Elite Mathematics
Pearson Edexcel International GCSE

IGCSE LINEAR · 4MA1

4MA1/2HR January 2021 Worked Solutions

January 2021 paper rebuilt with the worked solution after each question.

22	2020–2026	Single-paper solutions
paper questions	52 past papers	checked by Dr Eslam



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PAST PAPER

4MA1/2HR January 2021

January 2021

22	100	2 h
questions	marks	exam time

Each question is followed by its worked solution and final answer.

4MA1/2HR JANUARY 2021

Question 1

8 marks | Expanding Brackets

1 $w = 5y^2 - y^3$

(a) Work out the value of w when $y = -2$

$w =$ .....

(2)

(b) Factorise fully $8p^2 - 2p$

.....

(2)

(c) Expand $4t(3t - 2)$

.....

(2)

(d) Expand and simplify $(5x - 2)(x + 4)$

.....

(2)

(Total for Question 1 is 8 marks)

WORKED SOLUTION

Question 1 · 4MA1/2HR January 2021

1 **Expand brackets**

For $w = 5y^2 - y^3$ and $y = -2$:

$$w = 5(-2)^2 - (-2)^3 = 20 + 8 = 28$$

$$8p^2 - 2p = 2p(4p - 1)$$

$$4t(3t - 2) = 12t^2 - 8t$$

$$(5x - 2)(x + 4) = 5x^2 + 18x - 8$$

FINAL ANSWER

$28,\ 2p(4p - 1),\ 12t^2 - 8t,\ 5x^2 + 18x - 8$

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Question 2

3 marks | Perimeter & Area

2 The diagram shows a rectangle $ABCD$ and a semicircle with diameter AB where $AB = 12\,\text{cm}$. The point E lies on DC and also on the semicircle.

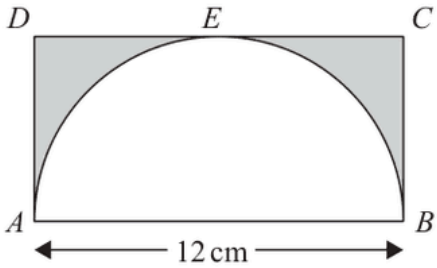


Diagram **NOT** accurately drawn

Work out the area of the shaded region.
Give your answer correct to 3 significant figures.

..... cm^2

(Total for Question 2 is 3 marks)

WORKED SOLUTION

Question 2 · 4MA1/2HR January 2021

1 **Calculate area**

The semicircle has diameter $12\ \text{cm}$, so its radius is $6\ \text{cm}$.

2 **The rectangle has area**

The rectangle has area

$$12 \times 6 = 72$$

3 **Area of the semicircle**

Area of the semicircle:

$$\frac{1}{2}\pi(6)^2 = 18\pi$$

4 **Shaded area**

Shaded area:

$$72 - 18\pi = 15.451\ldots$$

FINAL ANSWER

$15.5\ \text{cm}^2$.

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Question 3

3 marks | Set Notation & Venn Diagrams

3 $\mathscr{E} = \{21, 22, 23, 24, 25, 26, 27, 28, 29, 30\}$
$A = \{22, 24, 26, 28, 30\}$
$B = \{21, 24, 27, 30\}$

(a) List the members of the set

(i) $A \cap B$

(ii) A'

.....

(2)

$C = \{23, 25, 29\}$

(b) Using set notation, find an expression for C in terms of A and B.

.....

(1)

(Total for Question 3 is 3 marks)

WORKED SOLUTION

Question 3 · 4MA1/2HR January 2021

1 Calculate value

$$A \cap B = \{24, 30\}$$

2 Set is

The complement of A, using the given universal set, is

$$A' = \{21, 23, 25, 27, 29\}$$

3 The set

The set

$$C = \{23, 25, 29\}$$

4 Calculate value

is everything not in A and not in B, so

$$C = A' \cap B'$$

5 **Calculate value**

Equivalently,

$$C = (A \cup B)'$$

✓ **FINAL ANSWER**

$A \cap B = \{24, 30\}$, $A' = \{21, 23, 25, 27, 29\}$, and $C = A' \cap B'$.

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Question 4

4 marks | Algebraic Roots & Indices

4 (a) Simplify $(3k^2)^4$

.....

(2)

(b) Simplify $(21m^4n) \div (3n^{-5})$

.....

