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JURONG SECONDARY SCHOOL
2022 GRADUATION EXAMINATION 2
SECONDARY 4 EXPRESS/ SECONDARY 5 NORMAL (ACADEMIC)

CANDIDATE NAME	

CLASS		INDEX NUMBER	

MATHEMATICS 4048/01

PAPER 1

26 Aug 2022
2 hours

Candidates answer on the Question paper.

READ THESE INSTRUCTIONS FIRST

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

Answer **all** the 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 80.

For Examiner's Use
80

This document consists of **23** printed pages, including this page.

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

1 Simplify $-2(-3x-4)+5$.

$-2(-3x-4)+5=6x+8+5$

$=6x+13$ **B1**

Answer ……………………..…………[1]

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2 The ratio of interior angle : exterior angle of a regular polygon is $5:1$.
Calculate the number of sides that the polygon has.

Exterior angle $=\dfrac{1}{1+5}\times 180°=30°$

Number of sides $=\dfrac{360°}{30°}=12$ **B1**

Answer ....sides [1]

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3 A photocopier can photocopy at a rate of 30 double-sided papers per minute.

Calculate

(a) in minutes, the time taken to print 600 pages on double-sided setting,

600 pages $=$ 300 double sided papers

Time taken $=\dfrac{300}{30}=10$ minutes **B1**

Answer ……………………..…minutes [1]

(b) the number of double-sided papers that can be photocopied in 1 hour.

1 hour $=$ 60 minutes

No. of pages printed $=30\times 60=1800$ **B1**

Answer …………...double-sided papers [1]

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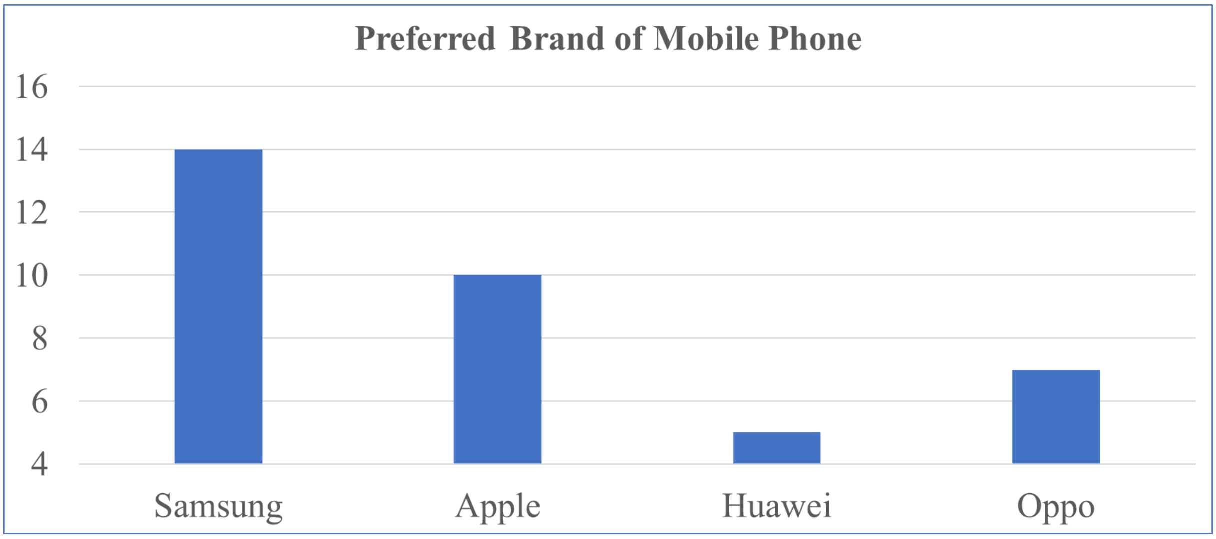
4 A survey was conducted to find out the preferred brand of mobile phone that secondary school students like.



State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph.

The y-axis does not start with 0. **B1**

Hence it looks like there are three times the number of students choosing Samsung than Oppo, which in fact is only two times. **B1** (14 students for Samsung, 7 students for Oppo)

....

....

....[2]

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5 Solve the inequality $-2+x \le 2-3x < 9+4x$.

$-2+x \le 2-3x < 9+4x$ **M1**: Split inequality

$-2+x \le 2-3x$ AND $2-3x < 9+4x$

$4x \le 4$ AND $-7 < 7x$

$x \le 1$ AND $x > -1$

$\therefore -1 < x \le 1$ **A1**: (Don't give if there is no AND)

Answer .... [2]

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6 Find a possible set of integer values of a and b such that the lines $x + y = 1$ and $ax + by = 1$

(a) do not intersect,

$a = 2$

$b = 2$

B1: Any integer values of a and b such that $a = b$ but $a \neq 0,1,\ b \neq 0,1$

Answer $a =$ ……………………..………....

$b =$ ………...……………..……[1]

(b) intersect at exactly one point.

