Write your name here

Surname		Other names

Pearson Edexcel
International GCSE

Centre Number

Candidate Number

Mathematics A
Level 1/2
Paper 2H

Higher Tier

Thursday 7 June 2018 – Morning
Time: 2 hours

Paper Reference
4MA1/2H

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 ▶

Pearson

International GCSE Mathematics

Formulae sheet – Higher Tier

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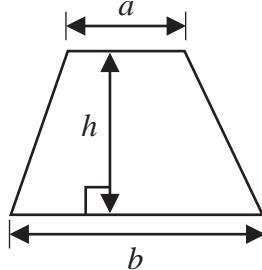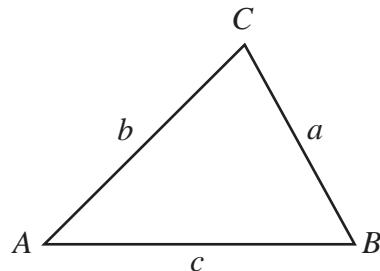
Sum to n terms, $S_n = \dfrac{n}{2}\,[2a + (n-1)d]$

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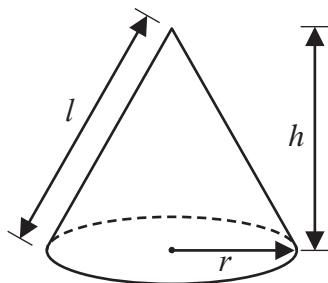
Sine Rule $\quad \dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Cosine Rule $\quad a^2 = b^2 + c^2 - 2bc\cos A$
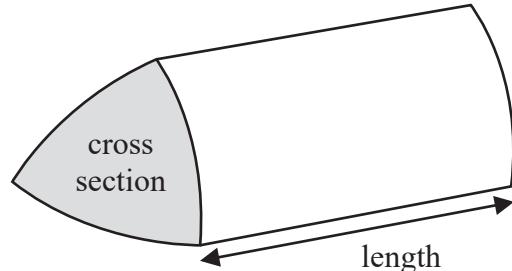
Area of triangle $= \dfrac{1}{2}ab\sin C$

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

Curved surface area of cone $= \pi r l$
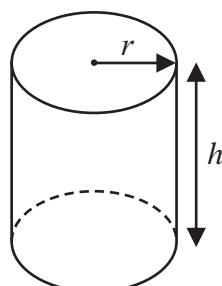
Volume of prism
= area of cross section × length

Volume of cylinder $= \pi r^2 h$
**Curved surface area
of cylinder** $= 2\pi r h$
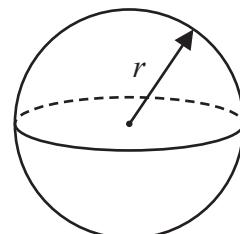
Volume of sphere $= \dfrac{4}{3}\pi r^3$

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

Answer ALL TWENTY THREE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Make *a* the subject of the formula $M = ac - bd$

$$M + bd = ac \qquad \text{+bd to both sides so that only the term containing 'a' is on the right hand side}$$

$$\div c \quad \frac{M + bd}{c} = a \quad \div c$$

$$a = \frac{M + bd}{c}$$

(2)

(b) Solve the inequality $5x - 4 < 39$

$$+4 \quad 5x - 4 < 39 \quad +4$$

$$5x < 43$$

$$\div 5 \quad x < \frac{43}{5} \quad \div 5$$

$\frac{43}{5}$ as a mixed number $\Rightarrow \frac{43}{5} = \frac{40}{5} + \frac{(43-40)}{5}$

$$= 8 + \frac{3}{5} = 8\frac{3}{5}$$

hence $x < 8\frac{3}{5}$

$$x < 8\frac{3}{5}$$

(2)

(c) Factorise fully $18e^2f^3 - 12e^3f$

$$18e^2f^3 - 12e^3f$$

take out the common factor $= (3 \times 6 \times e \times e \times f \times f \times f) - (2 \times 6 \times e \times e \times e \times f)$

$= 6e^2f (3 \times f \times f - 2 \times e)$

$= 6e^2f$ $= 6e^2f (3f^2 - 2e)$

$$6e^2f (3f^2 - 2e)$$

(2)

(Total for Question 1 is 6 marks)

P 5 4 6 9 5 A 0 3 2 4

2 Work out the difference between the largest share and the smallest share when 3450 yen is divided in the ratios $2:6:7$

$2:6:7 \Rightarrow 2+6+7 = 15$ 'parts' of ratio

$\dfrac{3450 \text{ yen}}{15} = 230$ yen per 'part'

Largest share $= 7 \times 230 = 1610$ yen

Smallest share $= 2 \times 230 = 460$ yen

Difference = largest share – smallest value

$= 1610 - 460$

$= 1150$ yen.

.................1150................. yen

(Total for Question 2 is 3 marks)

3 Gopal is paid 20 000 rupees each month.
Jamuna is paid 19 200 rupees each month.

Gopal and Jamuna are both given an increase in their monthly pay.
After the increase, they are both paid the same amount each month.

Gopal was given an increase of 8%

Work out the percentage increase that Jamuna was given.

Gopal

$100\% + 8\% = 108\%$

$\uparrow$ Original Salary $\uparrow$ increase

multiplier $= \dfrac{108}{100} = 1.08$

Gopal's new salary $= 20000 \times 1.08 = 21600$ rupees

Jamuna :-

Percentage increase $= \dfrac{\text{New Salary} - \text{Original salary}}{\text{Original salary}} \times 100$

Jamuna's new salary $= 21600$ rupees

percentage increase $= \dfrac{21600 - 19200}{19200} \times 100$

$= \dfrac{2400}{19200} \times 100 = 12.5\%.$

.................12.5................. %

(Total for Question 3 is 4 marks)

4 Show that $3\frac{4}{7} - 1\frac{5}{8} = 1\frac{53}{56}$

$3\frac{4}{7} = \frac{21}{7} + \frac{4}{7} = \frac{25}{7} \longrightarrow \frac{200}{56}$

$1\frac{5}{8} = \frac{8}{8} + \frac{5}{8} = \frac{13}{8} \longrightarrow \frac{91}{56}$

LCM of 7 & 8 is 56

write over 56

hence $3\frac{4}{7} - 1\frac{5}{8} = \frac{200}{56} - \frac{91}{56} = \frac{109}{56}$

