Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

3300U60-1

A20-3300U60-1

WEDNESDAY, 11 NOVEMBER 2020 – MORNING

MATHEMATICS
UNIT 2: CALCULATOR-ALLOWED
HIGHER TIER

1 hour 45 minutes

ADDITIONAL MATERIALS

A calculator will be required for this examination.

A ruler, a protractor and a pair of compasses may be required.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

If you run out of space, use the additional page at the back of the booklet. Question numbers must be given for all work written on the additional page.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

In question **2**, the assessment will take into account the quality of your linguistic and mathematical organisation, communication and accuracy in writing.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**7**	
3.	**4**	
4.	**2**	
5.	**4**	
6.	**5**	
7.	**2**	
8.	**3**	
9.	**4**	
10.	**6**	
11.	**2**	
12.	**3**	
13.	**6**	
14.	**2**	
15.	**3**	
16.	**3**	
17.	**4**	
18.	**3**	
19.	**5**	
20.	**8**	
Total	**80**	

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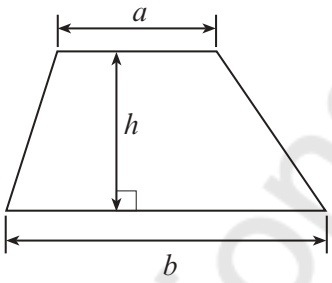
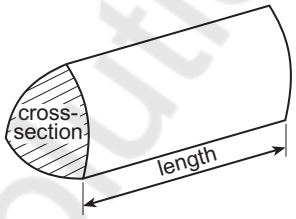
Formula List - Higher Tier

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



Volume of prism = area of cross-section × length

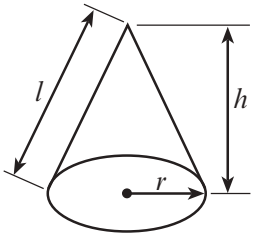


Volume of sphere = $\frac{4}{3}\pi r^3$

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

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

Curved surface area of cone = $\pi r l$

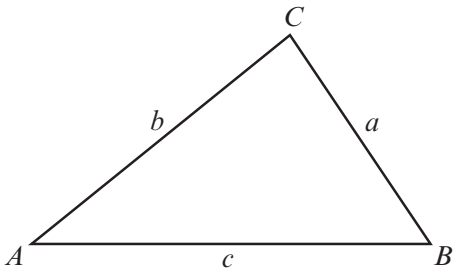


In any triangle ABC

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

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

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



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$ are given by $x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

Annual Equivalent Rate (AER)

AER, as a decimal, is calculated using the formula $\left(1 + \frac{i}{n}\right)^n - 1$, where i is the nominal interest rate per annum as a decimal and n is the number of compounding periods per annum.

Examiner only

1. *(a)* Caryl has two fair dice.

Dice A is a cube. It shows the numbers 1 to 6.
Dice B is a tetrahedron. It shows the numbers 1 to 4.

Caryl throws both dice.

What is the probability that she throws a 5 on dice A and a 3 on dice B? [2]

Dice A = 1, 2, 3, 4, 5, 6

Dice B = 1, 2, 3, 4

$P(\text{Dice A}, \text{Dice B}) = P(5, 3) = P(5) \times P(3)$

$= \frac{1}{6} \times \frac{1}{4} = \frac{1}{24}$

(b) Asif has a biased four-sided dice.
The dice shows the numbers 10, 20, 30 and 40.

Asif throws the dice once.

The table below gives the probability of obtaining each number.

Number	10	20	30	40
Probability	$\frac{1}{2}$	$\frac{1}{5}$	$\frac{1}{5}$	$\frac{1}{10}$

What is the probability that Asif throws a 30 or a 40? [2]

$P(30 \text{ or } 40) = P(30) + P(40)$

$= \frac{1}{5} + \frac{1}{10} = \frac{1 \times 2}{5 \times 2} + \frac{1}{10} = \frac{2}{10} + \frac{1}{10} = \frac{2+1}{10}$

$= \frac{3}{10}$

Examiner only

2. *In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

The diagram shows two right-angled triangles, joined together along a common side.
AB = 10·8 cm, *BC* = 14·4 cm and *CD* = 24 cm.