$a = 1$

$b = 2$

B1: Any integer values of a and b such that $a \neq b$

Answer $a =$ ……………………..………....

$b =$ ………...……………..……[1]

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7 Factorise $4ax^2 - 4ay^2 + 2bx^2 - 2by^2$ completely.

$4ax^2 - 4ay^2 + 2bx^2 - 2by^2$

$= 4a\left(x^2 - y^2\right) + 2b\left(x^2 - y^2\right)$

$= (4a + 2b)\left(x^2 - y^2\right)$ **B1**: $(x + y)(x - y)$

$= 2(2a + b)(x - y)(x + y)$ **B1**

Answer ……………………..…………[2]

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8 Simplify $\left(\dfrac{a^{16}}{b^{-6}}\right)^{\frac{3}{2}}$.

$$\left(\frac{a^{16}}{b^{-6}}\right)^{\frac{3}{2}}=\frac{\left(a^{16}\right)^{\frac{3}{2}}}{\left(b^{-6}\right)^{\frac{3}{2}}}$$

M1: Correct multiplication of power to the indices respectively

$$=\frac{a^{24}}{b^{-9}}$$

$$=a^{24}b^{9}$$

A1: Must be in positive index notation

Answer ……………………..………….[2]

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9 Given that $25\times125^{x}=5$, find the value of x.

$$25\times125^{x}=5$$

M1: Convert all bases to base 5 correctly

$$5^{2}\times\left(5^{3}\right)^{x}=5$$

$$5^{2}\times5^{3x}=5$$

$$5^{2+3x}=5^{1}$$

$$\therefore 2+3x=1$$

$$x=-\frac{1}{3}$$

A1

Answer $x=$ ……………………..……...[2]

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10 Solve $\dfrac{5}{(2-x)^2}+\dfrac{1}{x-2}=4$.

$\dfrac{5}{(2-x)^2}+\dfrac{1}{x-2}=4$

$\dfrac{5}{(x-2)^2}+\dfrac{1}{x-2}=4$

$\dfrac{5}{(x-2)^2}+\dfrac{x-2}{(x-2)^2}=4$

$\dfrac{5+x-2}{(x-2)^2}=4$

M1: Common denominator (only accept quadratic denominator)

$\dfrac{3+x}{(x-2)^2}=4$

$3+x=4(x-2)^2$

$3+x=4(x^2-4x+4)$

$3+x=4x^2-16x+16$

$4x^2-17x+13=0$

$(x-1)(4x-13)=0$

M1: Factorisation or quadratic formula

$x=1$ or $x=3.25$

A1

Answer $x=$ ……………………..……..[3]

---

11 **(a)** Express $1+x^2-5x$ in the form of $(x+a)^2+b$.

$1+x^2-5x=x^2-5x+1$

$=\left(x-\dfrac{5}{2}\right)^2-\left(\dfrac{5}{2}\right)^2+1$

$=(x-2.5)^2-5.25$

$=[x+(-2.5)]^2+(-5.25)$

B1: Must be this form

Answer ……………………..…………[1]

(b) Write down the equation of line of symmetry of the graph of $y=1+x^2-5x$.

Eqn of line of symmetry: $x=2.5$

B1

Answer ……………………..…………[1]

(c) Write down the coordinates of intersection between the line of symmetry and the graph of $y = 1 + x^2 - 5x$.

Point of intersection is at the turning point.

$(2.5, -5.25)$ **B1**

Answer (………...… , …………….) [1]

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12 The area of triangle *ABC* is 7.5 cm^2. Two of the sides are of length 5 cm and 6 cm respectively. Find the length of the third side.

Area of $\Delta = 7.5$ **M1**: Using Sine Rule correctly

$\frac{1}{2}(5)(6)\sin\theta = 7.5$

$\sin\theta = \frac{1}{2}$

$\theta = \sin^{-1}\frac{1}{2}$ or $180° - \sin^{-1}\frac{1}{2}$

$\theta = 30°$ or $150°$

Length of third side **M1**: Using Cosine Rule correctly (FT)

$= \sqrt{5^2 + 6^2 - 2(5)(6)\cos 30°}$

OR

$\sqrt{5^2 + 6^2 - 2(5)(6)\cos 150°}$

$\therefore$ Length of third side $= 3.01$ cm or 10.6 cm **A1**: Both correct

Answer …………………..………cm [3]

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13 The Ideal Gas Law

$$PV = 8.3145nT$$

relates pressure P (measured in Pascal), volume V (measured in metres^3), the number of moles of a gas n (measured in moles), and temperature T (measured in Kelvins).

One mole of gas is found to exert a pressure of 101 325 Pascal at room temperature 293 Kelvins. Find the volume of the gas in **cm^3**.

$$V=\frac{8.3145(1)(293)}{101325}$$ **M1**: Correct substitution

$= 0.0240\ \text{m}^3\ (3\ \text{s.f})$

$= 24000\ \text{cm}^3$ **A1**

Answer ……………………..……..cm^3 [2]

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14 A map of the United States of America has a scale of $1:8\ 000\ 000$.

