Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE

Centre Number	Candidate Number

Wednesday 13 January 2021

Afternoon (Time: 2 hours)	Paper Reference **4MA1/2HR**

Mathematics A

Paper 2HR
Higher Tier

You must have: Ruler graduated in centimetres and millimetres, protractor, compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.	Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Without sufficient working, correct answers may be awarded no marks.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- **Calculators may be used.**
- You must **NOT** write anything on the formulae page. Anything you write on the formulae page will gain NO credit.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Check your answers if you have time at the end.

Turn over ▶

International GCSE Mathematics

Formulae sheet – Higher Tier

Arithmetic series

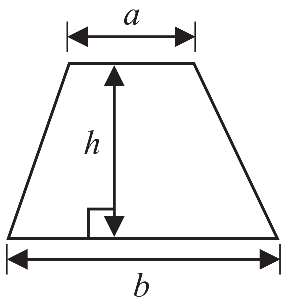
Sum to n terms, $S_n = \dfrac{n}{2}\,[2a + (n-1)d]$

The quadratic equation

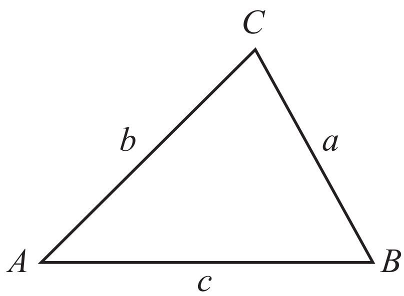
The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$ are given by:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Area of trapezium $= \dfrac{1}{2}(a + b)h$



Trigonometry



In any triangle ***ABC***

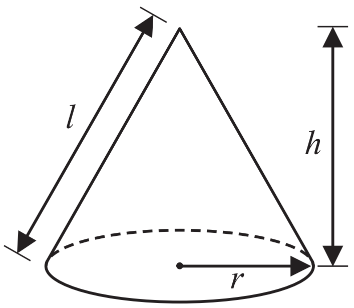
Sine Rule $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

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

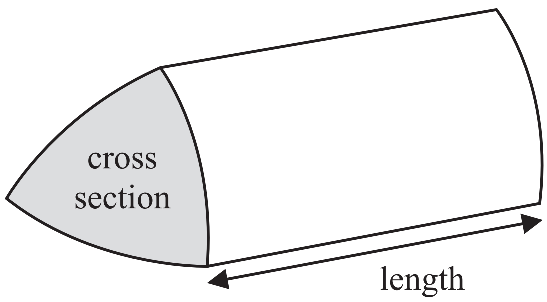
Area of triangle $= \dfrac{1}{2}ab\sin C$

Volume of cone $= \dfrac{1}{3}\pi r^2 h$

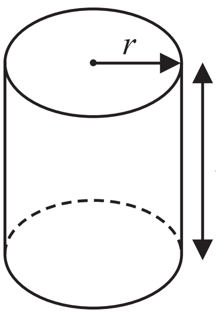
Curved surface area of cone $= \pi rl$



Volume of prism
= area of cross section × length

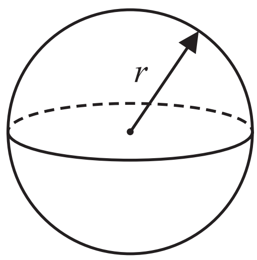


Volume of cylinder $= \pi r^2 h$
Curved surface area of cylinder $= 2\pi rh$



Volume of sphere $= \dfrac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$



Answer ALL TWENTY TWO questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

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

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

$w = 5(-2)^2 - (-2)^3$ 1

$= 5(4) - (-8)$

$= 20 + 8$

$= 28$ 1

$w =$ 28

(2)

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

$2p(4p-1)$ 2

$2p(4p-1)$

(2)

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

$= 12t^2 - 8t$ 2

$12t^2 - 8t$

(2)

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

$= 5x^2 + 20x - 2x - 8$ 1

$= 5x^2 + 18x - 8$ 1

$5x^2 + 18x - 8$

(2)

(Total for Question 1 is 8 marks)

2 The diagram shows a rectangle *ABCD* and a semicircle with diameter *AB* where *AB* = 12 cm. The point *E* lies on *DC* and also on the semicircle.