(2)

(Total for Question 4 is 4 marks)

WORKED SOLUTION

Question 4 · 4MA1/2HR January 2021

1 Use index laws

For part (a),

$$(3k^2)^4 = 3^4(k^2)^4$$

$$= 81k^8$$

2 Use index laws

For part (b),

$$(21m^4n) \div (3n^{-5}) = \frac{21m^4n}{3n^{-5}}$$

$$= 7m^4n^{1-(-5)}$$

$$= 7m^4n^6$$

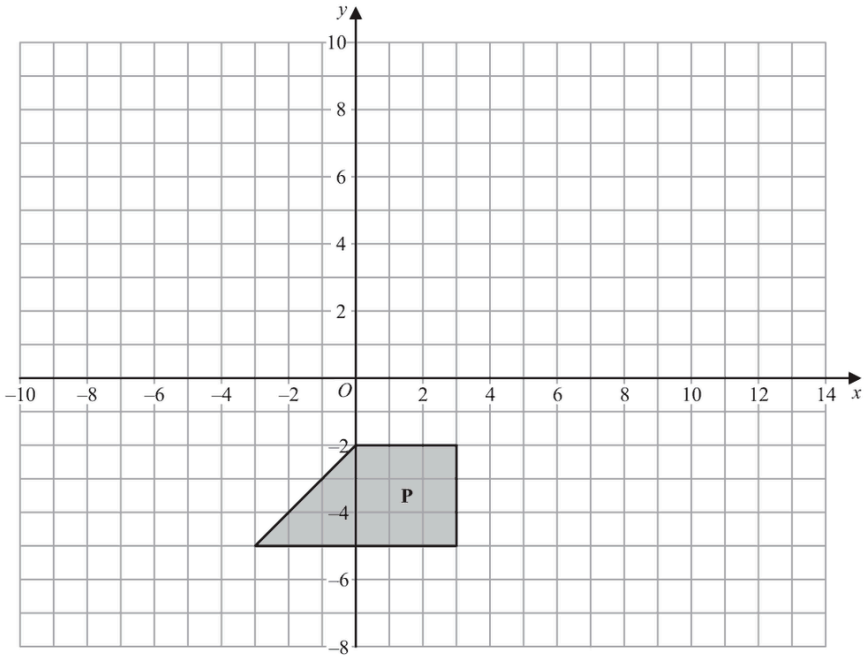
FINAL ANSWER

(a) $81k^8$, (b) $7m^4n^6$.

Question 5

6 marks | Transformations

5 Here is a shape **P** drawn on a grid of squares.



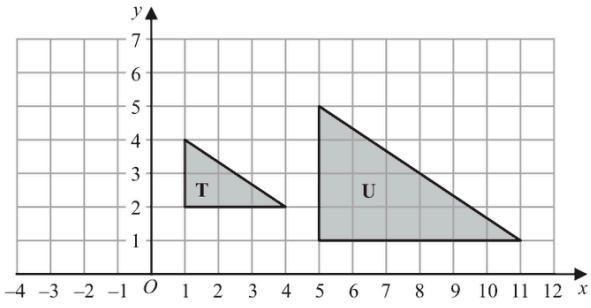
(a) On the grid, rotate shape **P** 180° about the point (–3, 2)
Label the new shape **Q**.

(2)

(b) On the grid, translate shape **P** by the vector $\begin{pmatrix} 10 \\ 8 \end{pmatrix}$
Label the new shape **R**.

(1)

Here are triangle **T** and triangle **U** drawn on a grid of squares.



(c) Describe fully the single transformation that maps triangle **T** onto triangle **U**.

(3)

(Total for Question 5 is 6 marks)