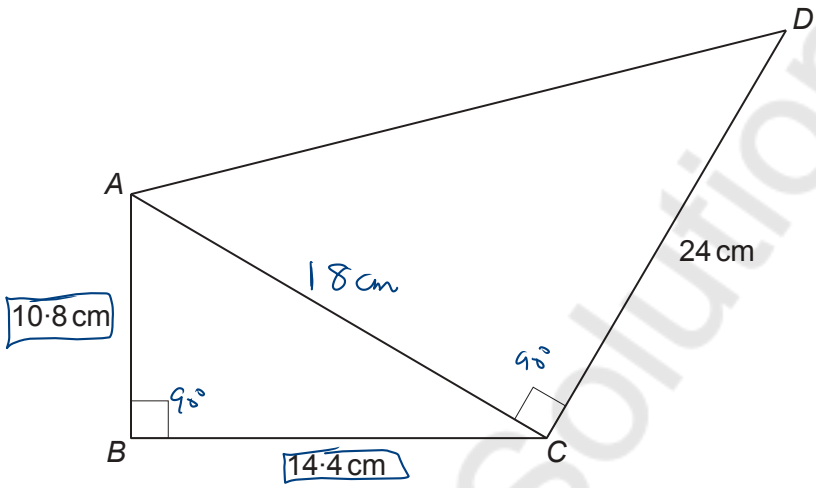


Diagram not drawn to scale

Calculate the area of triangle *ACD*.
You must show all your working. [5 + 2 OCW]

By Pythagoras theorem :

$hyp^2 = opp^2 + adj^2 \Rightarrow hyp = \sqrt{10.8^2 + 14.4^2}$

$hyp = \sqrt{324} = 18\ cm$

Area of ACD $= \frac{1}{2} \times b \times h \Rightarrow \frac{1}{2} \times 24 \times 18^9$

$= 24 \times 9$

$= 216\ cm^2$

Examiner only

3. A solution of the equation

$$x^3 - 5x - 350 = 0$$

lies between 7·2 and 7·3.

Use the method of trial and improvement to find this solution correct to 2 decimal places. You must show all your working. [4]

Given the equation : $x^3 - 5x - 350 = 0$

$f(x) = x^3 - 5x - 350$

$f(7.2) = (7.2)^3 - 5(7.2) - 350 = -12.752$

$f(7.3) = (7.3)^3 - 5(7.3) - 350 = 2.517$

* Try midpoint : $\frac{7.2 + 7.3}{2} = \boxed{7.25}$

$f(7.25) = (7.25)^3 - 5(7.25) - 350 = -5.172$

$f(7.28) = (7.28)^3 - 5(7.28) - 350 = -0.311$

$f(7.29) = (7.29)^3 - 5(7.29) - 350 = 1.102$

⇒ There's solution which lies between 7.28 & 7.29

* Try $x = 7.281$

$f(7.281) = (7.281)^3 - 5(7.281) - 350 = -0.027$ (-ve)

$f(7.282) = (7.282)^3 - 5(7.282) - 350 = 0.084$ (+ve)

⇒ There's a solution which lies between 7.281 & 7.282

* Round off two 2.dp

∴ 7.28

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Examiner only

4. *(a)* Which one of the following options describes $2x + 5y$?
Circle your answer. [1]

an equation a formula an expression

an inequality none of these

(b) Which one of the following options describes $3x - 2 = 7$?
Circle your answer. [1]

an equation a formula an expression

an inequality none of these

5. Data for different values of t are shown in the table below.

t	Frequency
$0 \leqslant t < 5$	8 → f_1
$5 \leqslant t < 10$	0 → f_2
$10 \leqslant t < 15$	7 → f_3
$15 \leqslant t < 20$	5 → f_4

Calculate an estimate for the mean value of t. [4]

* Mid point : $\frac{0+5}{2} = \frac{5}{2} = 2.5$ (1)

$\Rightarrow \frac{5+10}{2} = \frac{15}{2} = 7.5$ (2) $\Rightarrow \frac{10+15}{2} = \frac{25}{2} = 12.5$ (3)