Answer as a mixed

number $\Rightarrow \frac{109}{56} = \frac{56}{56} + \frac{(109-56)}{56}$

$= 1 + \frac{53}{56} = 1\frac{53}{56}$

(Total for Question 4 is 3 marks)

Turn over ▶

5 In the diagram below, *P* and *Q* are points on a circle with centre *O*.
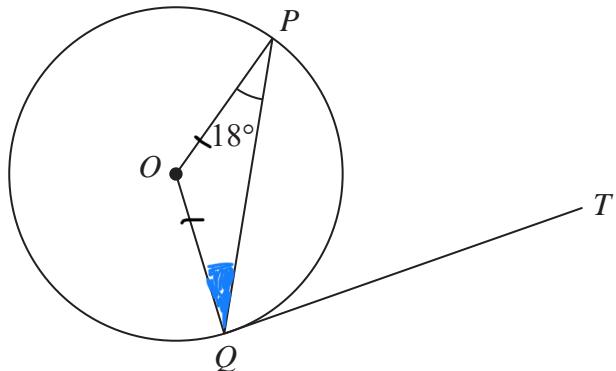
Diagram **NOT** accurately drawn

QT is a tangent to the circle.
Angle *OPQ* = 18°

Work out the size of angle *PQT*.
Give a reason for each stage of your working.

Triangle opq is isosceles because op and OQ are both radii of the circle, so are the same length

$P\hat{Q}O = 18°$
(because base angles in an isosceles triangle are equal)
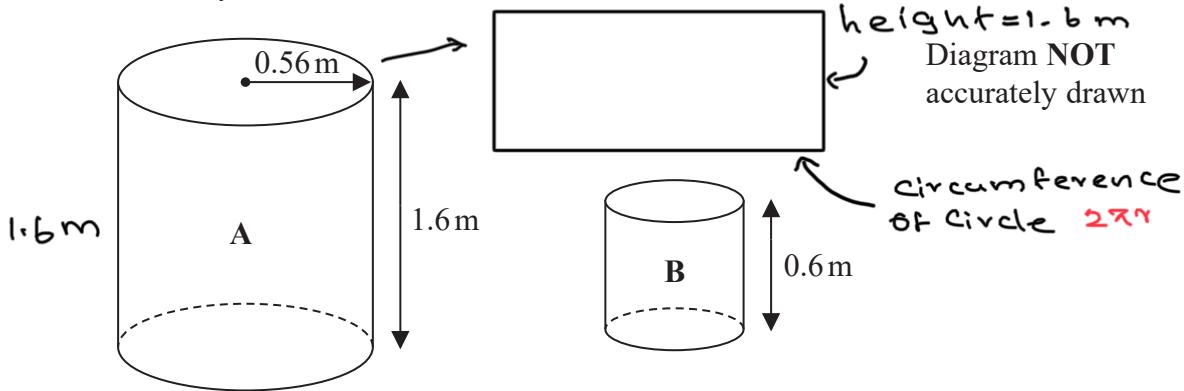
$P\hat{Q}T = 90 - 18 = 72°$
↑ because the angle between a tangent and radius is 90°

72 °

(Total for Question 5 is 3 marks)

P 5 4 6 9 5 A 0 6 2 4

6 The diagram shows two cylinders, **A** and **B**.

Curved Surface:

0.56 m

height = 1.6 m

Diagram **NOT** accurately drawn

1.6 m

A

1.6 m

B

0.6 m

circumference of circle $2\pi r$

Cylinder **A** has height 1.6 m and radius 0.56 m.

(a) Work out the curved surface area of cylinder **A**.
    Give your answer in m² correct to 3 significant figures.

Circumference $= 2 \times \pi \times 0.56$
$= 3.518583772$

area of curved Surface
$= 3.518583772 \times 1.6$
$= 5.629734035$ (round up to 5.63 to 3sf as 9 > 5)
$= 5.63$ m³

Area of rectangle
$A = l \times b$

......5.63...... m²

(2)

Cylinder **B** is mathematically similar to cylinder **A**.
The height of cylinder **B** is 0.6 m.

(b) Work out the radius of cylinder **B**.

Scale factor $= \dfrac{B}{A} \Rightarrow$ height $= \dfrac{0.6}{1.6} = \dfrac{3}{8}$

So the lengths of B are $\frac{3}{8}$ the size of the corresponding lengths of A

← radius of A

radius of B $= \frac{3}{8} \times 0.56 = 0.21$ m

......0.21...... m

(2)

(Total for Question 6 is 4 marks)

P 5 4 6 9 5 A 0 7 2 4

Turn over ▶

7 The students in Class A and in Class B take the same examination.

There are 28 students in Class A and 32 students in Class B.
The mean score for all the students in both classes is 72.6
The mean score for the students in Class A is 75

(a) Work out the mean score for the students in Class B.

mean score for $=\dfrac{\text{Sum of all scores}}{\text{total number of students}}$
all students

$\times(28+32)$ $\dfrac{\text{Sum of all scores}}{28+32} = 72.6$ $\Big)$ $\times(28+32)$

$\searrow$ Sum of all Scores $= 72.6 \times (28+32)$
$= 72.6 \times 60 = 4356$

<ins>Class A</ins>

mean $\Rightarrow 75 = \dfrac{\text{Sum of Class A score}}{28}$ $\nearrow$ 28 students
in class A

$28 \times 75 = 2100 =$ Sum of Class A scores

<ins>class B</ins> Sum of class B scores

total $= 4356 - 2100 \leftarrow$ Sum of class A
Sum $= 2256.$

$\therefore$ mean $= \dfrac{2256}{32}$ $\nwarrow$ 32 students in

Class B

.... 70.5 ....

(4)

The lowest score in Class A is 39
The range of scores for Class A is 57
The lowest score in Class B is 33
The range of scores for Class B is 60

(b) Find the range of scores for all the students in both classes.

Highest Score in $=$ lowest score + range
Class A $= 39 + 57 = 96$

lowest score
Highest score in Class B $= 33 + 60 = 93$
range

Lowest overall Score $= 33$, Highest overall score $= 96$

Overall range $= 96 - 33$

.... 63 ....