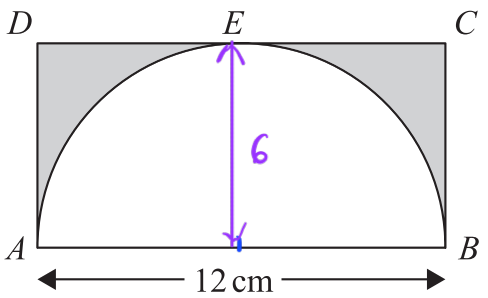


Diagram **NOT** accurately drawn

radius = 6 cm

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

Area of rectangle = $12 \times 6 = 72 \text{ cm}^2$ 1

Area of semicircle = $\frac{1}{2} \times \pi \times 6^2 = 56.54 \text{ cm}^2$

Area of shaded region = Area of rectangle − Area of semicircle

$= 72 \text{ cm}^2 - 56.54 \text{ cm}^2$ 1

$= 15.5 \text{ cm}^2$ 1

15.5 .... cm^2

(Total for Question 2 is 3 marks)

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) $A \cap B$ – is in set A AND set B

24, 30 ①

(ii) A' – not in set A

21, 23, 25, 27, 29 ①

(2)

$C = \{23, 25, 29\}$ – all not in set A or set B

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

$(A \cup B)'$ ①

(1)

(Total for Question 3 is 3 marks)

---

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

$3^4 \times k^{2\times 4}$

$= 81 \times k^8$

$= 81k^8$

$81k^8$ ②

(2)