(a) The length of the Mississippi River is 3766 km.
Calculate the length, in centimetres, of Mississippi River on the map.

1 cm : 8000000 cm

1 cm : 80 km

80 km $\rightarrow$ 1 cm

$3766\ \text{km} \rightarrow \frac{3766}{80} = 47.075\ \text{cm}$ **B1**: 47.075

Answer ………..................................cm [1]

(b) The area of California on the map is 66.25 cm^2.
Calculate the actual area, in square kilometres, of California.

1 cm : 8000000 cm **M1:** Using proportion

1 cm : 80 km

$\therefore 1\ \text{cm}^2 : 6400\ \text{km}^2$

$1\ \text{cm}^2 \rightarrow 6400\ \text{km}^2$

$66.25\ \text{cm}^2 \rightarrow 66.25(6400) = 424000\ \text{km}^2$ **A1**

Answer ....km^2 [2]

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15 **(a)** n is a positive integer.
Show that, for all n, $6n^2+25n+11$ is not a prime number.

$6n^2+25n+11=(3n+11)(2n+1)$ **B1**

For all positive integer n, $3n+11$ and $2n+1$ are also integers **more than 1**. Hence for all positive n, $6n^2+25n+11$ is a composite number since it can be factorised into smaller integers greater than 1. **B1**: With the idea of factors more than 1

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....

....[2]

(b) Hence, determine whether 16261 is a prime number. Show your working clearly.

$6n^2 + 25n + 11 = 16261$

$6n^2 + 25n - 16250 = 0$

$(n-50)(6n+325) = 0$

$n = 50$ or $n = -\frac{325}{6}$ (NA, since n is a positive integer)

By previous part, 16261 is a composite number.

M1: Can also use previous part to guess $n = 50$ (No working required)

A1 (If solve equation never reject negative minus 1)

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....[2]

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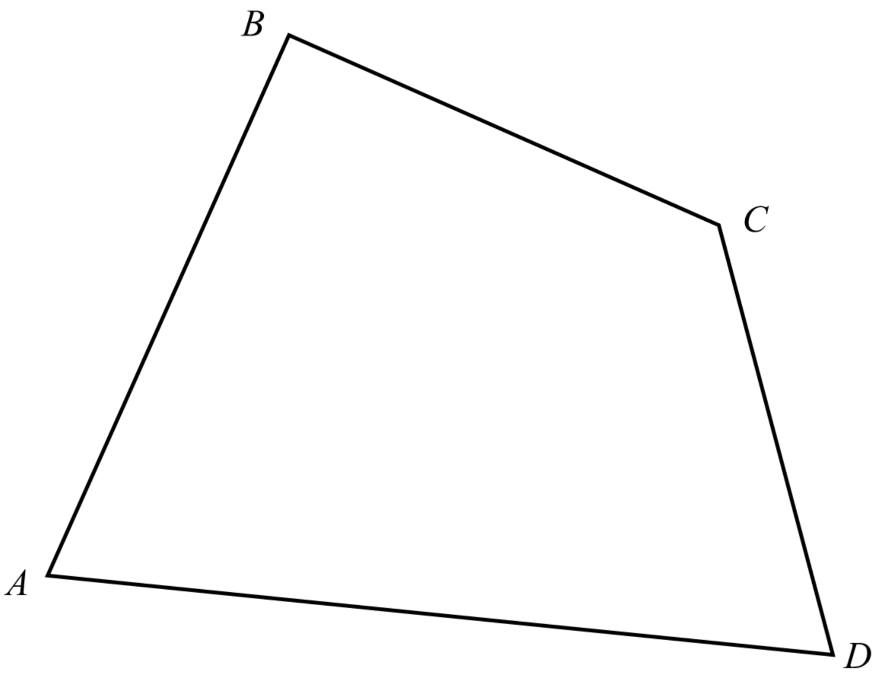
16 The diagram represents a plot of land, *ABCD*. The police is looking for a robber hiding in the land.

Scale: 1 cm represents 1 km



Here are the accounts from three witnesses:
Witness 1: The robber is located more than 6 km away from *A*.
Witness 2: The robber is located nearer to *B* than *A*.
Witness 3: The robber is located nearer to *AD* than *AB*.

Shade the region where the robber is hiding. [4]

17 $\xi = \{\text{integers } x : 1 < x < 21\}$

$A = \{\text{integers that are perfect squares}\}$

$B = \{\text{integers that are not prime numbers}\}$

$C = \{\text{integers that are divisible by } 5\}$

(a) List down all the elements in *A*, *B* and *C*.

$A = \{4, 9, 16\}$

$B = \{4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20\}$

$C = \{5, 10, 15, 20\}$

B2
Minus one mark per mistake

Answer $A =$ ………………………..………....

$B =$ ………………………..……….

$C =$ ……………………..………[2]

A number is chosen randomly from ξ.