(3)

(Total for Question 7 is 7 marks)

8

Diagram **NOT** accurately drawn

$52°$

A
12.6 cm

H
x cm

O
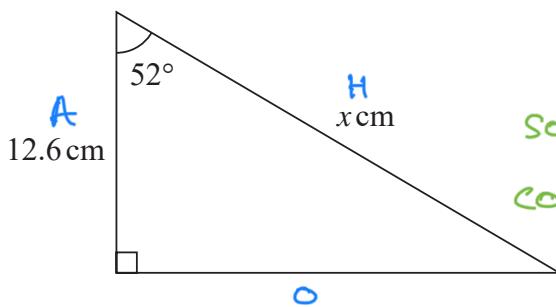
Solh CAH TOA

$\cos\theta = \dfrac{\text{adjacent}}{\text{hypotenuse}} = \dfrac{A}{H}$

Work out the value of x.
Give your answer correct to 3 significant figures.

$$\cos 52 = \frac{12.6}{x}$$

$\times x$ $\times x$

$$x \cos 52 = 12.6$$

$\div \cos 52$ $\div \cos 52$

$$x = \frac{12.6}{\cos 52}$$

$$x = 20.46579249 \approx 20.5 \ (3sf)$$

↳ round up to 20.5 as 6>5

$x =$ .... **20.5** ....

(Total for Question 8 is 3 marks)

9 Solve the simultaneous equations

so that both equations +/- 5y

1) $x + y = 15$ ——— ×5
2) $7x - 5y = 3$

Show clear algebraic working.

3) $5x + 5y = 75$

3) + 1): $5x + 5y = 75$
         $\underline{7x - 5y = 3}$
         $12x + 0 = 78 \Rightarrow 12x = 78$

$$x = \frac{78}{12} = 6.5$$

sub $x = 6.5$ into 1) $6.5 + y = 15$
             $y = 15 - 6.5$
             $y = 8.5$ → $x = 6.5$
                    $y = 8.5$

$x =$ .... **6.5** ....

$y =$ .... **8.5** ....

(Total for Question 9 is 3 marks)

Turn over ▶

10 $\dfrac{8}{2^7} = 2^n$

(a) Find the value of n.

$8 = 2 \times 2 \times 2 = 2^3$

$\dfrac{8}{2^7} = \dfrac{2^3}{2^7} = 2^{3-7} = 2^{-4}$ ← indices rule

$\dfrac{x^a}{x^b} = x^{a-b}$

$2^{-4} = 2^h$, so $n = -4$

they both have base 2, so put the indices equal to each other

$n = \underline{\quad -4 \quad}$

(2)

$(13^{-6})^4 \times 13^5 = 13^k$

(b) Find the value of k.

$(13^{-6})^4 = 13^{-24}$ ← $(x^a)^b = x^{ab}$

$(13^{-6})^4 \times 13^5 = 13^{-24} \times 13^5 = 13^{-24+5} = 13^{-19}$

$13^{-19} = 13^k \Rightarrow$ so $k = -19$

$k = \underline{\quad -19 \quad}$

(2)

(Total for Question 10 is 4 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

11 A solid metal sphere has radius 1.5 cm.
The mass of the sphere is 109.6 grams.

Work out the density of the sphere.
Give your answer correct to 3 significant figures.

volume of sphere = $\frac{4}{3} \times \pi \times 1.5^3 = \frac{9}{2} \pi$ cm³

$\frac{4}{3}\pi r^3$

density = $\frac{mass}{volume}$

density = $\frac{109.6g}{\frac{9}{2}\pi \text{ cm}^3}$ = 7.752674117 g/cm³

density = 7.75 g/cm³ (to 3 sf)

.... 7.75 .... g/cm³

(Total for Question 11 is 3 marks)

P 5 4 6 9 5 A 0 1 1 2 4

Turn over ▶

12
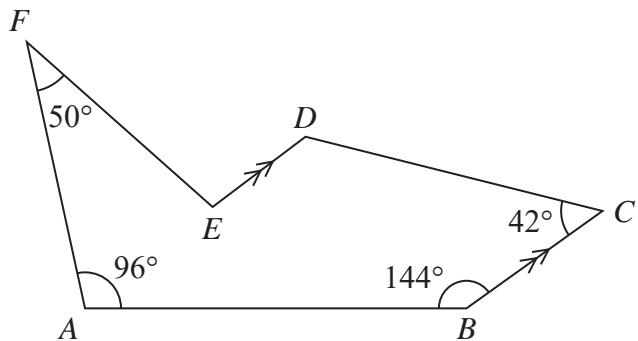
Diagram **NOT**
accurately drawn

The diagram shows a hexagon *ABCDEF*.
BC is parallel to *ED*.

Work out the size of the obtuse angle *DEF*.

$E\hat{D}C = 180 - 42 = 138°$
because co-interior angles add to 180°
Sum of interior angles = $(n-2) \times 180°$
for an n sided polygon
ABCDEF is a hexagon, so n=6
↳ sum of interior angles = $(6-2) \times 180°$
                         $= 4 \times 180$
                         $= 720°$

$D\hat{E}F$ (reflex) $= 720 - 50 - 96 - 144 - 42 - 138 = 250°$

$D\hat{E}F$ (obtuse) $= 360 - 250 = 110°$
because angles around a point
add to 360°

110 °

(Total for Question 12 is 5 marks)

