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1 Show that  $1\frac{2}{3} + 2\frac{3}{4} = 4\frac{5}{12}$

(Total for Question 1 is 3 marks)



2 There are 60 children in a club.

In the club, the ratio of the number of girls to the number of boys is 3 : 1

$\frac{3}{5}$  of the girls play a musical instrument.

$\frac{4}{5}$  of the boys play a musical instrument.

What fraction of the 60 children play a musical instrument?

(Total for Question 2 is 4 marks)

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3

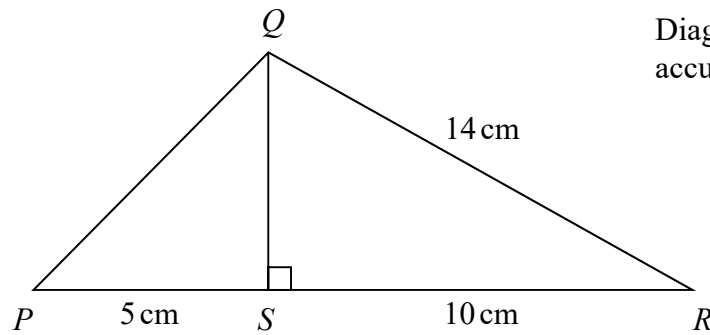


Diagram **NOT**  
accurately drawn

In triangle  $PQR$ ,

$S$  is the point on  $PR$  such that angle  $RSQ = 90^\circ$

$RQ = 14\text{ cm}$

$RS = 10\text{ cm}$

$SP = 5\text{ cm}$

Work out the length of  $PQ$ .

..... cm

(Total for Question 3 is 4 marks)



4  $a$ ,  $a$ ,  $b$  and 40 are four numbers.

$a$  is the least number.

40 is the greatest number.

The range of the four numbers is 14

The median of the four numbers is 30

Work out the value of  $a$  and the value of  $b$ .

$a =$  .....

$b =$  .....

(Total for Question 4 is 3 marks)

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- 5 The Shanghai Maglev Train takes 8 minutes to travel a distance of 30.5 kilometres.

Work out the average speed of the train.  
Give your answer in kilometres per hour.

..... kilometres per hour

**(Total for Question 5 is 3 marks)**



- 6 The diagram shows the triangle  $PQR$ .

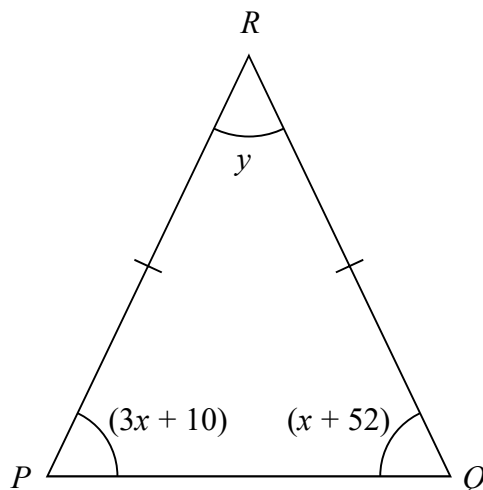


Diagram **NOT**  
accurately drawn

In the diagram, all the angles are in degrees.

$$RP = RQ$$

Find the value of  $y$ .

Show clear algebraic working.

$y = \dots\dots\dots$

(Total for Question 6 is 4 marks)

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- 7 The diagram shows two water towers in Kuwait.

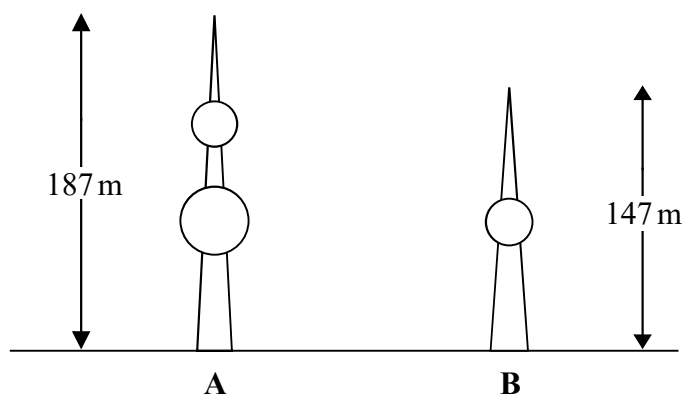


Diagram **NOT**  
accurately drawn

The real height of tower **A** is 187 m.