1 **(a) For a rotation about**

(a) For a $180°$ rotation about $(-3, 2)$,

$$(x, y) \mapsto (-6 - x,\ 4 - y)$$

2 **The image has vertices**

The image has vertices

$$(-3, 9),\ (-9, 9),\ (-9, 6),\ (-6, 6)$$

3 **(b) Translate by**

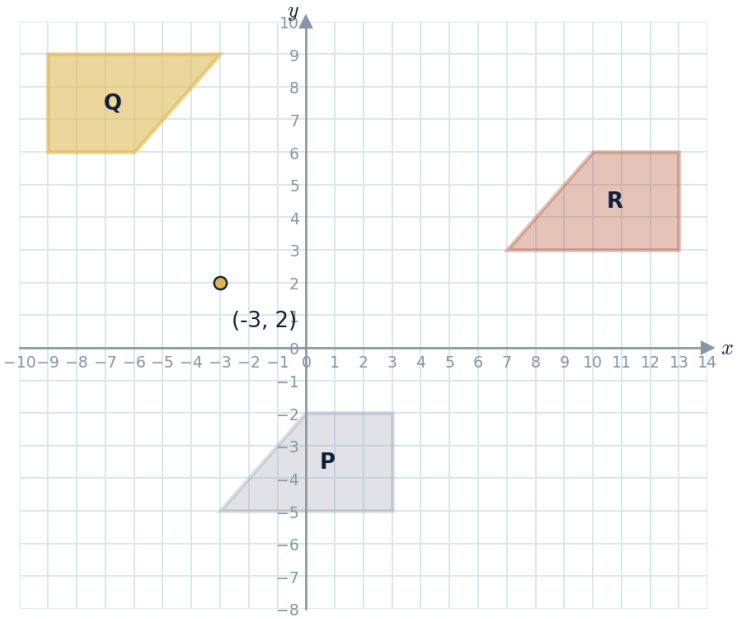
(b) Translate by

$$\begin{pmatrix} 10 \\ 8 \end{pmatrix}$$

4 **The image has vertices**

The image has vertices

$$(7, 3),\ (13, 3),\ (13, 6),\ (10, 6)$$



5 **Use trigonometry**

(c) Triangle T is mapped to triangle U by an enlargement with scale factor 2 and centre $(-3, 3)$.

✓ **FINAL ANSWER**

(a) vertices $(-3, 9), (-9, 9), (-9, 6), (-6, 6)$; (b) vertices $(7, 3), (13, 3), (13, 6), (10, 6)$; (c) enlargement, scale factor 2, centre $(-3, 3)$.

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Question 6

3 marks | Reverse Percentages

6 On Wednesday, the price of 1 litre of petrol was £1.26
The price of petrol on Wednesday was 5% more than the price of petrol on the previous Monday.

Calculate the price of 30 litres of petrol on the previous Monday.

£.....

(Total for Question 6 is 3 marks)

WORKED SOLUTION

Question 6 · 4MA1/2HR January 2021

1 Wednesday s price was more

Wednesday's price was 5% more than Monday's price.

2 Calculate percentage

So

$$1.26 = 1.05 \times \text{Monday price}$$

$$\text{Monday price} = \frac{1.26}{1.05} = 1.20$$

3 The cost of litres on

The cost of 30 litres on Monday was

$$30 \times 1.20 = 36$$

FINAL ANSWER

$\pounds 36$

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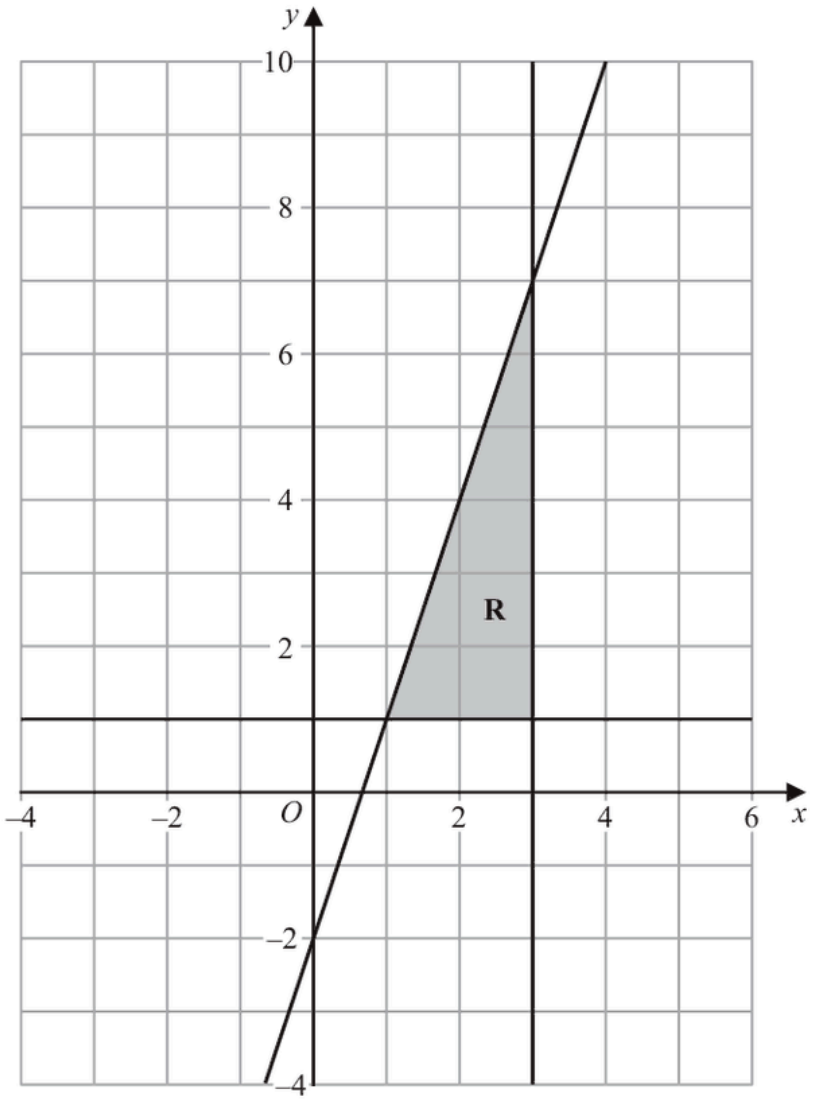
Question 7

3 marks

Inequalities (Solving & Graphing)

7 The shaded region **R**, shown in the diagram below, is bounded by the straight line with equation $y = 3x - 2$ and by two other straight lines.