$\Rightarrow \frac{15+20}{2} = \frac{35}{2} = 17.5$ (4)

Let $x_1 = 2.5$, $x_2 = 7.5$, $x_3 = 12.5$, $x_4 = 17.5$

$\text{Mean} = \frac{\sum_{i=1}^{4} x_i \cdot f_i}{\sum f_i} = \frac{(x_1 \times f_1) + (x_2 \times f_2) + (x_3 \times f_3) + (x_4 \times f_4)}{f_1 + f_2 + f_3 + f_4}$

$\text{Mean} = \frac{(2.5 \times 8) + (7.5 \times 0) + (12.5 \times 7) + (17.5 \times 5)}{8 + 0 + 7 + 5} =$

$= \frac{20 + 0 + 87.5 + 87.5}{20} = \frac{195}{20}$

$\text{Mean} = 9.75$

$\sum_{i=1}^{4} x_i f_i$

Examiner only

6. In the diagram below, *AB*, *BC* and *CD* are three sides of a **regular polygon**.
The polygon has 15 sides.
The length of each side is 8 cm.

The exterior angle of the polygon is $x°$.
BRC is a right-angled triangle.

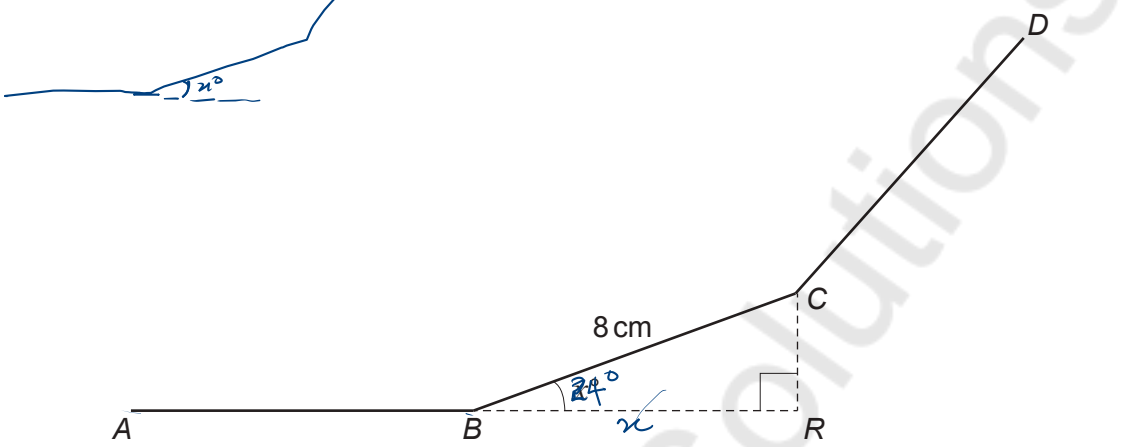


Diagram not drawn to scale

Calculate the length of *BR*. [5]

Exterior angle $x° \Rightarrow \frac{360}{\text{no of sides}} = \frac{360}{15} = 24°$

Adj = x cm, hyp = 8 cm

$\cos\theta = \frac{\text{Adj}}{\text{hyp}}$

$\frac{\cos 24°}{1} = \frac{x}{8}$

$x = 8 \times \cos 24°$

$x = 7.31\text{ cm} =$ Length of BR

Examiner only

7. Calculate the value of $(3{\cdot}2 \times 10^{7}) \times (8{\cdot}3 \times 10^{-2})$.
Give your answer in standard form. [2]

$(3{\cdot}2 \times 10^{7}) \times (8{\cdot}3 \times 10^{-2})$

$= 3{\cdot}2 \times 8{\cdot}3 \times 10^{7} \times 10^{-2} = 26{\cdot}56 \times 10^{7+-2}$

$= 2{\cdot}656 \times 10^{1} \times 10^{7-2} = 2{\cdot}656 \times 10^{1} \times 10^{5}$

$= 2{\cdot}656 \times 10^{1+5}$

$= 2{\cdot}656 \times 10^{6}$

8. The lengths of the sides of a rectangle are given as 24 cm and 15 cm.
Each measurement is given correct to the nearest centimetre.

