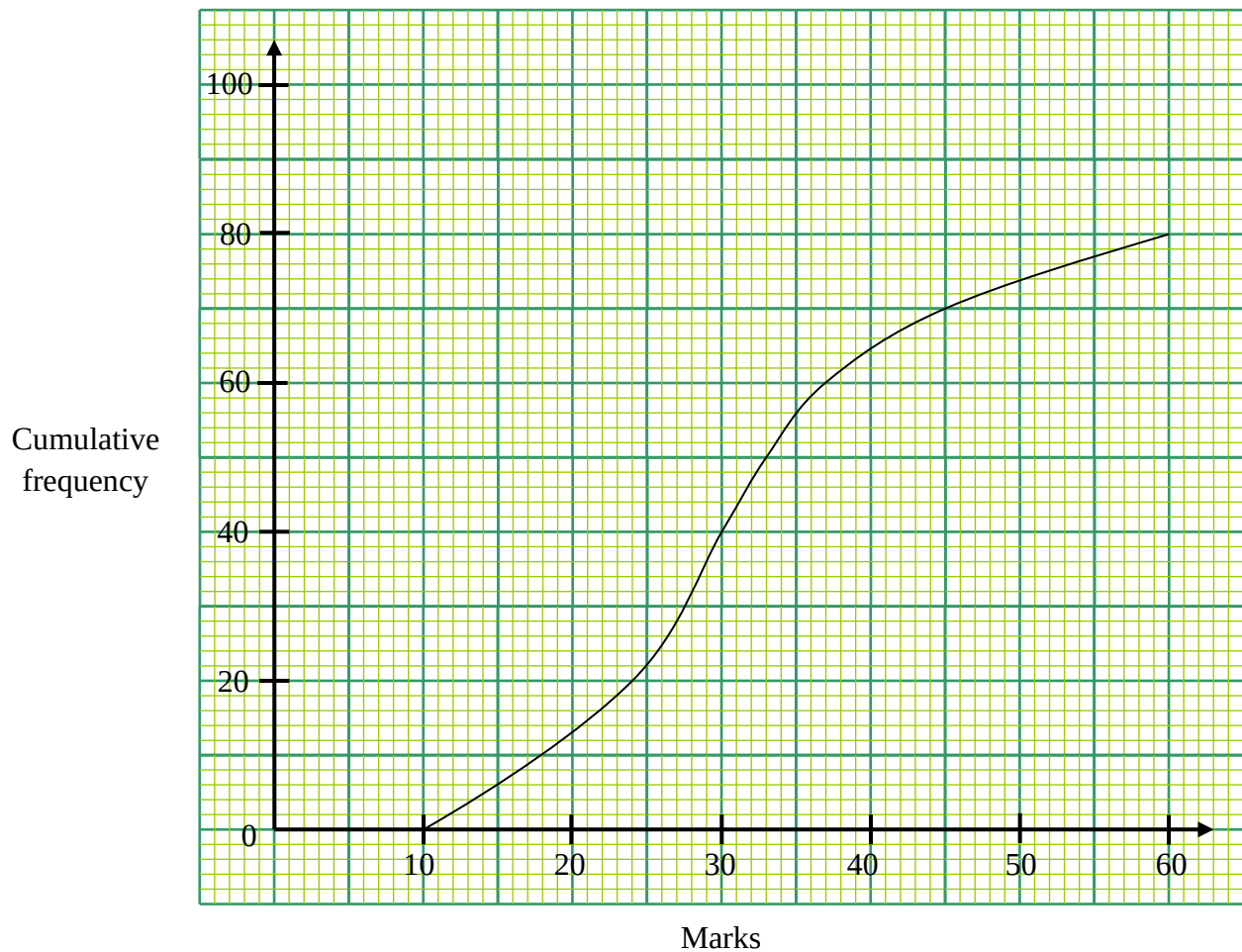
 _____ [1]

- (d) The number of micro-organisms in another test tube is given by the equation $y = -80t + 600$.
 By drawing the line $y = -80t + 600$, find the number of days for the number of micro-organisms in the two test tubes to be the same.