Write down the three inequalities that define region **R**.



(Total for Question 7 is 3 marks)

WORKED SOLUTION

Question 7 · 4MA1/2HR January 2021

1 The sloping boundary is

The sloping boundary is

$$y = 3x - 2$$

2 **The shaded region is below**

The shaded region is below this line:

$$y \leq 3x - 2$$

3 **The vertical boundary is so**

The vertical boundary is

$$x = 3$$

so the region has

$$x \leq 3$$

4 **The lower boundary is the**

The lower boundary is the x-axis, so

$$y \geq 0$$

✓ **FINAL ANSWER**

$y \leq 3x - 2$, $x \leq 3$, $y \geq 0$.

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Question 8

3 marks | Standard Form

8 The table gives the length of the coastline, in kilometres, of each of five oceans.

Ocean	Length of coastline (km)
Arctic	4.539×10^4
Atlantic	1.119×10^5
Pacific	1.357×10^5
Indian	6.653×10^4
Southern	1.797×10^4

(a) Which ocean has the greatest length of coastline?

.....

(1)

(b) Calculate the difference between the length of the Atlantic Ocean's coastline and the length of the Southern Ocean's coastline.
Give your answer in standard form.

..... km

(2)

(Total for Question 8 is 3 marks)

WORKED SOLUTION

Question 8 · 4MA1/2HR January 2021

1 **The greatest coastline is the**

The greatest coastline is the largest number in standard form.

$$1.357 \times 10^5$$

2 **Convert standard form**

is the largest, so the answer is the Pacific Ocean.

3 Convert standard form

For part (b),

$$1.119 \times 10^5 = 111900$$

$$1.797 \times 10^4 = 17970$$

4 Difference

Difference:

$$111900 - 17970 = 93930$$

$$93930 = 9.393 \times 10^4$$

FINAL ANSWER

(a) Pacific Ocean, (b) 9.393×10^4 km

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Question 9

3 marks | Quadratic Equations

9 Solve $x^2 - 21x + 20 = 0$
Show your working clearly.

(Total for Question 9 is 3 marks)

WORKED SOLUTION

Question 9 · 4MA1/2HR January 2021

1 Solve quadratic equation

$$x^2 - 21x + 20 = 0$$

2 Factorise

Factorise:

$$(x - 20)(x - 1) = 0$$

3 Solve quadratic equation

So

$$x = 20 \quad \text{or} \quad x = 1$$

FINAL ANSWER

$x = 20$ or $x = 1$.

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Question 10

4 marks | Averages from Frequency Tables

10 A mathematics teacher at a school asked a group of students how far, in kilometres, each student had travelled to get to school that day.

The table gives information about their answers.

Distance travelled (d km)	Number of students
$0 < d \leqslant 2$	x
$2 < d \leqslant 4$	11
$4 < d \leqslant 6$	8
$6 < d \leqslant 8$	6
$8 < d \leqslant 10$	5

The teacher calculated that an estimate for the mean distance travelled by the whole group of students was 4.25 km.

Work out the value of x.
Show your working clearly.

$x =$.....

(Total for Question 10 is 4 marks)

WORKED SOLUTION

Question 10 · 4MA1/2HR January 2021

1 Use class midpoints

Use class midpoints $1, 3, 5, 7, 9$.

2 The total frequency is

The total frequency is

$$x + 11 + 8 + 6 + 5 = x + 30$$

3 The total estimated distance is

The total estimated distance is

$$1x + 3(11) + 5(8) + 7(6) + 9(5) = x + 160$$

4 **The estimated mean is**

The estimated mean is 4.25:

$$\frac{x+160}{x+30}=4.25$$

$$x+160=4.25x+127.5$$

$$32.5=3.25x$$

$$x=10$$

✓ **FINAL ANSWER**

$x=10$.

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Question 11

4 marks | Circles, Arcs & Sectors

11 A circle centre O has radius 9 cm.

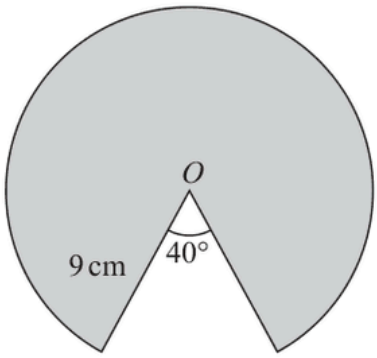


Diagram **NOT** accurately drawn

Calculate the perimeter of the shaded sector of the circle.
Give your answer correct to 3 significant figures.