13 Felix has 10 cards.
There are 5 red cards, 4 blue cards and 1 green card.
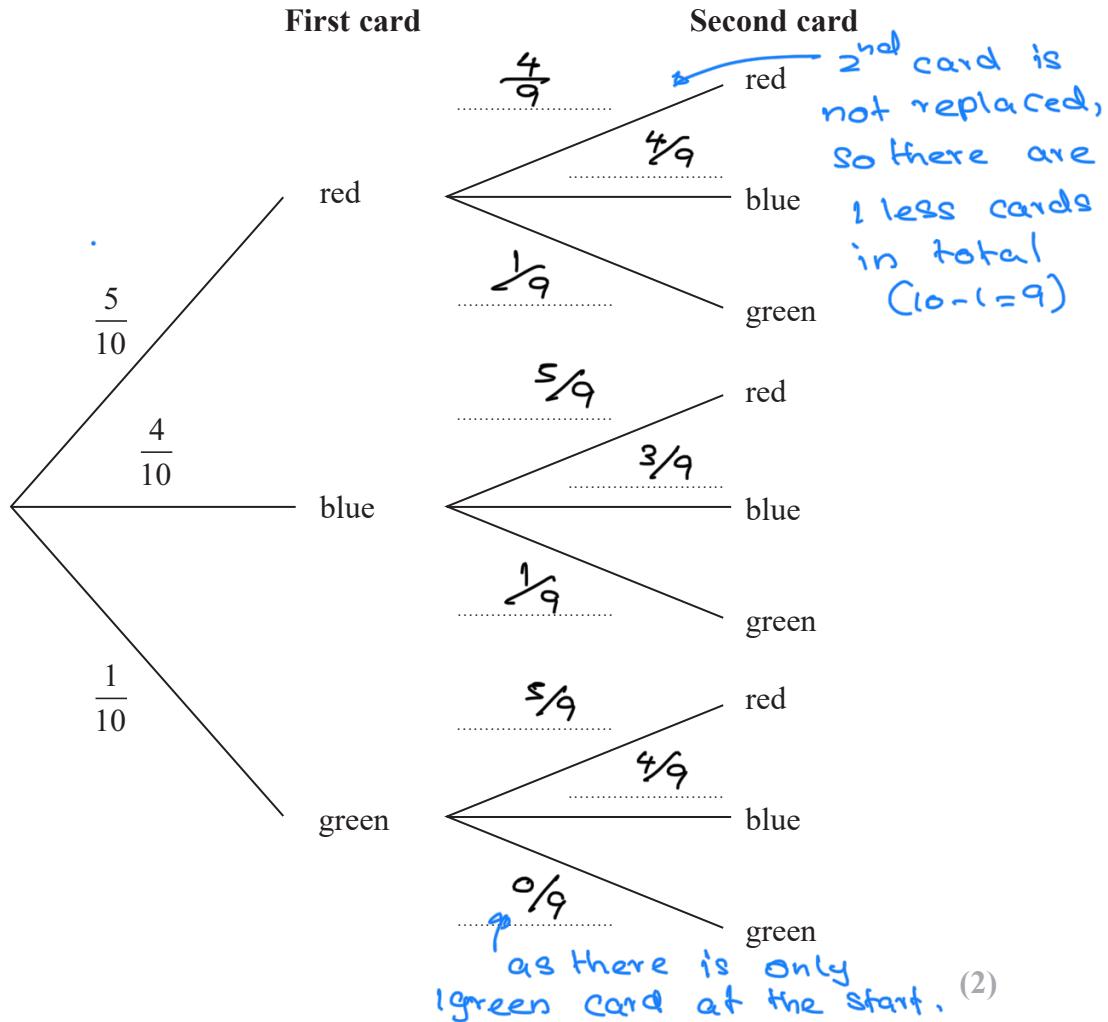
Felix takes at random one of the cards.
He does not replace the card.
Felix then takes at random a second card.

(a) Complete the probability tree diagram.

First card   **Second card**

$\frac{4}{9}$ red   2ⁿᵈ card is
not replaced,
so there are
1 less cards
in total
(10−1=9)

red

$\frac{4}{9}$ blue

$\frac{1}{9}$ green

$\frac{5}{10}$

$\frac{4}{10}$

blue

$\frac{5}{9}$ red

$\frac{3}{9}$ blue

$\frac{1}{9}$ green

$\frac{1}{10}$

green

$\frac{5}{9}$ red

$\frac{4}{9}$ blue

$\frac{0}{9}$ green   as there is only
1 green card at the start.

(2)

(b) Work out the probability that Felix takes at least one blue card and no green card.

possible combinations:-

red, blue $= \frac{5}{10} \times \frac{4}{9} = \frac{5 \times 4}{10 \times 9} = \frac{20}{90}$

blue, red $= \frac{4}{10} \times \frac{5}{9} = \frac{4 \times 5}{10 \times 9} = \frac{20}{90}$ ⎫
⎬ multiply along branches.
blue, blue $= \frac{4}{10} \times \frac{3}{9} = \frac{4 \times 3}{10 \times 9} = \frac{12}{90}$ ⎭

p(at least one blue, no green) $= \frac{20}{90} + \frac{20}{90} + \frac{12}{90}$
↳ p(r,b) or p(b,r) or p(b,b)
"or" rule add the probabilities.

$= \frac{52}{90}$

(3)

(Total for Question 13 is 5 marks)

P 5 4 6 9 5 A 0 1 3 2 4
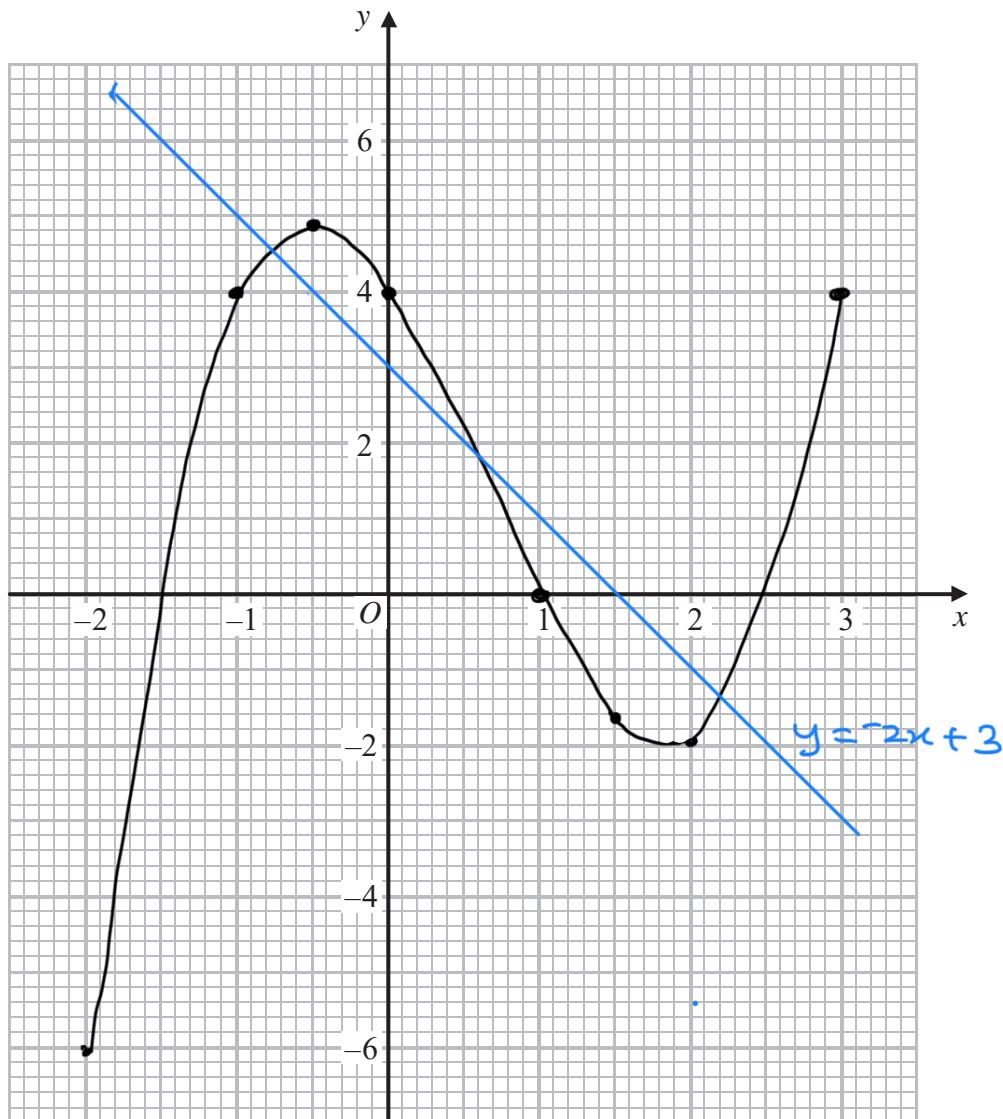
14 (a) Complete the table of values for $y = x^3 - 2x^2 - 3x + 4$