(b) Find the number of elements in $B \cap C'$.

$B = \{4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20\}$

$C = \{5, 10, 15, 20\}$

$B \cap C' = \{4, 6, 8, 9, 12, 14, 16, 18\}$

$\therefore$ Required number $= 8$

B1

Answer .... [1]

(c) Hence, find the probability that the chosen number is not a prime number and is not divisible by 5.

Required probability $= \dfrac{8}{19}$

B1: Follow through from part (b) answer, but denominator must be 19

Answer .... [1]

18 **(a)** The prime factorisation of 450 is $2\times3^2\times5^2$.
Express 648 as a product of its prime factors.

$648=2^3\times3^4$ **B1**

Answer $648=$ ……………….…..…..[1]

(b) Using your answer to **part (a)**, determine whether 583200 is a perfect square.

Note that $450\times648=291600$

$\therefore 583200=2\times450\times648=2^5\times3^6\times5^2$ **B1**

583200 is not a perfect square as the power (exponent) of base 2 in 583200 is not an even number. **B1**

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…..

………………………………………………………………………………………[2]

(c) Find the smallest integer n such that $450n$ is a multiple of 648.

$$n=\frac{LCM\left(450,648\right)}{450}$$
$$=\frac{2^3\times3^4\times5^2}{2\times3^2\times5^2}$$
$$=2^2\times3^2$$
$$=36$$
B1

Answer $n=$ ………………………..……...[1]

19 **(a)** The points $A(0,2)$ and $B(1,0)$ lie on the graph $y = x^2 + ax + b$.

Find the values of a and b.

When $x = 0,\ y = 2$:

$2 = b$ **B1**

When $x = 1,\ y = 0$:

$0 = 1^2 + a + 2$

$a = -3$ **B1**

Answer $a =$ ……………………..……......

$b =$ ………...…………..……..[2]

(b) C is another point on the graph such that the gradient of line AB is twice the gradient of AC. Find the coordinates of point C.

Method 1

Let $C = \left(c, c^2 - 3c + 2\right)$

Gradient of $AB = 2 \times$ Gradient of AC **B1**: Gradient of AB

$$\frac{2-0}{0-1} = 2\left(\frac{c^2 - 3c + 2 - 2}{c}\right)$$

M1: Formulating equation with gradients and solve

$$-2 = 2\left(\frac{c^2 - 3c}{c}\right)$$

$$-1 = \frac{c^2 - 3c}{c}$$

$c^2 - 3c = -c$

$c^2 - 2c = 0$

$c(c-2) = 0$

$c = 0$ (NA, since will get back point A) OR $c = 2$ **A1**

$\therefore C = \left(2, 2^2 - 3(2) + 2\right) = (2, 0)$

Method 2

Let $C=(x,y)$

Gradient of $AB = 2\times$ Gradient of AC

$\frac{2-0}{0-1}=2\left(\frac{y-2}{x-0}\right)$ **B1**: Gradient of AB

$\therefore y=-x+2$

Solve simultaneously with $y=x^2-3x+2$: **M1**: Formulating equations and solve simultaneously

$x^2-3x+2=-x+2$

$x^2-2x=0$

$x(x-2)=0$

$x=0$ $(\text{NA, since will get back point } A)$ OR $x=2$

$\therefore C=\left(2,2^2-3(2)+2\right)=(2,0)$ **A1**

Answer (………...… , …………….) [3]

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20 It is given that $\overrightarrow{AB}=\begin{pmatrix}-12\\a\end{pmatrix}$, $a>0$ and $\left|\overrightarrow{BA}\right|=37$ units.

(a) Find the value of a.

$\left|\overrightarrow{BA}\right|=\left|\overrightarrow{AB}\right|=37$

$\left|\begin{pmatrix}-12\\a\end{pmatrix}\right|=37$

$\sqrt{(-12)^2+a^2}=37$ **M1**: Distance formula

$144+a^2=1369$

$a^2=1225$

$a=35$ or $a=-35$ (NA) **A1**

Answer $a=$……………………..……...[2]

(b) C is a point $(0,10)$ and $\overrightarrow{AB}=\overrightarrow{DC}$.

Find the coordinates of D.

$\overrightarrow{AB}=\overrightarrow{DC}$

$\begin{pmatrix}-12\\35\end{pmatrix}=\overrightarrow{OC}-\overrightarrow{OD}$

M1: $\overrightarrow{OC}-\overrightarrow{OD}$

$\overrightarrow{OD}=\overrightarrow{OC}-\begin{pmatrix}-12\\35\end{pmatrix}$

$=\begin{pmatrix}0\\10\end{pmatrix}-\begin{pmatrix}-12\\35\end{pmatrix}$

$=\begin{pmatrix}12\\-25\end{pmatrix}$

$\therefore$ Coordinates of $D=(12,-25)$

A1

Answer (………...… , …………….) [2]

(c) What type of quadrilateral is *ABCD*? Explain your answer.