..... cm

(Total for Question 11 is 4 marks)

WORKED SOLUTION

Question 11 · 4MA1/2HR January 2021

1 **The shaded sector is the**

The shaded sector is the major sector:

$$360° - 40° = 320°$$

2 **Arc length**

Arc length:

$$\frac{320}{360} \times 2\pi(9) = 16\pi$$

3 **Perimeter**

Perimeter:

$$16\pi + 2(9) = 68.265\ldots$$

✓ **FINAL ANSWER**

68.3 cm.

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Question 12

4 marks | Simultaneous Equations

12 Solve the simultaneous equations $2x + 7y = 17$
$5x + 3y = -1$

Show clear algebraic working.

$x =$ .....

$y =$ .....

(Total for Question 12 is 4 marks)

WORKED SOLUTION

Question 12 · 4MA1/2HR January 2021

1 **Solve simultaneous equations**

$$2x + 7y = 17$$

$$5x + 3y = -1$$

2 **Multiply the first equation by**

Multiply the first equation by 5:

$$10x + 35y = 85$$

3 **Multiply the second equation by**

Multiply the second equation by 2:

$$10x + 6y = -2$$

4 **Subtract**

Subtract:

$$29y = 87$$

$$y = 3$$

5 **Solve simultaneous equations**

Substitute into $2x + 7y = 17$:

$$2x + 21 = 17$$

$$2x = -4$$

$$x = -2$$

✓ **FINAL ANSWER**

$x = -2$, $y = 3$.

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Question 13

3 marks | Right-Angled Triangles - Pythagoras & Trigonometry

13 The diagram shows two hot air balloons.
A is a point on the base of one of the balloons and B is a point on the base of the other balloon.

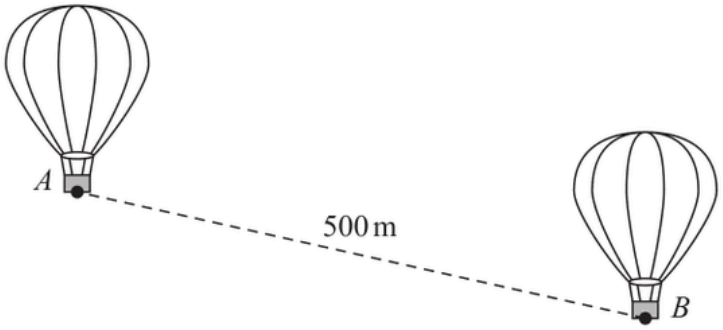


Diagram **NOT** accurately drawn

The distance between A and B is 500 metres.
The angle of depression of B from A is 23°

Calculate the vertical height of A above B.
Give your answer correct to one decimal place.

..... metres

(Total for Question 13 is 3 marks)

WORKED SOLUTION

Question 13 · 4MA1/2HR January 2021

1 **The vertical height is opposite**

The vertical height is opposite the $23°$ angle, and $AB = 500\ \text{m}$ is the hypotenuse.

$$\sin 23° = \frac{h}{500}$$

$$h = 500 \sin 23° = 195.365\ldots$$

FINAL ANSWER

$195.4\ \text{m}$.

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Question 14

4 marks | Compound Interest & Depreciation

14 Simon bought a house at the beginning of 2018
The value of Simon's house had decreased by 15% by the end of 2018

The house increased in value during both 2019 and 2020
The percentage increases in the value of the house during 2019 and 2020 were the same.

The value of Simon's house at the end of 2020 was 2.85% greater than the amount he paid for his house at the beginning of 2018

Calculate the percentage increase in the value of the house during 2019

.....%

(Total for Question 14 is 4 marks)

WORKED SOLUTION

Question 14 · 4MA1/2HR January 2021

1 **Let the original house value**

Let the original house value be V.

2 **Use compound interest**

After the 15% decrease in 2018:

$$0.85V$$

3 **Use compound interest**

Let the percentage increase in each of 2019 and 2020 be r.

4 **The final value is greater**

The final value is 2.85% greater than the original value:

$$1.0285V$$

5 **Use compound interest**

So

$$0.85V(1+r)^2 = 1.0285V$$

$$(1+r)^2 = \frac{1.0285}{0.85} = 1.21$$

$$1+r = \sqrt{1.21} = 1.1$$

$$r = 0.1 = 10\%$$

✓ **FINAL ANSWER**

10%

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Question 15

4 marks | Algebraic Proof

15 Prove algebraically that the product of any two odd numbers is always an odd number.

(Total for Question 15 is 4 marks)

WORKED SOLUTION

Question 15 · 4MA1/2HR January 2021

1 Let the two odd numbers

Let the two odd numbers be

$$2m+1 \quad \text{and} \quad 2n+1$$

2 Their product is

Their product is

$$(2m+1)(2n+1)$$

$$= 4mn + 2m + 2n + 1$$

$$= 2(2mn + m + n) + 1$$

3 This is of the form

This is of the form

$$2k+1$$

where k is an integer.