Answer $t =$ _____ days [2]



- 4 (a) The cumulative frequency curve shows the distribution of the scores of a Geography test (Test 1) taken by 80 students. Test 1 was marked out of 60.



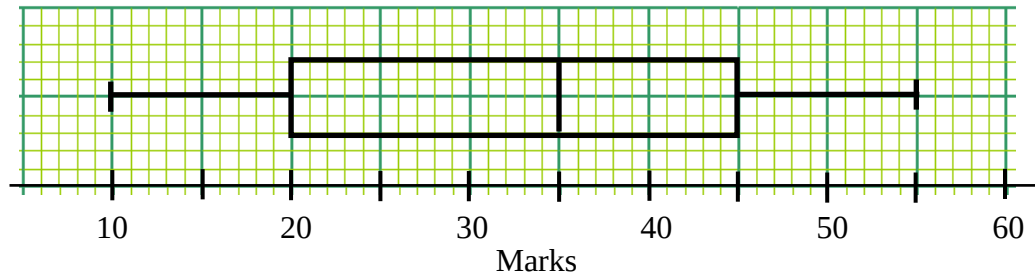
- (i) Use the curve to estimate
 (a) the 40th percentile for Test 1,

Answer _____ [1]

- (b) the interquartile range for Test 1.

Answer _____ [2]

- (ii) This box-and-whisker plot represents the distribution of the scores of the same group of students for another Geography test (Test 2). Test 2 was marked out of 60.



Find the median mark for Test 2.

Answer _____ [1]

- (iii) To obtain a distinction for Test 1 and Test 2, a student needs to score at least x marks.
If 12.5% of the students scored distinction for Test 1, find x .

Answer $x =$ _____ [2]

- (iv) “There is a higher proportion of students who scored distinction for Test 1.”
Do you agree with this statement? Give a reason for your answer.

Answer

[1]

- (b) The table below summarises the speeds of 95 cars on a stretch of road.

Speed (x km/h)	$35 < x \leq 45$	$45 < x \leq 55$	$55 < x \leq 65$	$65 < x \leq 75$	$75 < x \leq 85$
Number of cars	13	29	40	8	5

Calculate an estimate of

- (i) the mean speed,

Answer _____ km/h [1]

- (ii) the standard deviation.

Answer _____ km/h [1]

- 5 **(a)** In 2018, Ben earned a total of \$56 000.
 In 2019, he earned \$4800 each month.
 Calculate the percentage increase in his earnings from 2018 to 2019.

Answer _____ % [2]

- (b)** A bank offers a savings account with a rate of compound interest of 1.6% per year.
 Ben invests \$25 000 in this account.
 He leaves the money in the account for 5 years.
 Calculate the total amount of interest he has earned after 5 years.
 Give your answer correct to the nearest cent.

Answer \$ _____ [3]

- (c) The exchange rate between Singapore dollars (S\$) and pounds (£) is S\$1 = £0.59.
 The exchange rate between euros (€) and Singapore dollars (S\$) is €1 = S\$1.56.
 Ben is planning a trip to Europe and he finds these hotel prices on a website.

London Hotel	£160 per night
Berlin Hotel	€160 per night

- (i) By comparing the exchange rates or otherwise, determine which hotel is more expensive and provide an explanation for your claim.

Answer

The hotel in _____ is more expensive because

[2]

- (ii) Ben decides to book 3 nights in the hotel in London and 5 nights in the hotel in Berlin. He pays using his credit card.
 The credit card company converts the prices to Singapore dollars and charges a fee of 3.35% for the currency conversion.
 Calculate the total amount Ben pays for the two hotels, including the credit card fee.
 Give your answer correct to the nearest dollar.