$\because \overrightarrow{AB}=\overrightarrow{DC}$

There is a pair of parallel sides with equal length.

$\therefore$ *ABCD* is a parallelogram.

B1: Parallelogram

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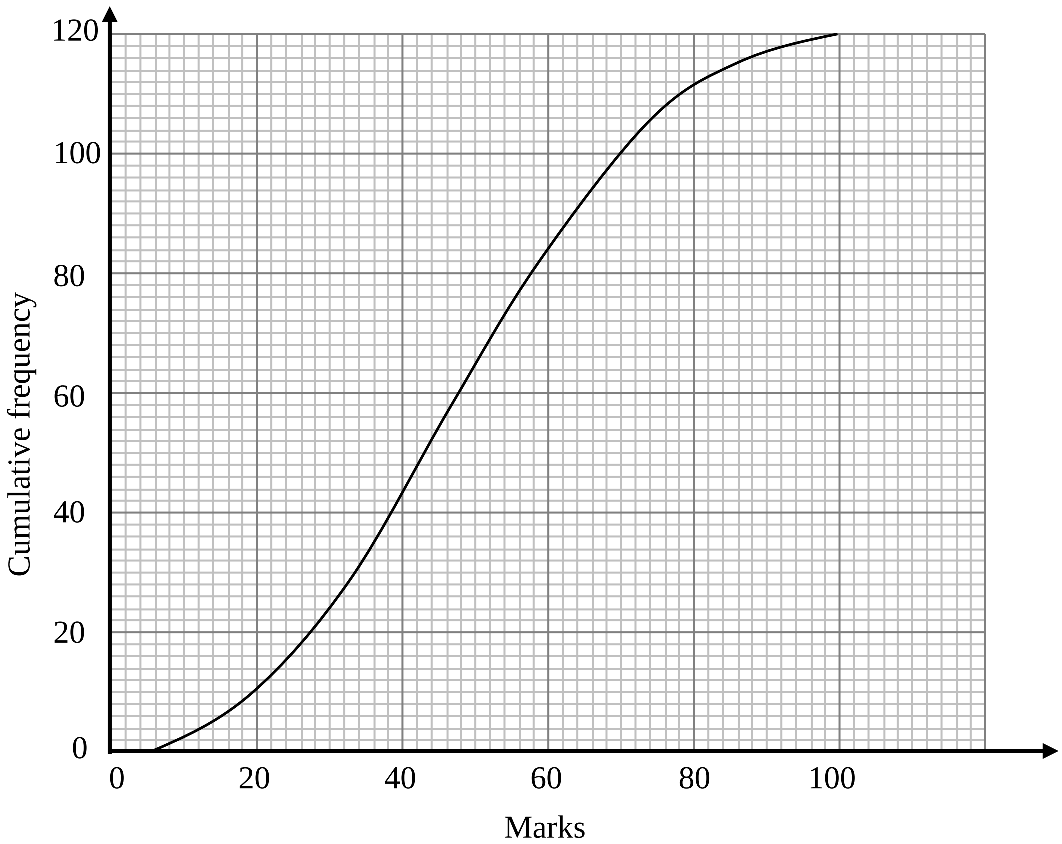
………..

…………………………………………………………………………………………[1]

21 The cumulative frequency curve shows the marks obtained by the 120 students in a recent Mathematics Test. The maximum mark is 100.



(a) Complete the grouped frequency table for the marks obtained.

Marks obtained by students, x	Frequency
$0 \le x < 20$	10
$20 \le x < 40$	34
$40 \le x < 60$	40
$60 \le x < 80$	28
$80 \le x < 100$	8

[1]

(b) Calculate an estimate of the mean mark.

Required estimate

$$= \frac{(10)(10)+(30)(34)+(50)(40)+(70)(28)+(90)(8)}{120}$$

$= 48\frac{1}{3}$ marks

$0 \le x < 20$
$20 \le x < 40$
$40 \le x < 60$
$60 \le x < 80$
$80 \le x < 100$

B1: Accept 48.7 marks

Answer ....marks [1]

(c) Calculate an estimate of the standard deviation.

Required estimate

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

$$=\sqrt{\frac{(10)^2(10)+(30)^2(34)+(50)^2(40)+(70)^2(28)+(90)^2(8)}{120}-\left(48\frac{1}{3}\right)^2}$$

M1: Using S.D formula

$$=\sqrt{2780-\left(48\frac{1}{3}\right)^2}$$

$= 21.1$ marks (3 s.f)

A1

Answer ....marks [2]

(d) The passing mark is 50. Two students are chosen at random. Find the probability that both of them passed.

Within 10% of 50 means from 40 to 60.