The real height of tower **B** is 147 m.

Ahmed makes a scale model of both towers.

The height of tower **A** on the scale model is 90 cm.

Work out the height of tower **B** on the scale model.

Give your answer correct to the nearest centimetre.

..... cm

(Total for Question 7 is 3 marks)



8 Solve the simultaneous equations

$$4x + 2y = 9$$

$$x - 4y = 9$$

Show clear algebraic working.

$$x = \dots\dots\dots$$

$$y = \dots\dots\dots$$

(Total for Question 8 is 3 marks)

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9  $N = 480 \times 10^9$

- (a) Write  $N$  as a number in standard form.

.....  
(1)

- (b) Write  $N$  as a product of powers of its prime factors.  
Show your working clearly.

.....  
(3)

- (c) Find the largest factor of  $N$  that is an odd number.

.....  
(1)

(Total for Question 9 is 5 marks)



- 10 The shape, shown shaded in the diagram, is the region between two semicircles.

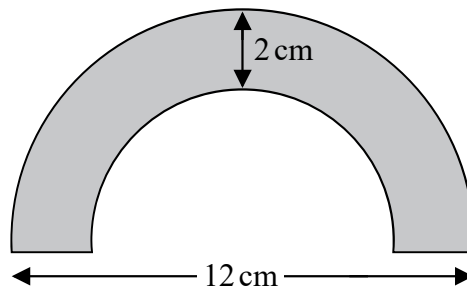


Diagram **NOT**  
accurately drawn

The diameter of the outer semicircle is 12 cm.  
The shape has constant thickness 2 cm.

Calculate the area of the shape.  
Give your answer as a multiple of  $\pi$ .

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

(Total for Question 10 is 3 marks)

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- 11 There are 12 boys and 8 girls in a class.  
The boys and the girls have some coins.

The mean number of coins that the boys have is 5.5  
The girls have a total of 18 coins.

Work out the mean number of coins the 20 children have.

(Total for Question 11 is 3 marks)



12 Here are the first four terms of a sequence of fractions.

$$\frac{1}{1} \quad \frac{2}{3} \quad \frac{3}{5} \quad \frac{4}{7}$$

The numerators of the fractions form the sequence of whole numbers 1 2 3 4 ...

The denominators of the fractions form the sequence of odd numbers 1 3 5 7 ...

(a) Write down an expression, in terms of  $n$ , for the  $n$ th term of this sequence of fractions.

(2)

(b) Using algebra, prove that when the square of any odd number is divided by 4 the remainder is 1

(3)

(Total for Question 12 is 5 marks)

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13 A curve **C** has equation  $y = x^3 - x^2 - 8x + 12$

(a) Find  $\frac{dy}{dx}$

$$\frac{dy}{dx} = \dots\dots\dots (2)$$

The curve **C** has two turning points.

(b) Work out the  $x$  coordinates of the two turning points.  
Show your working clearly.