x	-2	-1	-0.5	0	1	1.5	2	3
y	-6	4	4.875	4	0	-1.625	-2	4

(2)

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

$= -8 - 8 + 6 + 4$

$= -6$

do same process

$y = (-1)^3 - 2(-1)^2 - 3(-1) + 4$

$= -1 - 2 + 3 + 4$

$= 4$

(b) On the grid, draw the graph of $y = x^3 - 2x^2 - 3x + 4$ for values of x from -2 to 3

$y = -2x + 3$

(2)

(c) By drawing a suitable straight line on the grid,
find estimates for the solutions of the equation $x^3 - 2x^2 - x + 1 = 0$
Give your solutions correct to 1 decimal place.

original graph $y = x^3 - 2x^2 - 3x + 4$

$x^3 - 2x^2 - x + 1 = 0$ (with annotations: $+2x$, -3)

So $x^3 - 2x^2 - 3x + 2x + 4 - 3 = 0$

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

So draw the graph of $y = -2x + 3$

y-intercept = 3

gradient = -2

Solutions are the x-coordinates of the points where the two lines intersect

$x = -0.8$, $x = 0.6$ and $x = 2.2$ -0.8, 0.6, 2.2
....

(4)

(Total for Question 14 is 8 marks)

15 $e = 8.31$ correct to 2 decimal places
              $f = 0.65$ correct to 2 decimal places

Work out the lower bound for the value of $e - f$
Show your working clearly.

lower bound of $e - f$ = lower bound of e - upper bound of f

bounds $\Rightarrow$ $8.305 \leq e < 8.315$ } to 2dp, so bounds
              $0.645 \leq f < 0.655$ } are ± 0.005 from
                                                          value

Lower bound of $e - f = 8.305 - 0.655$
                                = 7.65
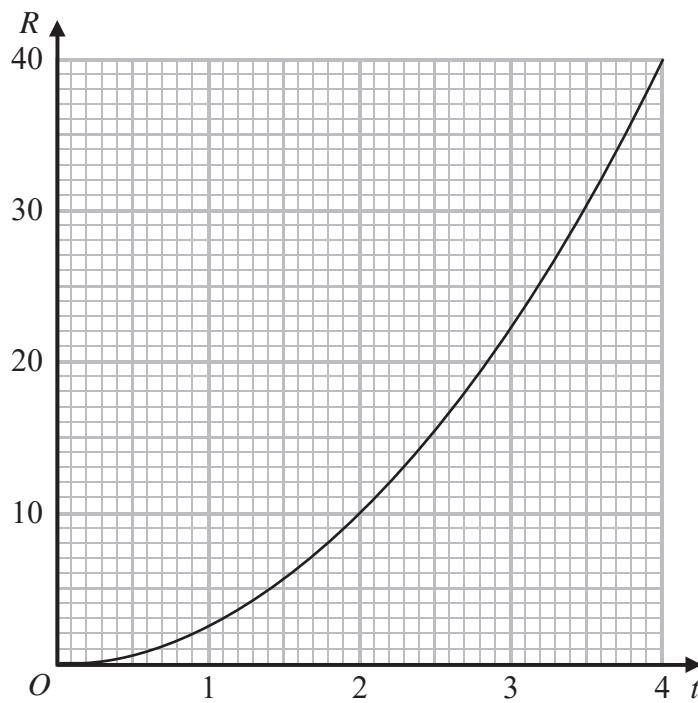
7.65
....

(Total for Question 15 is 2 marks)

Turn over ▶

16 R is proportional to t^2

The graph shows the relationship between R and t for $0 \leqslant t \leqslant 4$

(a) Find a formula for R in terms of t.

$R \propto t^2$, so $R = kt^2$

from graph $\Rightarrow$ when $t = 2$, $R = 10$

$10 = k \times 2^2$ ← sub into $R = kt^2$

$\div 4 \Big(\begin{array}{c} 10 = 4k \\ \frac{5}{2} = k \end{array} \Big) \div 4$

So $R = \frac{5}{2} t^2$

$R = \frac{5}{2} t^2$

(3)

Given also that $R = \dfrac{8}{5x}$

(b) show that t is inversely proportional to $\sqrt{x}$ for $t > 0$

$R = \dfrac{8}{5x}$ and $R = \dfrac{5t^2}{2}$

$\dfrac{8}{5x} \times \dfrac{5t^2}{2}$

cross multiply

$8 \times 2 = 5x \times 5t^2$

$16 = 25x \times t^2$

$\div 25x$ $\quad \dfrac{16}{25x} = t^2$ $\div 25x$

$\dfrac{\sqrt{16}}{\sqrt{25x}} = t \implies t = \dfrac{4}{5\sqrt{x}}$

Inversely proportional: $t \propto \dfrac{1}{\sqrt{x}}$, so $t = \dfrac{c}{\sqrt{x}}$

c is the constant of proportionality

$c = \dfrac{4}{5}$, hence t is inversely proportional to $\sqrt{x}$

(2)

(Total for Question 16 is 5 marks)

17 $y = x^3 - 2x^2 - 15x + 5$

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

$y = x^3 - 2x^2 - 15x + 5$ ← differentiate by multiplying by the original power, and then decreasing magnitude of original power by 1

$\dfrac{dy}{dx} = 3x^{3-1} - 2(2x^{2-1}) - 15x^{1-1}$

$x^0 = 1$

$\dfrac{dy}{dx} = 3x^2 - 4x - 15$

$\dfrac{dy}{dx} = \underline{3x^2 - 4x - 15}$

(2)

C is the curve with equation $y = x^3 - 2x^2 - 15x + 5$

(b) Work out the range of values of x for which **C** has a negative gradient.