Answer S\$ _____ [3]

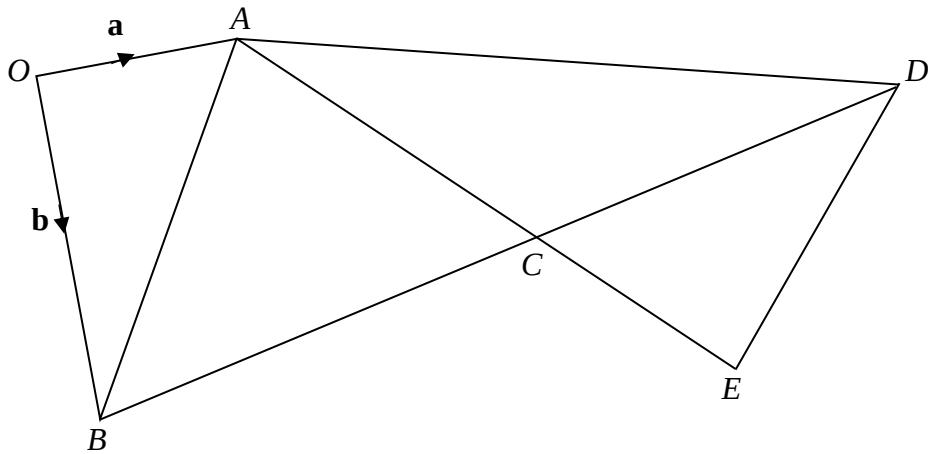
- 6 (a) A is the point $(3, 4)$ and B is the point $(6, 0)$.
(i) Find $|\overrightarrow{AB}|$.

Answer _____ [2]

- (ii) Find the value of k if $\overrightarrow{XY} = \begin{pmatrix} 9 \\ k \end{pmatrix}$ and XY is parallel to AB .

Answer $k =$ _____ [2]

(b)



In the diagram, $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$. ACE is a straight line such that $\overrightarrow{AE} = 2\mathbf{a} + \mathbf{b}$.
 C is a point on AE such that $AC : CE = 3 : 2$.

(i) Express, as simply as possible, in terms of $\mathbf{a}$ and/or $\mathbf{b}$,

(a) $\overrightarrow{BA}$,

Answer $\overrightarrow{BA} =$ _____ [1]

(b) $\overrightarrow{AC}$,

Answer $\overrightarrow{AC} =$ _____ [1]

(c) $\overrightarrow{BC}$.

Answer $\overrightarrow{BC} =$ _____ [2]

It is given that $\overrightarrow{CD} = \frac{22}{15}\mathbf{a} - \frac{4}{15}\mathbf{b}$.

(ii) State two facts about the points B , C and D .

[2]

(iii) What can you deduce about triangle ABC and triangle EDC ?

[1]

(iv) Find $\frac{\text{area of triangle } ABC}{\text{area of triangle } ADC}$.

Answer _____ [2]

- 7 Tap A, when turned on alone, will need x hours to fill up a swimming pool.
Tap B, when turned on alone, will fill the pool 4 hours earlier than Tap A.

(a) Write down, in terms of x ,

(i) the fraction of the pool filled by Tap A alone in an hour.

Answer _____ [1]

(ii) the fraction of the pool filled by Tap B alone in an hour.

Answer _____ [1]

(b) Tap A and Tap B can fill up the swimming pool in 6 hours if they are both turned on together.

Form an equation in x and show that it reduces to $x^2 - 16x + 24 = 0$.

Answer

[3]

- (c) (i) Solve $x^2 - 16x + 24 = 0$.
Give your solutions correct to 2 decimal places.

Answer $x = \underline{\hspace{2cm}}$ or $x = \underline{\hspace{2cm}}$ [4]