$$\dots\dots\dots (3)$$

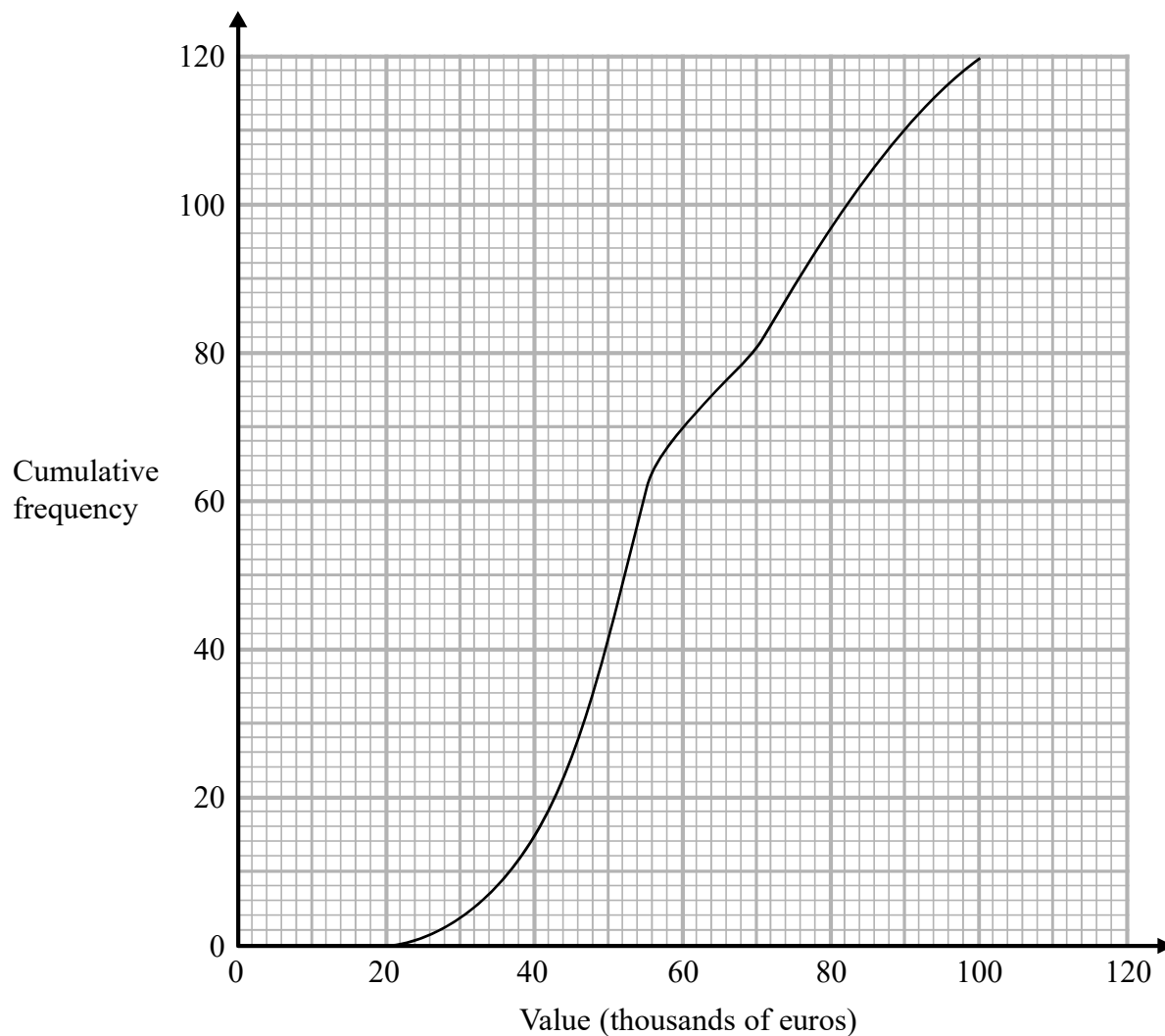
(c) Show that the  $x$ -axis is a tangent to the curve **C**.

(2)

(Total for Question 13 is 7 marks)



- 14 The cumulative frequency diagram gives information about the values, in thousands of euros, of 120 apartments in 2015



- (a) Find an estimate for the number of these apartments with a value of 80 thousand euros or less in 2015

.....  
(1)

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The table gives information about the values, in thousands of euros, of the same 120 apartments in 2018

Value in thousands of euros ( $v$ )	Cumulative frequency
$0 < v \leq 20$	0
$0 < v \leq 40$	15
$0 < v \leq 60$	44
$0 < v \leq 80$	85
$0 < v \leq 100$	102
$0 < v \leq 120$	120

- (b) On the grid opposite, draw a cumulative frequency diagram for this information. (2)
- (c) Find an estimate for the increase in the median value for these apartments from 2015 to 2018

.....thousand euros  
(2)

(Total for Question 14 is 5 marks)



15 (a) Simplify  $(3x^2y^5)^4$

.....  
(2)

(b) Expand and simplify  $4n(n - 3)(n + 5)$

.....  
(2)

(c) Factorise  $4c^2 - 9d^2$

.....  
(1)

(d) Simplify fully  $\frac{x^2 - 7x + 12}{4x - x^2}$

.....  
(3)

(Total for Question 15 is 8 marks)



16 There are 12 beads in a bag.

7 of the beads are red.