4 Use algebraic proof asks general

So the product is odd.

FINAL ANSWER

The product of any two odd numbers is always odd.

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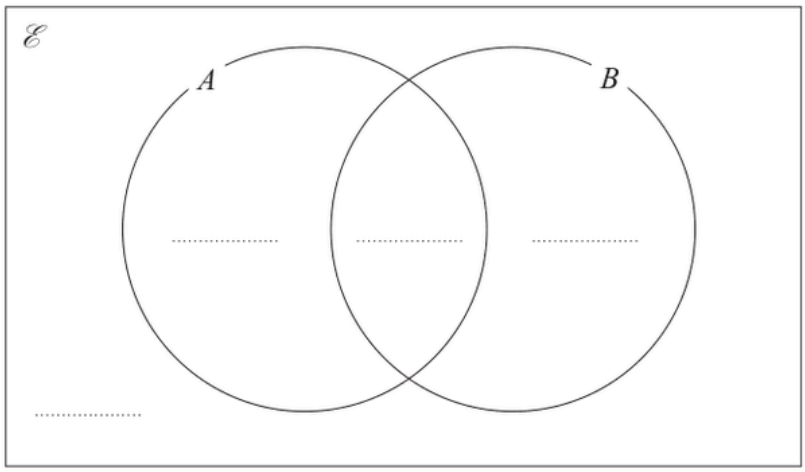
Question 16

5 marks | Set Notation & Venn Diagrams

16 Two events A and B are such that $n(A) = 62$ $n(B) = 30$ and $n(A \cup B) = 68$

Given that $n(\mathscr{E}) = 80$

(a) complete the Venn diagram to show the number of elements in each region.



(2)

An element is chosen at random from $\mathscr{E}$.

(b) Using the Venn diagram, find the probability that this element is in

(i) $A \cap B$

.....

(1)

(ii) $A \cup B'$

.....

(2)

(Total for Question 16 is 5 marks)

WORKED SOLUTION

Question 16 · 4MA1/2HR January 2021

1 **(a) Find the intersection**

$$n(A \cap B) = n(A) + n(B) - n(A \cup B) = 62 + 30 - 68 = 24$$

2 **(a) Fill every region**

A only $= 62 - 24 = 38$, B only $= 30 - 24 = 6$, outside $= 80 - 68 = 12$.

3 **(b)(i) In both A and B**

$$P(A \cap B) = \frac{24}{80} = \frac{3}{10}$$

---

4 **(b)(ii) In A or not in B**

$A \cup B'$ is everything except "B only": $80 - 6 = 74$.

$$P(A \cup B') = \frac{74}{80} = \frac{37}{40}$$

✓ **FINAL ANSWER**

(a) $38, 24, 6$, outside 12 (b)(i) $\frac{3}{10}$ (ii) $\frac{37}{40}$

4MA1/2HR JANUARY 2021

Question 17

9 marks | Functions

17 The functions f and g are defined as

$f(x) = x^2 + 6$
$g(x) = x - 10$

(a) Find fg(3)

.....

(2)

(b) Solve the equation $fg(x) = f(x)$
Show clear algebraic working.

.....

(3)

The function h is defined as

$$h(x) = \frac{2x - 4}{x}$$

(c) State the value of x that cannot be included in the domain of h

.....

(1)

(d) Express the inverse function h^{-1} in the form $h^{-1}(x) = \ldots$

$h^{-1}(x) =$ .....

(3)

(Total for Question 17 is 9 marks)

WORKED SOLUTION

Question 17 · 4MA1/2HR January 2021

1 **Solve quadratic equation**

$$f(x) = x^2 + 6, \qquad g(x) = x - 10$$

2 **(a)**

(a)

$$g(3) = 3 - 10 = -7$$

$$fg(3) = f(-7) = (-7)^2 + 6 = 55$$

3 **(b)**

(b)

$$fg(x) = f(g(x)) = (x-10)^2 + 6$$

4 **Solve**

Solve $fg(x) = f(x)$:

$$(x-10)^2 + 6 = x^2 + 6$$

$$x^2 - 20x + 100 = x^2$$

$$-20x + 100 = 0$$

$$x = 5$$

5 **(c)**

(c)

$$h(x) = \frac{2x-4}{x}$$

6 **Solve quadratic equation**

The denominator cannot be zero, so $x = 0$ cannot be included.

7 **(d) Let**

(d) Let

$$y = \frac{2x-4}{x}$$

$$y = 2 - \frac{4}{x}$$

$$y - 2 = -\frac{4}{x}$$

$$x = \frac{4}{2-y}$$

8 **Solve quadratic equation**

Therefore

$$h^{-1}(x) = \frac{4}{2-x}$$

FINAL ANSWER

$fg(3) = 55$, $x = 5$, excluded value 0, and $h^{-1}(x) = \dfrac{4}{2 - x}$.