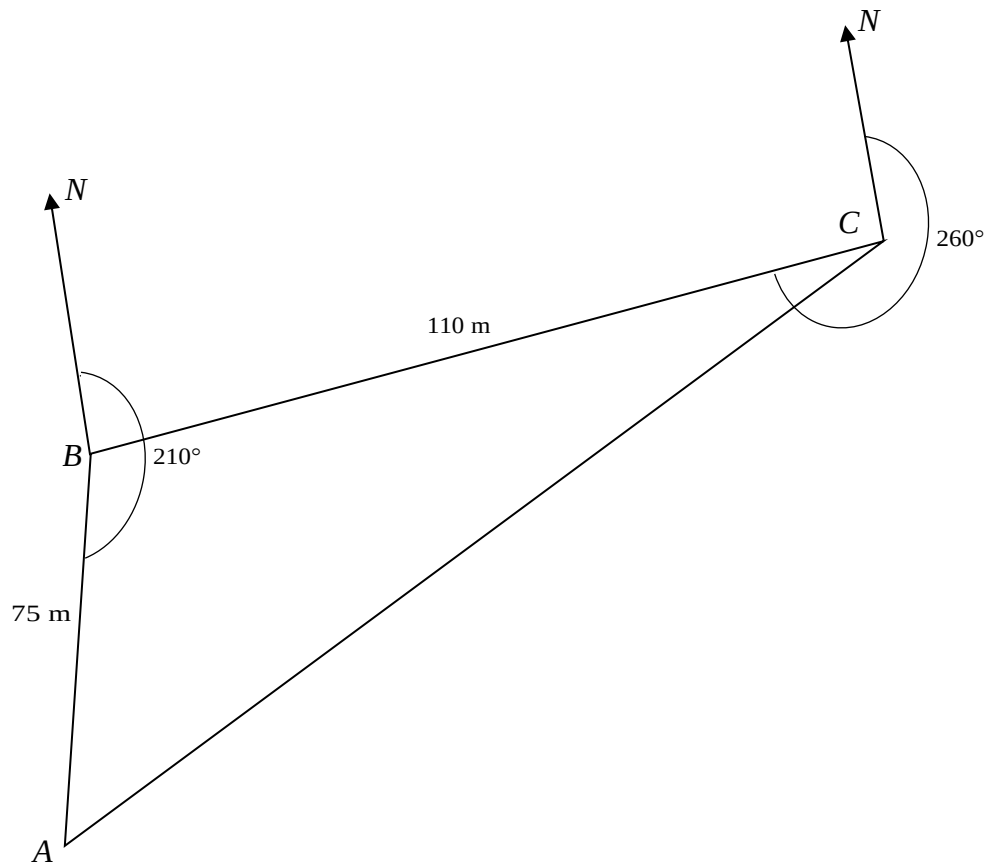
- (ii) Briefly explain why one of the answers cannot be accepted.

 [1]

- (d) Find the time taken by Tap B to fill the pool alone, giving your answers in hours and minutes to the nearest minute.

Answer $\underline{\hspace{2cm}}$ hours $\underline{\hspace{2cm}}$ minutes [2]

- 8 The diagram below shows 3 points, A, B and C on a level ground.
The bearing of A from B and B from C are 210° and 260° respectively.
 $AB = 75$ m and $BC = 110$ m.



- (a) Show that $\angle ABC = 130^\circ$.

[2]

Answer

(b) Find

(i) the distance AC ,

Answer $AC =$ _____ m [3]

(ii) the bearing of C from A .

Answer _____ ° [3]

- (c) A kite was seen flying 55 m vertically above point B . Find the greatest angle of elevation of the kite observed by a person walking in a straight path from A to C .

Answer _____[°] [3]

- 9 Owen did well for his school examinations and his mother decided to reward him with a smartphone. She is considering mobile plans from 2 local service providers, MoonHub and SingCom. The table below shows an overview of the 2 mobile plans.

	MoonHub	SingCom
	\$42.90 (2-year plan)	\$56.61(2-year plan)
Local SMS/MMS	Unlimited	Unlimited
Incoming Calls	Free	Free
Outgoing Local Calls	150 mins	200 mins
	Excess local call charges: 16.05 cents/min	Excess local call charges: 16.05 cents/min
Local Bundle Data	4 GB	4 GB
	Excess local data charges: \$10.70/GB	Excess local data charges: \$8.60/GB

Note: Excess local data usage is charged at up to 1 GB for each of the respective prices stated.

- (a) The table below shows Owen's average mobile usage per month.

Outgoing Local Calls	180 mins
Local Data	5.5 GB

Which mobile plan would be more suitable for Owen?
Justify your answer with calculations.