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

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

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

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

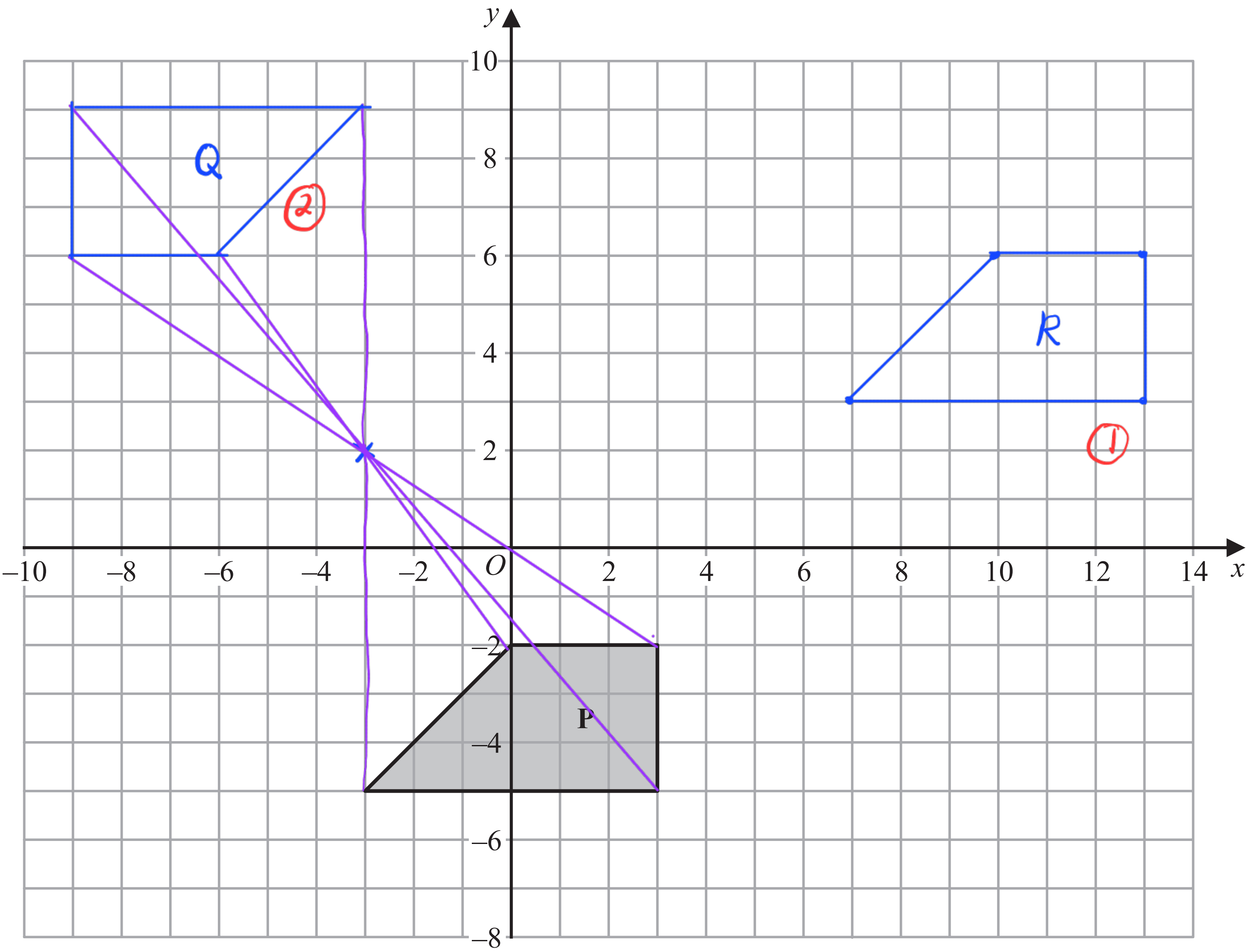
$= 7m^4n^6$

$7m^4n^6$ ②

(2)

(Total for Question 4 is 4 marks)

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**.

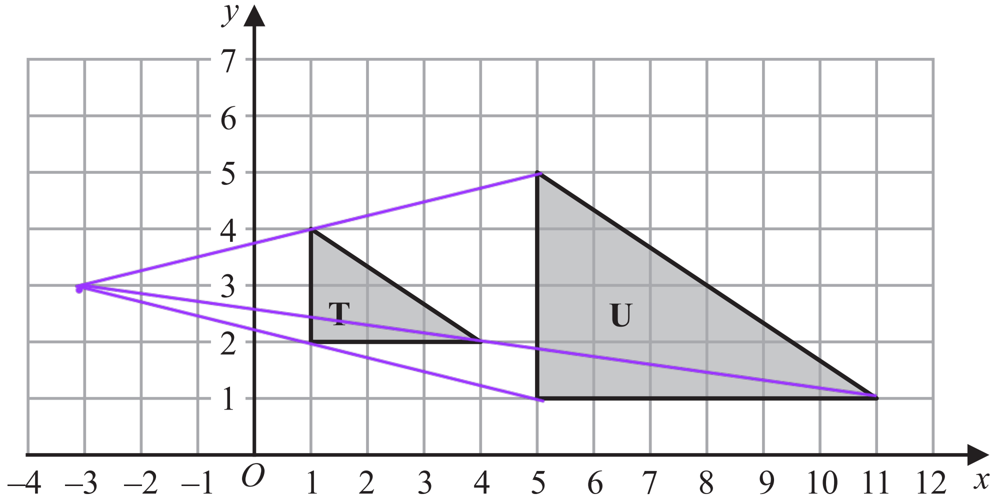
(2)

(b) On the grid, translate shape **P** by the vector $\begin{pmatrix} 10 \\ 8 \end{pmatrix}$ 10 position to the right
8 position upwards

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**.

Enlargement of Scale factor 2 at centre (-3,3)
1 1 1

(3)

(Total for Question 5 is 6 marks)

---

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.