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Question 18

5 marks | Algebraic Fractions

18 Solve the equation

$$\frac{5}{x+2}+\frac{3}{x^2+2x}=2$$

Show clear algebraic working.

(Total for Question 18 is 5 marks)

WORKED SOLUTION

Question 18 · 4MA1/2HR January 2021

1 **Solve equation**

$$\frac{5}{x+2}+\frac{3}{x^2+2x}=2$$

2 **Solve equation**

Since

$$x^2+2x=x(x+2)$$

3 **multiply by**

multiply by $x(x+2)$:

$$5x+3=2x(x+2)$$

$$5x+3=2x^2+4x$$

$$2x^2-x-3=0$$

4 **Factorise**

Factorise:

$$(2x-3)(x+1)=0$$

$$x=\frac{3}{2} \quad \text{or} \quad x=-1$$

5 **Both values are allowed because**

Both values are allowed because $x \neq 0$ and $x \neq -2$.

✓ **FINAL ANSWER**

$x = \frac{3}{2}$ or $x = -1$.

4MA1/2HR JANUARY 2021

Question 19

7 marks | Algebraic Roots & Indices

19 (a) Simplify $8^2 \times \sqrt[3]{4^6}$

Give your answer in the form 2^a where a is an integer.

Show each stage of your working clearly.

.....

(3)

Given that $n^{\left(-\frac{4}{5}\right)} = \left(\frac{1}{2}\right)^4$ where $n > 0$

(b) find the value of n.

$n =$ .....

(4)

(Total for Question 19 is 7 marks)

WORKED SOLUTION

Question 19 · 4MA1/2HR January 2021

1 **Simplify surd**

$$8^2 = (2^3)^2 = 2^6$$

$$\sqrt[3]{4^6} = \sqrt[3]{(2^2)^6} = \sqrt[3]{2^{12}} = 2^4$$

2 **Simplify surd**

So

$$8^2 \times \sqrt[3]{4^6} = 2^6 \times 2^4 = 2^{10}$$

3 **Use index laws**

For part (b),

$$n^{-4/5} = \left(\frac{1}{2}\right)^4 = 2^{-4}$$

4 **Use index laws**

So

$$n^{4/5} = 2^4$$

5 **Raise both sides to the**

Raise both sides to the power $\frac{5}{4}$:

$$n = (2^4)^{5/4} = 2^5 = 32$$

FINAL ANSWER

(a) 2^{10}, (b) $n = 32$.

4MA1/2HR JANUARY 2021

Question 20

5 marks | Circles, Arcs & Sectors

20 A, B and C are points on a circle with centre O.

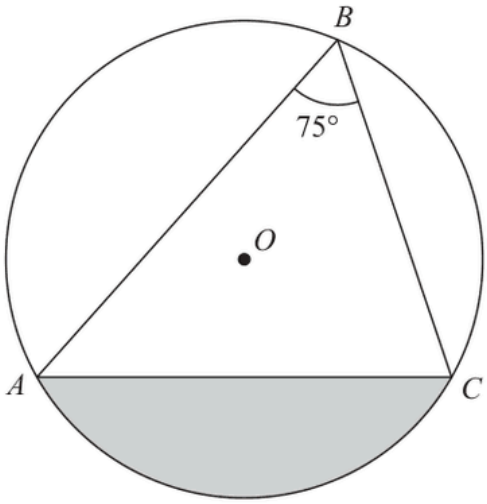


Diagram **NOT** accurately drawn

Angle $ABC = 75°$

The area of the shaded segment is $200\,\text{cm}^2$

Calculate the radius of the circle.
Give your answer correct to 3 significant figures.

..... cm

(Total for Question 20 is 5 marks)

WORKED SOLUTION

Question 20 · 4MA1/2HR January 2021

1 **Use trigonometry**

$$\angle ABC = 75°$$

2 **The angle at the centre**

The angle at the centre is twice the angle at the circumference, so

$$\angle AOC = 2(75°) = 150°$$

3 **The shaded segment is**

The shaded segment is:

$$\text{sector } AOC - \text{triangle } AOC$$

4 **Let the radius be**

Let the radius be r.