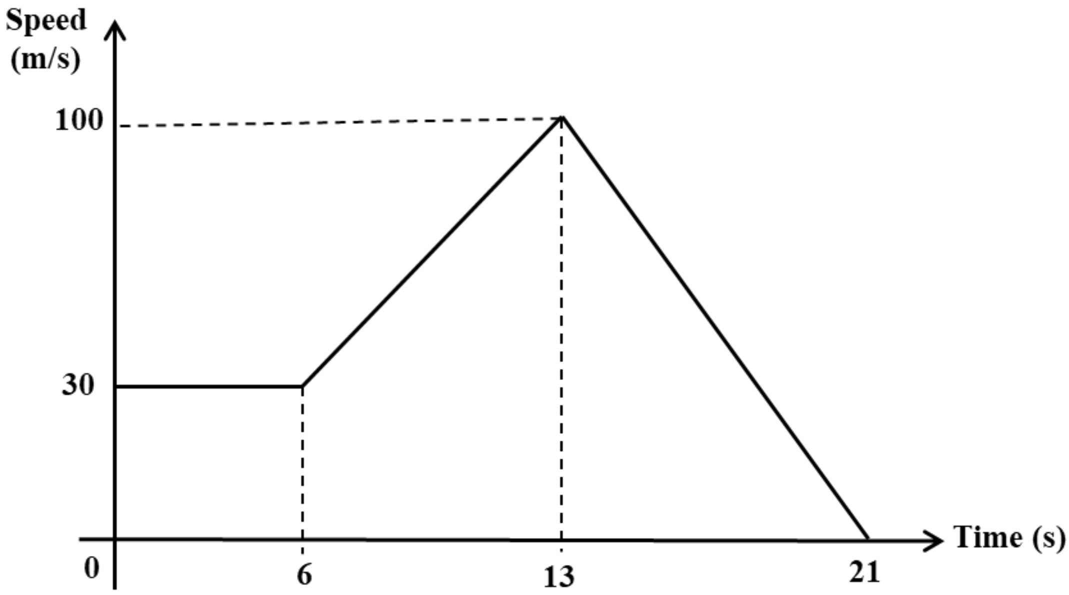
Required probability $=\left(\frac{40}{120}\right)\left(\frac{39}{119}\right)$

$=\frac{13}{119}$

B1

Answer .... [1]

22 The diagram shows the speed-time graph of a particle.



(a) Find the speed of the particle when t = 12s.

Let the speed of the particle when $t=12$ be v **M1**: Equating gradients

$$\frac{v-30}{12-6}=\frac{100-30}{13-6}$$

$\therefore v=90$ m/s

A1

Answer ....m/s [2]

(b) Find the distance covered before the particle starts to slow down.

Distance = Area under the graph from 0s to 13s **M1**: Finding area under the graph using correct formula

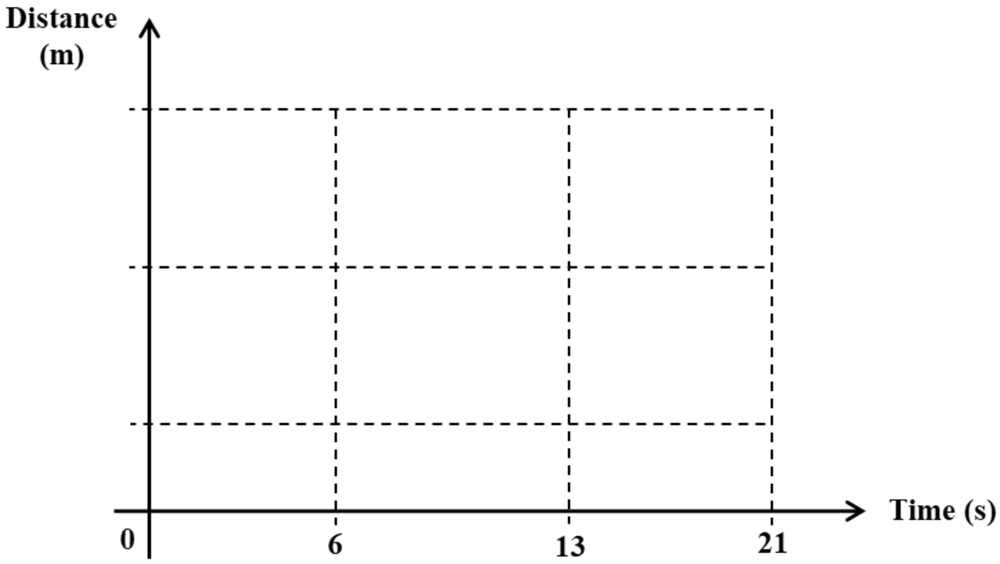
$$=(6)(30)+\frac{1}{2}(30+100)(13-6)$$

$$=635 \text{ m}$$

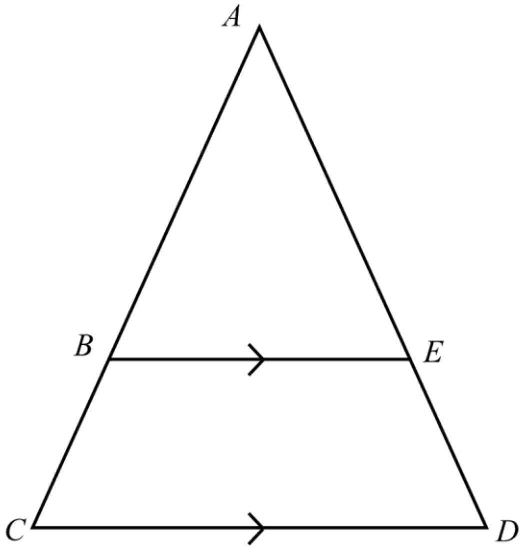
A1

Answer ....m [2]

(c) Complete the distance-time graph of the particle. [1]



23



In the diagram, ABC and AED are straight lines and BE is parallel to CD.