$\dfrac{dy}{dx}$ is the gradient so for a negative gradient $\dfrac{dy}{dx} < 0$

$3x^2 - 4x - 15 < 0$

$3 \times 15 = 45$ Factors of 45: 1, 3, <u>5</u>, <u>9</u> 15 45

$3x^2 + 5x - 9x - 15 = 0$

$x(3x+5) - 3(3x+5) = 0$
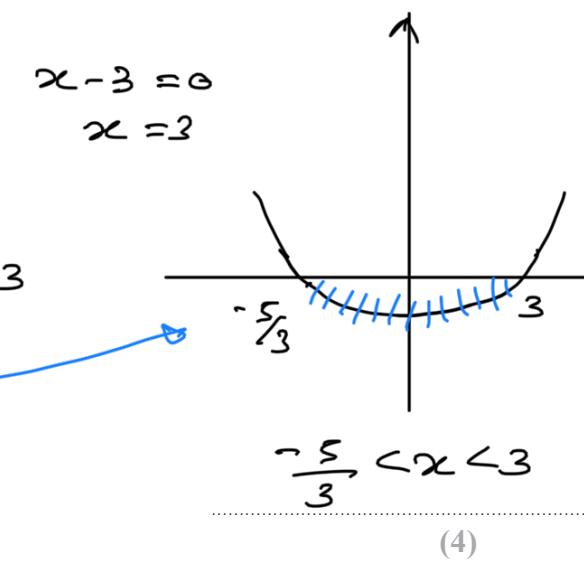
$(3x+5)(x-3) = 0$

roots of equation $\Rightarrow$ $3x + 5 = 0$ or $x - 3 = 0$
                                           $x = \dfrac{-5}{3}$ $x = 3$

So for $\dfrac{dy}{dx} < 0$, $\dfrac{-5}{3} < x < 3$

$3x^2 - 4x - 15 < 0$, So want region of the graph that is below the x-axis

$\underline{\dfrac{-5}{3} < x < 3}$

(4)
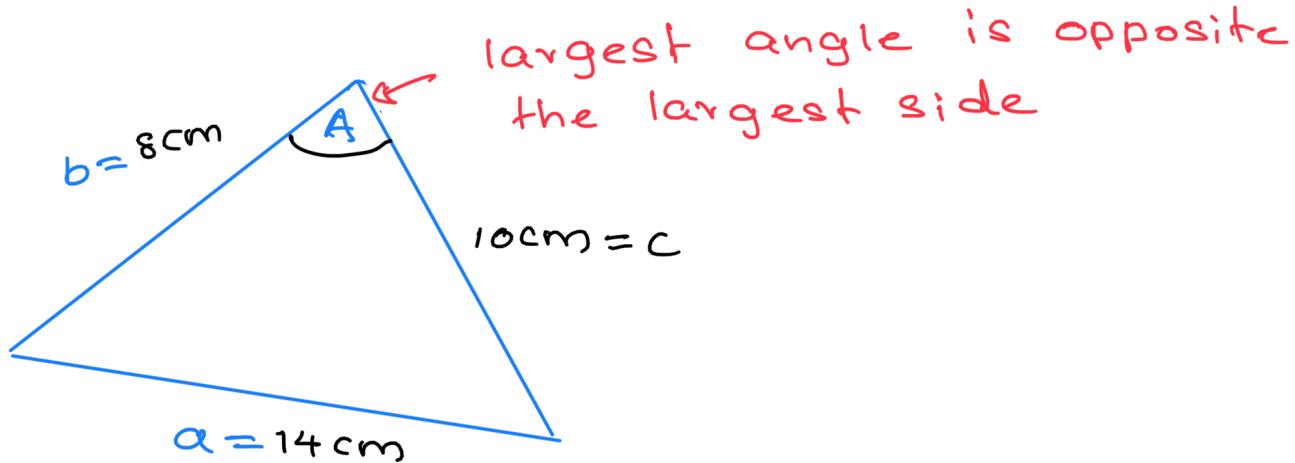
(Total for Question 17 is 6 marks)

P 5 4 6 9 5 A 0 1 8 2 4

18 A triangle has sides of length $8\,cm$, $10\,cm$ and $14\,cm$.

Work out the size of the largest angle of the triangle.
Give your answer correct to 1 decimal place.

largest angle is opposite
the largest side

$b = 8cm$

A

$10cm = c$

$a = 14\,cm$

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

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

$$\cos A = \frac{10^2 + 8^2 - 14^2}{2 \times 8 \times 10} = \frac{-32}{160} = -\frac{1}{5}$$

$$A = \cos^{-1}\left(-\frac{1}{5}\right) = 101.536959° = 101.5° \text{ (1dp)}$$

.... 101.5 °

(Total for Question 18 is 3 marks)