3 of the beads are green.

2 of the beads are yellow.

Lucy takes at random a bead from the bag and keeps it.

Then Julian takes at random a bead from the bag.

(a) Work out the probability that they each take a yellow bead.

.....  
(2)

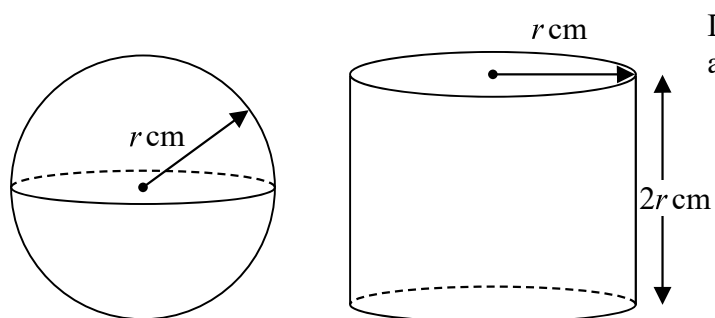
(b) Work out the probability that the beads they take are **not** the same colour.

.....  
(3)

(Total for Question 16 is 5 marks)



17 Here are a solid sphere and a solid cylinder.



The radius of the sphere is  $r \text{ cm}$ .

The radius of the cylinder is  $r \text{ cm}$ .

The height of the cylinder is  $2r \text{ cm}$ .

The total surface area of the cylinder is  $k\pi \text{ cm}^2$

(a) Find an expression for  $k$  in terms of  $r$ .

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(2)



(b) Show that the ratio

total surface area of the cylinder : total surface area of the sphere

is the same as the ratio

volume of the cylinder : volume of the sphere

(3)

(Total for Question 17 is 5 marks)

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- 18 Show that  $\frac{\sqrt{8}}{\sqrt{8}-2}$  can be written in the form  $n + \sqrt{n}$ , where  $n$  is an integer.

Show your working clearly.

(Total for Question 18 is 3 marks)



19

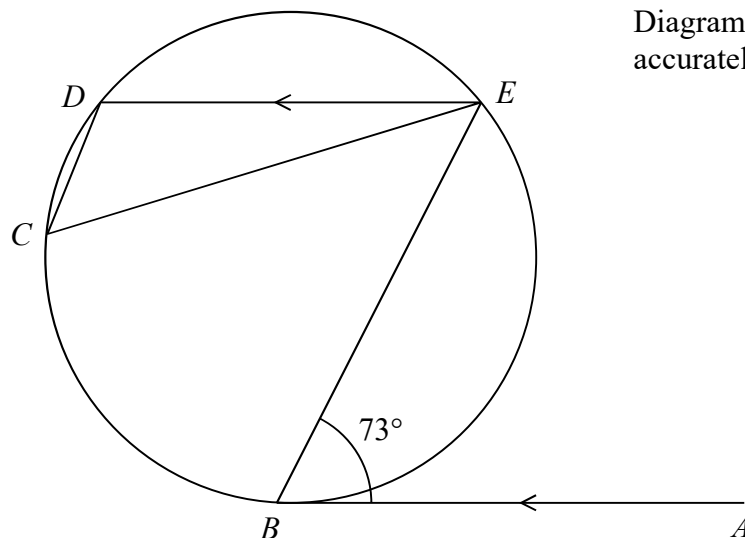


Diagram **NOT**  
accurately drawn

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$B$ ,  $C$ ,  $D$  and  $E$  are points on a circle.

$AB$  is the tangent at  $B$  to the circle.

$AB$  is parallel to  $ED$ .

Angle  $ABE = 73^\circ$

Work out the size of angle  $DCE$ .