5 **Sector area**

Sector area:

$$\frac{150}{360}\pi r^2$$

6 **Triangle area**

Triangle area:

$$\frac{1}{2}r^2 \sin 150°$$

7 **Use trigonometry**

So

$$\frac{150}{360}\pi r^2 - \frac{1}{2}r^2 \sin 150° = 200$$

$$r^2\left(\frac{5\pi}{12} - \frac{1}{4}\right) = 200$$

$$r^2 = \frac{200}{\frac{5\pi}{12} - \frac{1}{4}}$$

$$r = 13.7426\ldots$$

✓ **FINAL ANSWER**

$\boxed{13.7 \text{ cm}}$

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Question 21

6 marks | Probability Toolkit

21 A bag contains n beads.
6 of the beads are red and the rest are blue.

Ravi is going to take at random 2 beads from the bag.

The probability that the 2 beads will be of the same colour is $\frac{9}{17}$

Using algebra, and showing each stage of your working, calculate the value of n.

$n =$ .....

(Total for Question 21 is 6 marks)

WORKED SOLUTION

Question 21 · 4MA1/2HR January 2021

1 There are beads altogether

There are n beads altogether.

2 Red beads

Red beads:

$$6$$

3 Blue beads

Blue beads:

$$n - 6$$

4 The probability of taking two

The probability of taking two beads of the same colour is

$$P(RR) + P(BB) = \frac{9}{17}$$

5 **Use trigonometry**

So

$$\frac{6}{n} \cdot \frac{5}{n-1} + \frac{n-6}{n} \cdot \frac{n-7}{n-1} = \frac{9}{17}$$

$$\frac{30 + (n-6)(n-7)}{n(n-1)} = \frac{9}{17}$$

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6 **Expand**

Expand:

$$(n-6)(n-7) = n^2 - 13n + 42$$

---

7 **Use trigonometry**

So

$$\frac{n^2 - 13n + 72}{n(n-1)} = \frac{9}{17}$$

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8 **Cross multiply**

Cross multiply:

$$17(n^2 - 13n + 72) = 9n(n-1)$$

$$17n^2 - 221n + 1224 = 9n^2 - 9n$$

$$8n^2 - 212n + 1224 = 0$$

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9 **Divide by 4**

Divide by 4:

$$2n^2 - 53n + 306 = 0$$

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10 **Factor**

Factor:

$$(2n - 17)(n - 18) = 0$$

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11 **Use trigonometry**

So

$$n = \frac{17}{2} \quad \text{or} \quad n = 18$$

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12 **The number of beads must**

The number of beads must be a whole number, so

$$n = 18$$

✓ **FINAL ANSWER**

$\boxed{18}$

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Question 22

4 marks | 3D Pythagoras & Trigonometry

22 ABC is an isosceles triangle in a horizontal plane.
The point T is vertically above B.

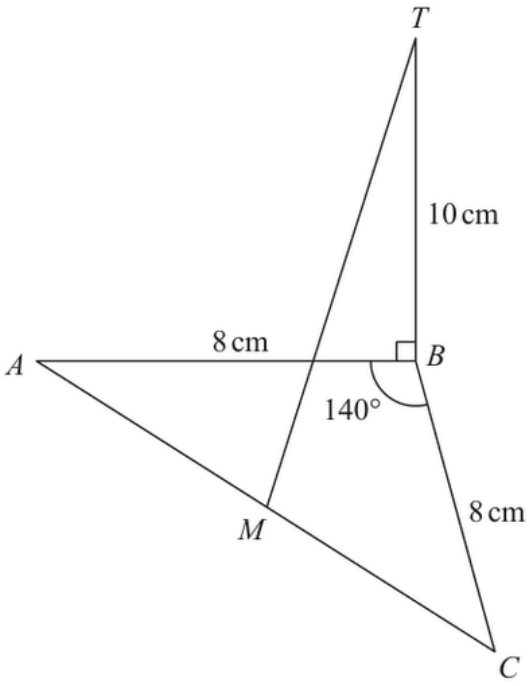


Diagram **NOT** accurately drawn

Angle $ABC = 140°$
$AB = BC = 8$ cm
$TB = 10$ cm
M is the midpoint of AC.

Calculate the size of the angle between MT and the horizontal plane ABC.
Give your answer correct to one decimal place.

.....°

(Total for Question 22 is 4 marks)

WORKED SOLUTION

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1 **Use trigonometry**

Since $AB = BC = 8$, triangle ABC is isosceles.

2 **The line from to the**

The line from B to the midpoint M bisects angle ABC.

$$\angle ABM = \frac{140^\circ}{2} = 70^\circ$$

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3 **Use trigonometry**

In right triangle ABM,

$$\cos 70^\circ = \frac{BM}{8}$$

$$BM = 8\cos 70^\circ$$

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4 **Use trigonometry**

Since T is vertically above B, the projection of MT onto the horizontal plane is MB.

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5 **Let the required angle be**

Let the required angle be θ.

$$\tan\theta = \frac{TB}{BM}$$

$$\tan\theta = \frac{10}{8\cos 70^\circ}$$

$$\theta = 74.7^\circ$$

✓ **FINAL ANSWER**

74.7°