Let the price of 1 litre petrol on Monday = x

$x + \frac{5}{100}x = 1.26$

$1.05x = 1.26$

$x = \frac{1.26}{1.05}$

$= 1.2$ 1

Price of 30 litres of petrol on Monday:

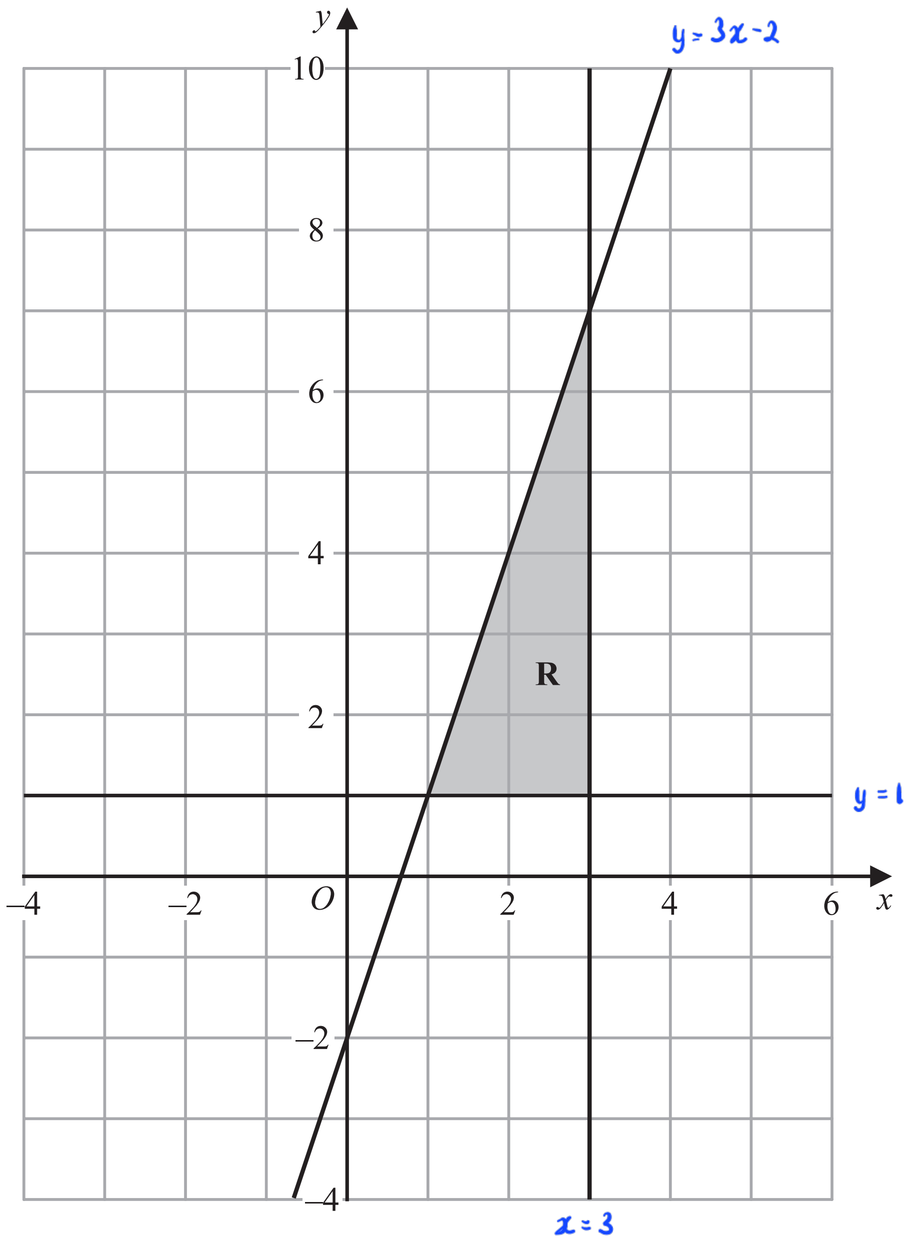
$1.2 \times 30 = 36$ 1
1

£ 36

(Total for Question 6 is 3 marks)

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**.