[5]

- (b) The contracts for Owen's mother's mobile plan and fibre broadband plan are both ending soon. She is currently deciding two options:

	SingCom	MoonHub
Mobile Plan	\$56.61 per month	\$42.90 per month
Fibre Broadband Plan	\$38.89 per month	\$39.90 per month

Furthermore, SingCom is offering her a discount of 15% on her total bill.

Assume that her mobile usage per month does not exceed any limit and

Owen's mobile usage per month is as shown in **part (a)**.

Given that all the three plans should be from the same provider, which service provider should she use?

Justify your answer with calculations.

Answer

[4]

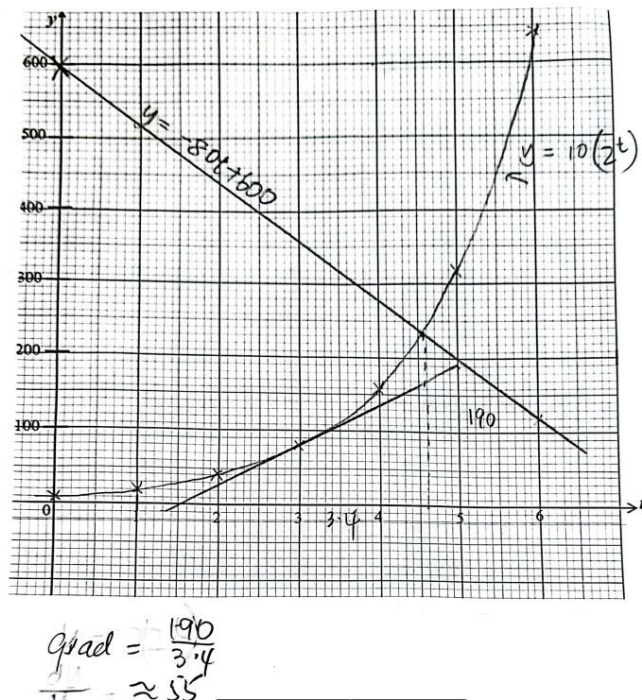
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1	(a)(i)	42.25			
	(ii)	$\frac{1}{2}at^2 = s - ut$ $a = \frac{2(s - ut)}{t^2}$			
	(b)	$(x - 4)(2x - 1) = 9$ $2x^2 - x - 8x + 4 = 9$ $2x^2 - 9x - 5 = 0$ $(2x + 1)(x - 5) = 0$ $x = -\frac{1}{2}$ or $x = 5$			
	(c)	$8x - 6y = 36$ $18x + 6y = 3$ $x = \frac{3}{2}$ $y = -4$			
2	(a)(i)	In triangle CFD and triangle BFA , Angle $CDF =$ angle BAF (angle in the same segment) Angle $ABF =$ angle DCF (angle in the same segment) Angle $CFD =$ angle BFA (Vert. opp angles) By AA similarity test, the triangles are similar.	}		
	(ii)	$BC = 10 \tan 48^\circ$ $= 11.106\text{cm}$ $\frac{1}{2} \times 10 \times 11.106$ $= 55.5\text{cm}^2$			
	(b)(i)	radius $= \frac{60}{100} \times 21.5 + 8(2.54) = 33.22$ circumference $= 2 \times \pi \times 33.22 = 208.727\text{cm} = 2.087\text{m}$ or 2.09m			
	(ii)	$2.087 \times 50 = 104.35 = 104\text{m}$ (to 3 sig fig)			
3	(a)	160			
	(b)	All 7 points plotted			
		Smooth curve through plotted points.			