Give a reason for each stage of your working.

(Total for Question 19 is 5 marks)



20 Here is a cube  $ABCDEFGH$ .

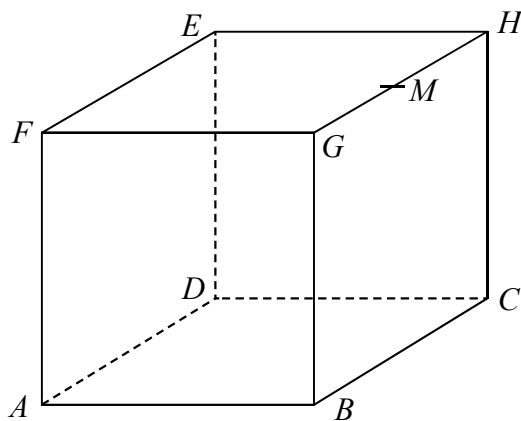


Diagram **NOT**  
accurately drawn

$M$  is the midpoint of the edge  $GH$ .

Find the size of the angle between the line  $MA$  and the plane  $ABCD$ .  
Give your answer correct to 1 decimal place.

(Total for Question 20 is 4 marks)



21 Here is a triangle  $XYZ$ .

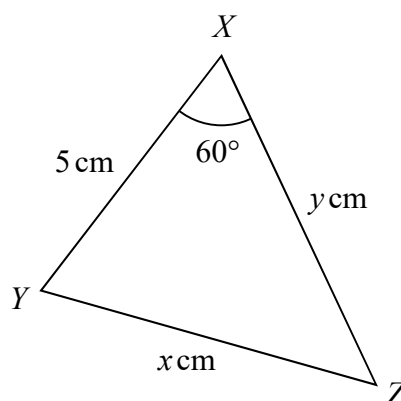


Diagram **NOT**  
accurately drawn

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The perimeter of the triangle is  $k\text{ cm}$ .

Given that  $x = y - 1$

find the value of  $k$ .

Show your working clearly.

$k = \dots\dots\dots$

(Total for Question 21 is 5 marks)



22  $ABCDEF$  is a regular hexagon.

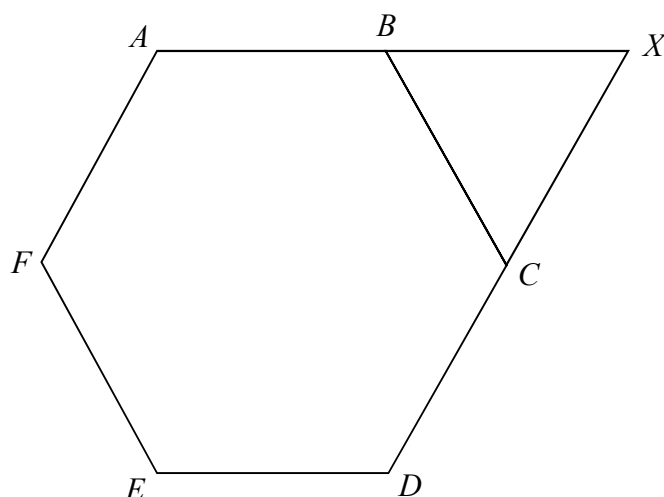


Diagram **NOT**  
accurately drawn

$ABX$  and  $DCX$  are straight lines.

$$\vec{AB} = \mathbf{a} \quad \vec{BC} = \mathbf{b}$$

Find  $\vec{EX}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

Give your answer in its simplest form.

(Total for Question 22 is 4 marks)



23 The function  $f$  is defined as  $f(x) = \frac{\sqrt{x^2 + k^2}}{x}$  for  $x > 0$  and where  $k$  is a positive number.

(a) Find the value of  $p$  for which  $f^{-1}(p) = k$

$$p = \dots\dots\dots (3)$$

The function  $g$  is defined as  $g(x) = x^2$  for  $x > 0$

(b) Given that  $gf(a) = k$  for  $k > 1$   
find an expression for  $a$  in terms of  $k$ .

$$a = \dots\dots\dots (3)$$

(Total for Question 23 is 6 marks)

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