$x \leqslant 3$ ①

$y \geqslant 1$ ①

$y \leqslant 3x - 2$ ①

(Total for Question 7 is 3 marks)

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

11.19×10^4

13.57×10^4

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

Pacific (1)

(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.

$11.19 \times 10^4 - 1.797 \times 10^4$ (1)

$= (11.19 - 1.797) \times 10^4$

$= 9.393 \times 10^4$ (1)

9.393×10^4 km

(2)

(Total for Question 8 is 3 marks)

---

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

By using quadratic formula:

$$x = \frac{21 \pm \sqrt{(-21)^2 - 4(1)(20)}}{2}$$ (1)

$$= \frac{21 \pm \sqrt{361}}{2}$$

$$= \frac{21 \pm 19}{2}$$ (1)

$$= \frac{21+19}{2} \text{ or } \frac{21-19}{2}$$

$$= \frac{40}{2} \text{ or } \frac{2}{2}$$

$x = 20$ or 1 (1)

20, 1

(Total for Question 9 is 3 marks)

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.

Estimated mean $= \dfrac{(x \times 1) + (11 \times 3) + (8 \times 5) + (6 \times 7) + (5 \times 9)}{x + 11 + 8 + 6 + 5} = 4.25$ (1)

$= \dfrac{x + 33 + 40 + 42 + 45}{x + 30} = 4.25$

$= 160 + x = 4.25(30 + x)$ (1)

$160 + x = 127.5 + 4.25x$

$160 - 127.5 = 4.25x - x$

$32.5 = 3.25x$ (1)

$x = \dfrac{32.5}{3.25}$

$= 10$ (1)

$x =$ 10

(Total for Question 10 is 4 marks)

11 A circle centre O has radius 9 cm.

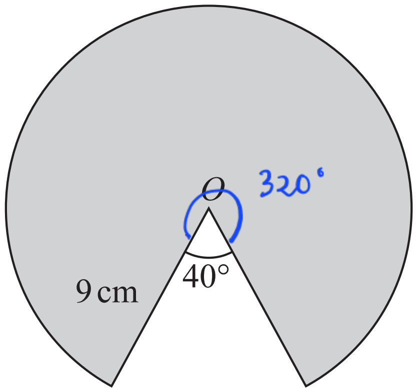


Diagram **NOT** accurately drawn

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

1 $\dfrac{320°}{360°} \times 2\pi(9) = 16\pi$ 1

Circumference $2\pi r$

Perimeter $= 16\pi + 9 + 9$ 1

$= 68.265\ldots$

$= 68.3$ (3sf)

68.3 1 cm

(Total for Question 11 is 4 marks)

---

12 Solve the simultaneous equations

$2x + 7y = 17$
$5x + 3y = -1$

Show clear algebraic working.

$2x + 7y = 17$

$2x = 17 - 7y$

$x = \dfrac{17 - 7y}{2}$ — 1

$5x + 3y = -1$

$5x = -1 - 3y$

$x = \dfrac{-1 - 3y}{5}$ — 2

Substitute 2 into 1

$\dfrac{-1 - 3y}{5} = \dfrac{17 - 7y}{2}$

$2(-1 - 3y) = 5(17 - 7y)$ 1

$-2 - 6y = 85 - 35y$

$-2 - 85 = -35y + 6y$

$-87 = -29y$

$y = 3$

$x = \dfrac{-1 - 3(3)}{5} = -2$ 1

$x =$ −2 1

$y =$ 3 1

(Total for Question 12 is 4 marks)

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.