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	(c)(i)	Drawing of tangent at $t = 3$ 55.5		
	(ii)	The micro organisms are increasing at rate of 55.5 per day after 3 days.		
	(d)	Drawing of line $y = -80t + 100$ 4.6		
4	(a)(i)(a)	28		
	(b)	$37 - 24 = 13$		
	(a)(ii)	35		
	(a)	$\frac{12.5}{100} \times 80 = 10$		
	(iii)	45 marks		
	(a)(iv)	Disagree. Test 1, 12.5% scored distinction, Test 2, 25 % scored distinction. High proportion of students scored distinction in Test 2.		
	(b)(i)	56.1		
	(ii)	9.98		
5	(a)	$\frac{57600 - 56000}{56000} \times 100\%$ $= 2.86\%$		

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	(b)	$TA = 25000 \left(1 + \frac{1.6}{100} \right)^5$ $= \$27065.03$ Total interest = \$27065.03 – \$25000 $= \$2065.03$			
	(c)(i)	London Hotel } £160=S\$271.19 Berlin Hotel } 160€=S\$249.60 The hotel in London is more expensive because It costs more at S\$271.19>a stay in Berlin Hotel at S\$249.60.			
	(ii)	3 nights in London=271.19×3 = 813.57 } 5 nights at Berlin 249.60×5 = 1248 $\text{Total} = 2061.57 \times \frac{103.35}{100}$ $= 2130 \text{ (correct to 10 dollars)}$			
6	(a)(i)	$\vec{AB} = \begin{pmatrix} 3 \\ -4 \end{pmatrix}$ $ \vec{AB} = 5 \text{ units}$			
	(ii)	$\frac{k}{9} = \frac{-4}{3}$ $k = -12$			
	(b)(i) (a)	a-b			
	(b)	$\frac{3}{5}(2a+b)$			
	(c)	$a-b + \frac{3}{5}(2a+b)$ $\frac{11}{5}a - \frac{2}{5}b$			
	(ii)	$CD = \frac{2}{3}BC$ $ \vec{CD} = \frac{2}{3} \vec{BC} $ B, C and D lie on a straight line.			
	(iii)	The two triangles are similar.			

Marking Scheme
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	(iv)	$\frac{\frac{1}{2} \times BC \times h}{\frac{1}{2} \times CD \times h} = \frac{3}{2}$			
7	(a)(i)	$\frac{1}{x}$			
	(ii)	$\frac{1}{x-4}$			
	(b)	$\frac{6}{x} + \frac{6}{x-4} = 1$ $\frac{2x-4}{x(x-4)} = \frac{1}{6}$ $x^2 - 4x = 12x - 24$ $x^2 - 16x + 24 = 0$			
	(c)(i)	$x = \frac{16 \pm \sqrt{16^2 - 4(24)}}{2}$ $= \frac{16 \pm \sqrt{160}}{2}$ $x = 14.32 \text{ or } x = 1.68$			
	(ii)	$x = 1.68$ will make time taken to be negative for Tap B			
	(d)	$14.32 - 4 = 10.324h$ $= 10\text{h}19\text{mins}$			
8	(a)	$\angle a = 360^\circ - 260^\circ = 100^\circ$ $\angle b = 80^\circ (\text{co-interior angles, parallel north lines})$ $\angle ABC = 210^\circ - 80^\circ = 130^\circ$			
	(b)(i)	$AC = \sqrt{75^2 + 110^2 - 2(75)(110)\cos 130^\circ}$ $= 168.318$ $= 168\text{m}$			
	(ii)	$\frac{\sin a}{110} = \frac{\sin 130^\circ}{168.318}$ $\angle a = 30.0^\circ$ $30^\circ + 30^\circ = 060.0^\circ$			
	(c)	$d = 75 \sin 30.04^\circ$ $= 37.545\text{m}$ $\tan \theta = \frac{55}{37.545}$ $\theta = 55.7^\circ$			

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9	(a)	Moon Hub $42.90 + (16.05 \times 30) + (10.70 \times 2)$ $\\$(42.90 + 4.815 + 21.4) = \\$69.12$ SingCom $56.61 + (8.60 \times 2)$ $\\$(56.61 + 17.20) = \\$73.81$ Hence Owen should use Moon Hub as it cost less at \$69.12.			
	(b)	SingCom $\\$(73.81 + 56.61 + 38.89)$ $\\$(73.81 + 56.61 + 38.89) \times 0.85$ $= \\$143.91$ MoonHub $\\$(69.12 + 42.90 + 39.90)$ $= \\$151.92$ Since SingCom cost < MoonHub cost, choose Singcom.			

20/7/2023