(a) Show that triangle ABE is similar to triangle ACD. Give a reason for each statement you make.

$\angle BAE = \angle CAD$ (Common angle)

$\angle ABE = \angle ACD$ (Corresponding angles, BE parallel to CD)

$\angle AEB = \angle ADC$ (Corresponding angles, BE parallel to CD)

$\therefore$ By AA similarity test, ΔABE is similar to ΔACD

M1: Any two correct statements with complete reasons

A1: Conclusion with test

....

....

....[2]

(b) Show that $\frac{BC}{ED} = \frac{AB}{AE}$. [2]

By similar Δs,

$$\frac{AC}{AB}=\frac{AD}{AE}$$

M1: Correct ratio with corresponding sides

$$\frac{AB+BC}{AB}=\frac{AE+ED}{AE}$$

$$\frac{AB}{AB}+\frac{BC}{AB}=\frac{AE}{AE}+\frac{ED}{AE}$$

$$1+\frac{BC}{AB}=1+\frac{ED}{AE}$$

$$\therefore \frac{BC}{AB}=\frac{ED}{AE}$$

$$\therefore \frac{BC}{ED}=\frac{AB}{AE}$$

A1 (AG)

(c) A circle is drawn with points B, C and D on its circumference. It is further given that $\text{angle } BCD+\text{angle } BED>180^\circ$. Explain why point E is **inside** the circle.

If point E is on the circumference of the circle, $BCDE$ will be a cyclic quadrilateral. Due to angles in opposite segments, $\angle BCD+\angle BED=180^\circ$.

B1: Accept drawing to aid explanation

Hence, E is not on circumference of the circle.

As E moves further away from the center of circle, $\angle BED$ will decrease in magnitude. Since $\angle BCD+\angle BED>180^\circ$, E will be in the circle.

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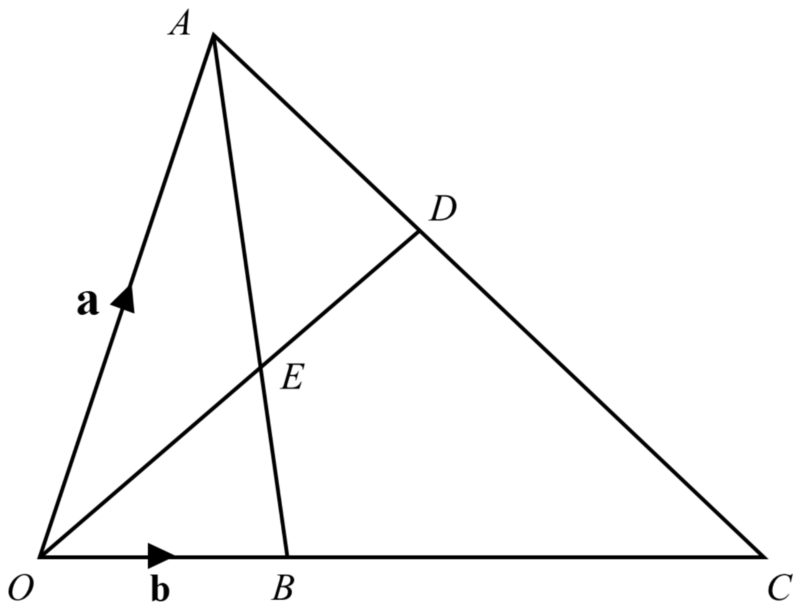
....[1]

24



OBC, *ADC*, *AEB* and *OED* are straight lines.
$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.
$OB = \frac{1}{3}OC$, $AE : EB = 3 : 2$ and $OE : ED = 1 : 1$.

(a) Find $\overrightarrow{OE}$ in terms of **a** and/or **b** as simply as possible.

$$\begin{aligned}\overrightarrow{OE} &= \overrightarrow{OA} + \overrightarrow{AE} \\ &= \overrightarrow{OA} + \frac{3}{5}\overrightarrow{AB} \\ &= \overrightarrow{OA} + \frac{3}{5}\left(\overrightarrow{OB} - \overrightarrow{OA}\right) \\ &= \mathbf{a} + \frac{3}{5}(\mathbf{b} - \mathbf{a}) \\ &= \frac{2}{5}\mathbf{a} + \frac{3}{5}\mathbf{b}\end{aligned}$$

M1: $\overrightarrow{OA} + \frac{3}{5}\overrightarrow{AB}$

A1

Answer: $\overrightarrow{OE} =$ ………….……...……..…...[2]

(b) Find the value of $\frac{\text{area of } \Delta OBE}{\text{area of } BEDC}$.