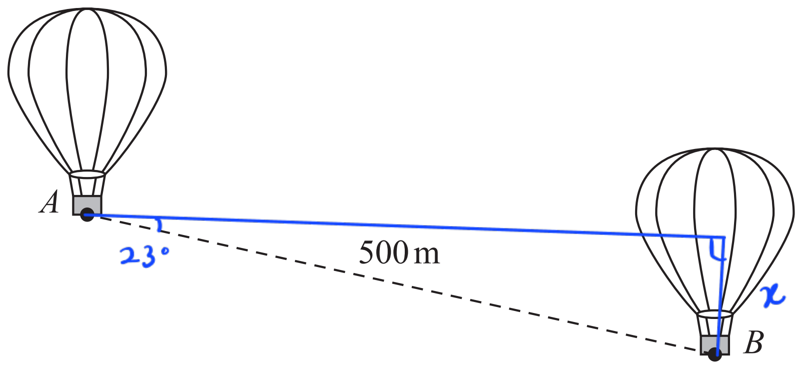
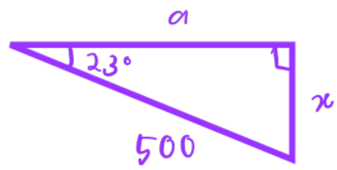


Diagram **NOT** accurately drawn

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.



$\sin\theta = \frac{o}{h}$

$\sin 23° = \frac{x}{500}$ 1

$x = 500 \sin 23°$ 1

$= 195.4$ (1dp) 1

195.4 .... metres

(Total for Question 13 is 3 marks)

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

Initial value of house = x

$\frac{100 - 15}{100}$

Value at the end of 2018 = $x \times 0.85 = 0.85x$

Let y be the percentage increase of 2019

Value at the end of 2020 = $0.85x \times \left(\frac{100+y}{100}\right)^2$

$x \times 1.0285 = 0.85x \times \left(\frac{100+y}{100}\right)^2$ (2)

$\frac{1.0285x}{0.85x} = \left(\frac{100+y}{100}\right)^2$

$\sqrt{1.21} = \frac{100+y}{100}$ (1)

$(1.1 \times 100) - 100 = y$

$y = 10$ (1)

10 %

(Total for Question 14 is 4 marks)

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

Let odd number 1 be = $2n+1$

Let odd number 2 be = $2m+1$

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

2

$= 2(2mn + n + m) + 1$ this will make sure the result will always be odd.

1

Since the product of 2 odd numbers is $2(2mn+n+m)+1$, this proves that the result will always be an odd number.

(Total for Question 15 is 4 marks)

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.

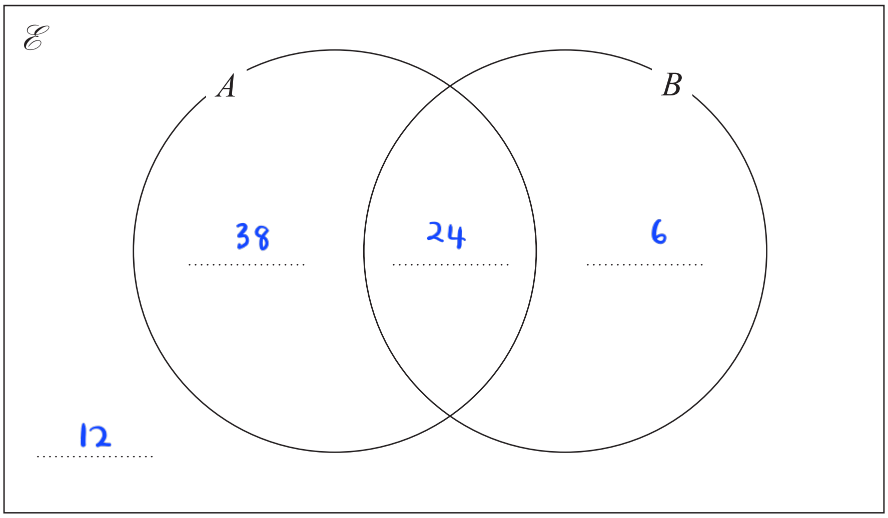
Let $n(A \cap B) = x$

$n(A \cup B) = n(A) + n(B) - x$

$68 = 62 + 30 - x$

$x = 92 - 68 = 24$

$80 - 68 = 12$



2

(2)

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

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

(i) $A \cap B$ – overlap of A and B

$\frac{24}{80}$ 1

....