Turn over ▶

19 The diagram shows a triangular prism.
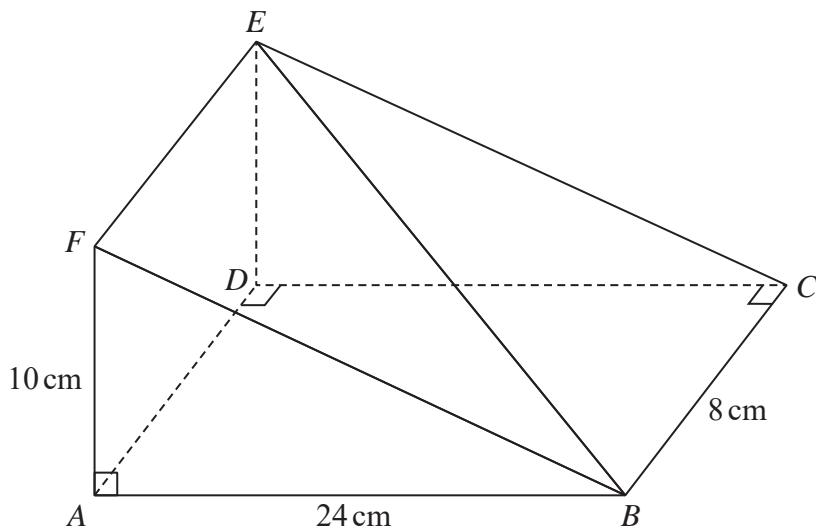
Diagram **NOT** accurately drawn

$AF = 10$ cm, $AB = 24$ cm and $BC = 8$ cm.
Angle FAB = angle ADC = angle BCD = 90°
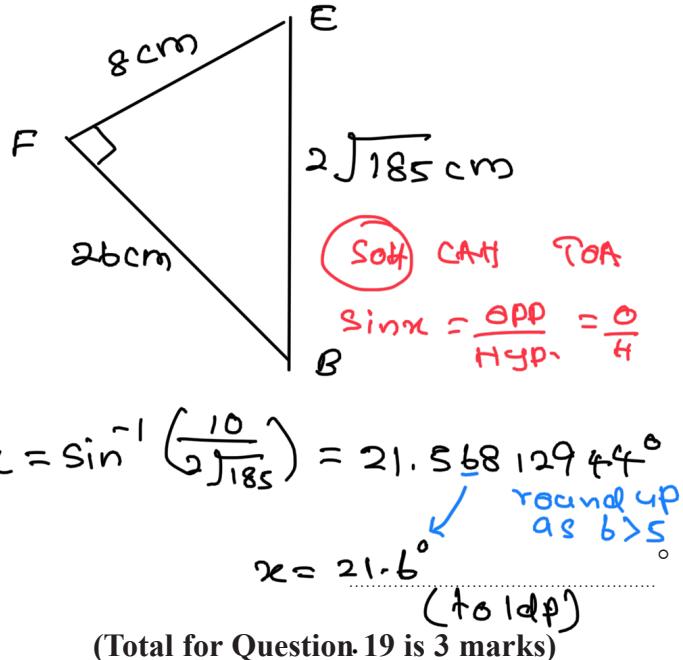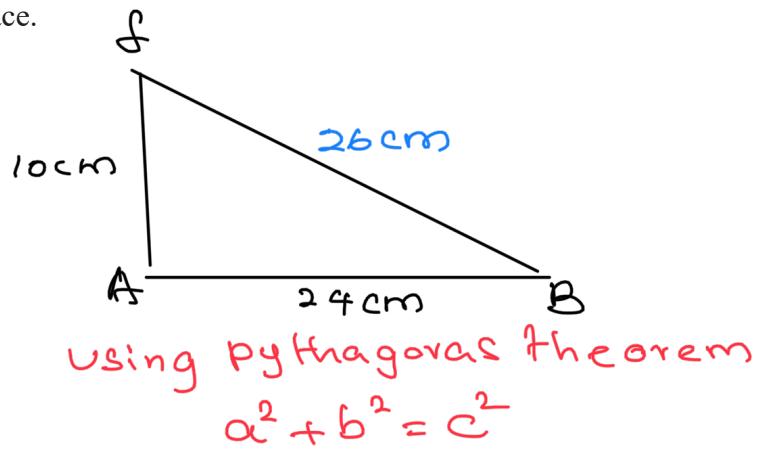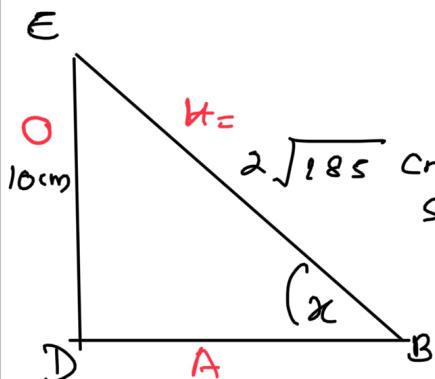
Work out the size of the angle between the line BE and the plane $ABCD$.
Give your answer correct to 1 decimal place.

$$BF^2 = 10^2 + 24^2$$
$$= 100 + 576$$
$$= 676$$
$$BF = \sqrt{676} = 26 \text{ cm}$$
$$BE^2 = 8^2 + 26^2$$
$$= 64 + 676$$
$$= 740$$
$$BE = \sqrt{740} = 2\sqrt{185} \text{ cm}$$

Using Pythagoras theorem
$$a^2 + b^2 = c^2$$

SOH CAH TOA
$$\sin x = \frac{OPP}{HYP} = \frac{O}{H}$$

$$H = 2\sqrt{185} \text{ cm}$$
$$\sin x = \frac{10}{2\sqrt{185}}, \quad x = \sin^{-1}\left(\frac{10}{2\sqrt{185}}\right) = 21.55812944°$$

round up as 8 > 5

$$x = 21.6°$$
(to 1 d.p.)

(Total for Question 19 is 3 marks)

P 5 4 6 9 5 A 0 2 0 2 4
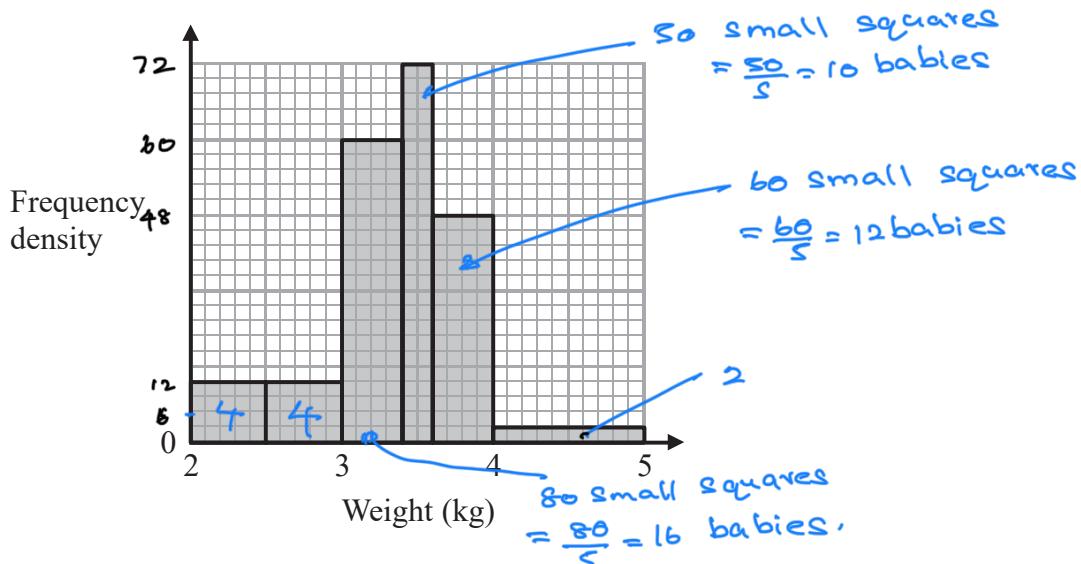
20 The histogram shows information about the birth weights of some babies.