Let area of ΔOBE be x

$\therefore$ area of $\Delta OAE = \frac{3}{2}x$ (Ratio of bases)

$\therefore$ area of $\Delta OAB = \frac{5}{2}x$ and area of $\Delta AED = \frac{3}{2}x$ (Ratio of bases)

$\therefore$ area of $\Delta ABC = 2\left(\frac{5}{2}x\right) = 5x$ (Ratio of bases)

$\therefore \frac{\text{area of } \Delta OBE}{\text{area of } BEDC} = \frac{x}{5x - \frac{3}{2}x} = \frac{2}{7}$

M1: Using ratio of bases to find area of ΔOAE

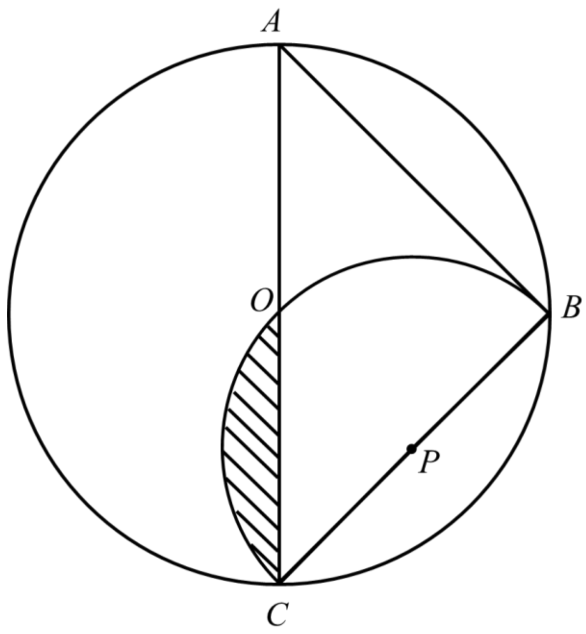
OR

Using ratio of bases to find area of ΔAED or ΔABC

A1

Answer .... [2]

25



AC is a diameter of a circle with centre O. $AC = \sqrt{2}r$ and $AB = BC$.
COB is a semi-circular arc, centre P.
What percentage of the circle is **not** shaded?

$\angle ABC = 90^\circ$ (Right angle in semicircle)	**B1**: Need to show $\angle ABC = 90^\circ$
$\because AB = BC,$	
$(AB)^2 + (BC)^2 = \left(\sqrt{2}r\right)^2$	
$2(BC)^2 = 2r^2$	
$(BC)^2 = r^2$	**M1**: Finding AB or BC
$\therefore BC = r$ (Reject -ve)	
$OC = \frac{1}{2}AC = \frac{\sqrt{2}}{2}r$	
$CP = PO = \frac{1}{2}BC = \frac{r}{2}$	
$\because OC^2 = CP^2 + PO^2$	
$\therefore$ By converse of Pythagoras' Theorem,	
ΔOPC is a right angled Δ.	**B1**: Need to show ΔOPC is a right angled Δ

<u>**Method 1:**</u>
<u>**Method 2:**</u>

Note that P and O are midpoints of BC and AC respectively.
$\therefore$ By midpoint theorem,
OP is parallel to AB,
and $\angle OPC = \angle ABC$
$\angle ABC = 90°$ (Right angle in semicircle)
$\therefore \angle OPC = 90°$
$\therefore \Delta OPC$ is a right angled Δ.

M1: Using midpoint theorem

A1: $\angle OPC = \angle ABC$

B1: Need to show ΔOPC is a right angled Δ

Percentage of circle shaded

$$= \frac{\text{Sector OPC} - \text{Triangle OPC}}{\text{Area of big circle}} \times 100\%$$

$$= \frac{\frac{1}{2}\left(\frac{r}{2}\right)^2\left(\frac{\pi}{2}\right) - \frac{1}{2}\left(\frac{r}{2}\right)^2 \sin\left(\frac{\pi}{2}\right)}{\pi\left(\frac{\sqrt{2}}{2}r\right)^2} \times 100\%$$

$$= \frac{\frac{1}{16}\pi r^2 - \frac{1}{8}r^2}{\frac{1}{2}\pi r^2} \times 100\%$$

$$= \frac{\frac{1}{16}\pi - \frac{1}{8}}{\frac{1}{2}\pi} \times 100\%$$

$= 4.542252845\%$

Percentage of circle shaded $= 100\% - 4.542252845\%$
$= 95.5\%$ (3 s.f)

M1: Correct percentage formula with the relevant shapes found using the correct formula (FT)

A1

Answer ………………………..………….% [5]