(1)

(ii) $A \cup B'$ – is in A and not in B

$62 + 12 = 74$

1

$\frac{74}{80}$ 1

....

(2)

(Total for Question 16 is 5 marks)

17 The functions f and g are defined as

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

(a) Find fg(3)

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

$= (3-10)^2 + 6$ 1

$= 55$ 1

55

(2)

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

$(x-10)^2 + 6 = x^2 + 6$ 1

1 $x^2 - 20x + 100 + 6 = x^2 + 6$

$-20x + 106 = 6$

$100 = 20x$

$x = 5$ 1

5

(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

0 1

(1)

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

Let $h(x)$ be y

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

1 $yx = 2x - 4$ — make x the subject

$yx - 2x = -4$

$x(y-2) = -4$ 1

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

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

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

(3)

(Total for Question 17 is 9 marks)

18 Solve the equation

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

Show clear algebraic working.

$$\frac{5(x^2+2x) + 3(x+2)}{(x+2)(x^2+2x)} = 2 \quad (1)$$

$$5(x^2+2x) + 3(x+2) = 2(x+2)(x^2+2x) \quad (1)$$

$$5x^2+10x+3x+6 = 2(x^3+2x^2+2x^2+4x)$$

$$5x^2+13x+6 = 2(x^3+4x^2+4x)$$

$$5x^2+13x+6 = 2x^3+8x^2+8x$$

$$2x^3+8x^2-5x^2+8x-13x-6 = 0$$

$$2x^3+3x^2-5x-6 = 0 \quad (1)$$

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

$$x = -1, 1.5, -2$$

Since $x+2 \neq 0$, x is equal to -1 and 1.5 (1)

ALTERNATIVE METHOD:

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

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

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

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

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

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

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

$$x = -1 \text{ and } 1.5$$

-1 and 1.5

(Total for Question 18 is 5 marks)

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.

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

$= (2^3)^2 \times (4^6)^{\frac{1}{3}}$

$= 2^6 \times 4^2$ (1)

$= 2^6 \times (2^2)^2$

$= 2^6 \times 2^4$ (1)

$= 2^{(6+4)}$

$= 2^{10}$ (1)

2^{10}
(3)

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

(b) find the value of n.

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

$\frac{1}{n^{\frac{4}{5}}} = \frac{1}{16}$ (1)

$16 = n^{\frac{4}{5}}$

$16^{\frac{5}{4}} = n$ (2)

$n = 32$ (1)

$n =$ 32
(4)

(Total for Question 19 is 7 marks)

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

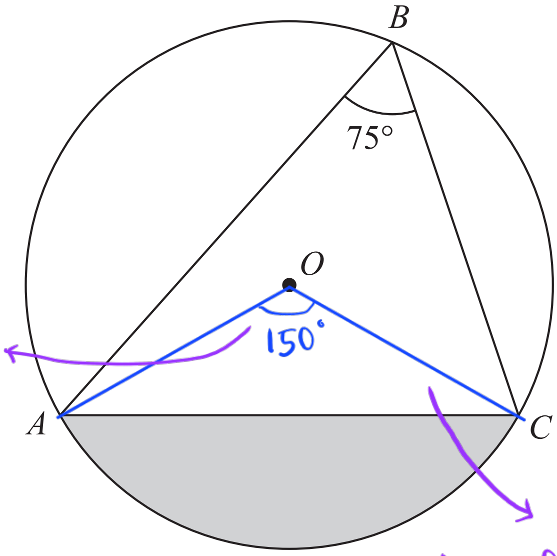


Diagram **NOT** accurately drawn

Angle at Centre is twice the angle at circumference

$75 \times 2 = 150°$ (1)

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

Angle $ABC = 75°$

The area of the shaded segment is 200 cm^2

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

(1) $\frac{150°}{360°} \times \pi r^2 = \frac{1}{2} r^2 \sin 150° + 200$ (1)