50 small squares
$= \frac{50}{5} = 10$ babies

60 small squares
$= \frac{60}{5} = 12$ babies

2

80 small squares
$= \frac{80}{5} = 16$ babies.

Frequency density

72
60
48
12
6
0

4   4

2   3   4   5

Weight (kg)

6 of these babies had a birth weight less than 2.5 kg or greater than 4 kg.

Work out the number of babies who had a birth weight between 2.5 kg and 4 kg.

On graph   On exam paper:

30 small squares = 6 babies

5 small squares = 1 baby

first bar: 20 small squares

= 4×5 small squares

= 4 babies

Number of babies that   = 4 + 16 + 10 + 12 = 42
weigh between 2.5 kg and 4 kg

.... 42 ....

(Total for Question 20 is 3 marks)

Turn over ▶

21 (a) Show that $\sqrt{45} + \sqrt{20} = 5\sqrt{5}$

Show your working clearly.

$$\sqrt{45} = \sqrt{9} \times \sqrt{5} = 3\sqrt{5} \quad \leftarrow \sqrt{a \times b} = \sqrt{a} \times \sqrt{b}$$

$$\sqrt{20} = \sqrt{4} \times \sqrt{5} = 2\sqrt{5}$$

$$\text{hence } \sqrt{45} + \sqrt{20} = 3\sqrt{5} + 2\sqrt{5} = 5\sqrt{5}$$

(2)

(b) Express $\dfrac{2}{\sqrt{3} - 1}$ in the form $p + \sqrt{q}$

where p and q are integers.
Show your working clearly.

$$\frac{2}{\sqrt{3} - 1} \times \frac{\sqrt{3} + 1}{\sqrt{3} + 1} = \frac{2(\sqrt{3} + 1)}{3 - 1} = \frac{2(\sqrt{3} + 1)}{2} = \sqrt{3} + 1$$

rationalise the denominator

So $\quad p = 1$ and $q = 3$

$$1 + \sqrt{3}$$

(2)

(c) Express $x^2 + 6\sqrt{2}x - 1$ in the form $(x + a)^2 + b$

Show your working clearly.

need to complete the square

$$x^2 + 6\sqrt{2}x - 1 = \left(x + \frac{6\sqrt{2}}{2}\right)^2 - \left(\frac{6\sqrt{2}}{2}\right)^2 - 1$$

$$= \left(x + 3\sqrt{2}\right)^2 - \left(3\sqrt{2}\right)^2 - 1 \quad \rightarrow 3^2 \times \left(\sqrt{2}\right)^2$$

$$= \left(x + 3\sqrt{2}\right)^2 - 18 - 1 \qquad 9 \times 2 = 18$$
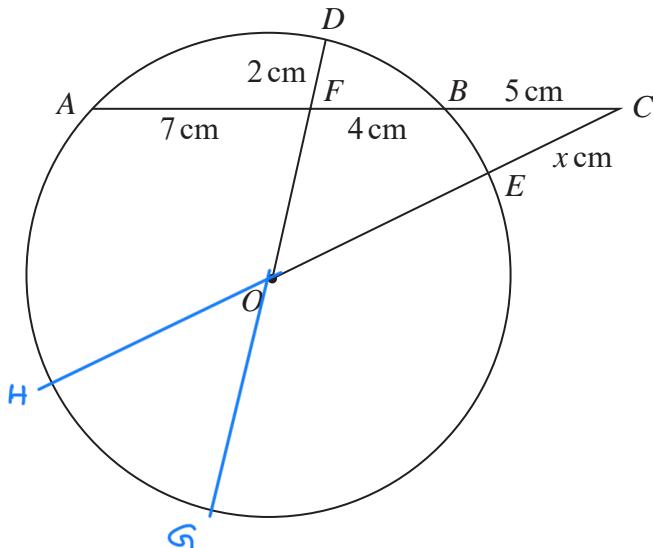
$$= \left(x + 3\sqrt{2}\right)^2 - 19$$

So $\quad a = 3\sqrt{2}$ and $b = -19$

$$\left(x + 3\sqrt{2}\right)^2 - 19$$

(2)

(Total for Question 21 is 6 marks)

22

Diagram **NOT** accurately drawn

A, D, B and E are points on a circle, centre O.
$AFBC$, OEC and OFD are straight lines.

$AF = 7$ cm, $FB = 4$ cm, $BC = 5$ cm, $FD = 2$ cm and $CE = x$ cm.

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

$AF \times FB = DF \times FG$

$7 \times 4 = 2 \times (\text{diameter} - 2)$

$28 = 2(d - 2)$ ÷2

$14 = d - 2$ +2

$16 = d$ +2

$AC \times BC = HC \times EC$ ← both lines have one point on the edge of the circle (A and H) and meet at c

$(5 + 4 + 7) \times 5 = (16 + x) \times x$

$16 \times 5 = x(16 + x)$

$80 = 16x + x^2$ ← move all terms into 1 side to from a quadratic equation

$0 = x^2 + 16x - 80$ ← 20 × -4 = ⁻80
          ↑
$20 - 4 = 16$

$0 = (x + 20)(x - 4)$

$\boxed{x = 4}$, $x \neq -20$ as it is a length so can't be negative

$x = $ ....4....

(Total for Question 22 is 6 marks)

Turn over ▶

23 The sum of the first 48 terms of an arithmetic series is 4 times the sum of the first 36 terms of the same series.

Find the sum of the first 30 terms of this series.

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

$$S_{48} = 4 \times S_{36}$$

$$\frac{48}{2}(2a + (48-1)d) = 4 \times \frac{36}{2}(2a + (36-1)d)$$

$$24(2a + 47d) = 72(2a + 35d)$$

$$48a + 1128d = 144a + 2520d$$

$^{-48a-1128d} \searrow \quad 0 = 96a + 1392d \longleftarrow {}^{-48a-1128d}$

$) \text{factorise}$

$$0 = 48(2a + 29d) \longrightarrow \text{hence } 2a + 29d = 0$$

$$S_{30} = \frac{30}{2}(2a + (30-1)d)$$

$$= 15(2a + 29d)$$

$$= 15 \times 0$$

$$= 0$$

(Total for Question 23 is 5 marks)

TOTAL FOR PAPER IS 100 MARKS