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

$= \frac{1}{4} r^2 + 200$

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

$(1.0589\ldots) r^2 = 200$

$r^2 = \frac{200}{1.0589\ldots}$

$= 188.85\ldots$

$r = \sqrt{188.85\ldots}$

$r = 13.7$ (3sf)

13.7 (1) .... cm

(Total for Question 20 is 5 marks)

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.

blue = $n-6$

red = 6

Probability same colour: $P(RR) + P(BB)$

Probability both is red = $P(RR) = \frac{6}{n} \times \frac{5}{n-1}$ (1)

$= \frac{30}{n(n-1)}$

Probability both is blue = $P(BB) = \frac{n-6}{n} \times \frac{(n-6-1)}{(n-1)}$

$= \frac{(n-6)(n-7)}{n(n-1)}$ (1)

$= \frac{n^2-13n+42}{n(n-1)}$

Probability same colour: $P(RR) + P(BB)$

$\frac{9}{17} = \frac{30}{n(n-1)} + \frac{n^2-13n+42}{n(n-1)}$ (1)

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

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

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

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

$$0 = 2n^2 - 53n + 306 \quad (1)$$

$$(2n-17)(n-18) = 0 \quad (1)$$

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

Since n must be an integer, our n must be 18.

$n =$ 18 (1)

(Total for Question 21 is 6 marks)

Turn over for Question 22

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

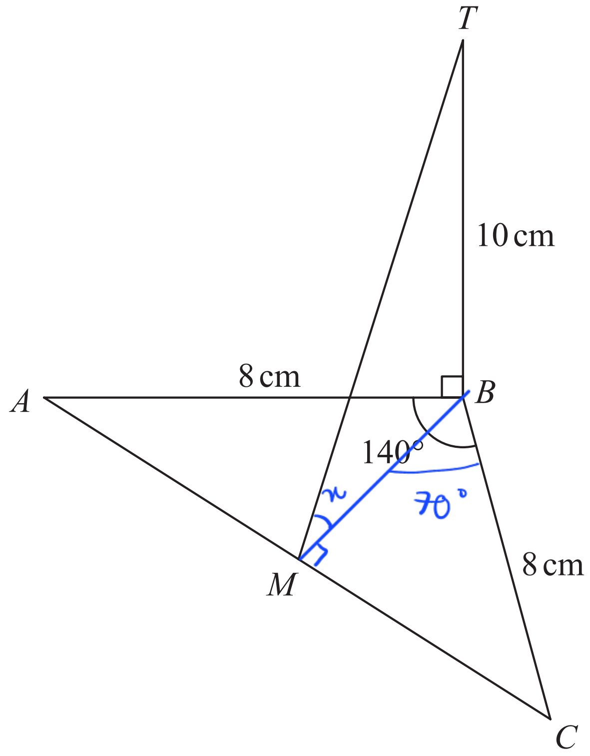
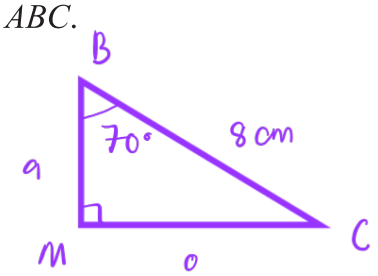


Diagram **NOT** accurately drawn

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

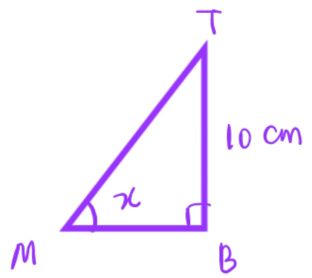
Calculate the size of the angle between *MT* and the horizontal plane *ABC*.
Give your answer correct to one decimal place.



$\cos 70° = \dfrac{MB}{8}$ (1)

$MB = 8 \cos 70°$

$= 2.73616..$ (1)



$\tan x = \dfrac{10}{2.73616...}$ (1)

$= 3.6547...$

$x = \tan^{-1}(3.6547...)$

$= 74.7°$ (1dp) (1)

74.7 °

(Total for Question 22 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS

BLANK PAGE