Calculate the difference between the greatest possible perimeter of the rectangle and the least possible perimeter of the rectangle. [3]

* Lower Bound of 24cm and 15cm

at Lower Bound ⇒ Subtract 0.5cm

@ LB ⇒ 24cm − 0.5cm = 23.5cm → L

⇒ 15cm − 0.5cm = 14.5cm → B

* Upper Bound of 24cm and 15cm

at Upper Bound ⇒ Add 0.5cm

@ UB ⇒ 24cm + 0.5cm = 24.5cm → L

⇒ 15cm + 0.5cm = 15.5cm → B

By formula:

Perimeter of a Rectangle = $2(L+B)$

$P_R = P_{UB} - P_{LB}$

$\Rightarrow P_{UB} = 2(24.5 + 15.5) \Rightarrow P_{LB} = 2(23.5 + 14.5)$

$\Rightarrow 2(24.5 + 15.5) - 2(23.5 + 14.5)$

$= 4\text{cm}$

Examiner only

9. Solve the following simultaneous equations using an algebraic (not graphical) method.

$$3x - 2y = 14$$
$$7x + 3y = 25$$

You **must** show all your working. [4]

$3x - 2y = 14$ —— eqn (1) $\times +3$

$7x + 3y = 25$ —— eqn (2) $\times -2$

$9x - 6y = 42$

$-14x - 6y = -50$ Subtract

$9x - -14x - 6y - -6y = 42 - -50$

$9x + 14x - 6y + 6y = 42 + 50$

$\frac{23x}{23} = \frac{92}{23}$

$x = 4$

Since $x = 4$

Rearrange from eqn (1) Substitute $x = 4$

$3x - 2y = 14$

$3(4) - 2y = 14$

$12 - 2y = 14$

$12 - 14 = 2y$

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

$y = -1$

$\therefore x = 4$ or $y = -1$

23 1
4
92

Examiner only

10. The diagram below shows a circle with centre at point *O*.
A, *B*, *C* and *D* are all points on the circumference of the circle.

AB = 7·5 cm and *BC* = 4·7 cm.

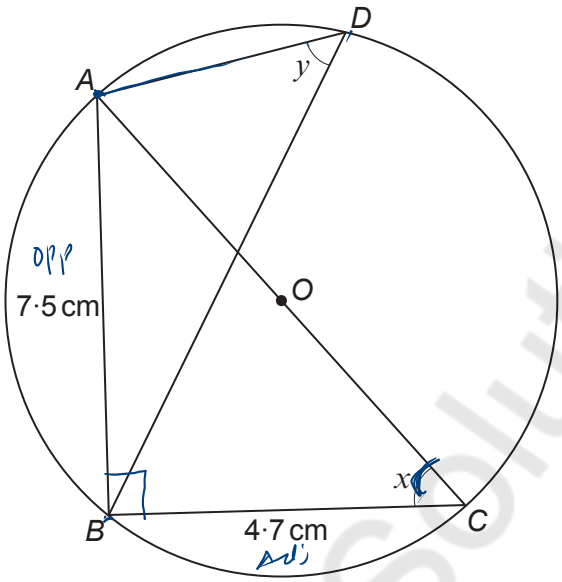


Diagram not drawn to scale

(a) (i) Give the reason why $A\hat{B}C$ is 90°. [1]

⇒ An angle at the circumference of a circle which is subtended by a diameter is at right angle = 90°

(ii) Calculate the size of angle *x*. [3]

$\tan x = \frac{Opp}{Adj}$

$\tan x = \frac{7.5}{4.7}$

$\tan^{-1}(\tan x) = \tan^{-1}\frac{7.5}{4.7}$

$x = \tan^{-1}\left(\frac{7.5}{4.7}\right)$

$x = 57.8\ldots$

$\therefore 58°$

(b) Write down the size of angle *y*.
State the circle theorem you have used to find your answer. [2]

$y = x° = 58°$

Circle theorem used: "angle formed in the same segments of a circle are equal."

Examiner only

11. Write 16^{100} in the form 2^n. [2]

$16 = 2^1 \times 2^1 \times 2^1 \times 2 = 2^{1+1+1+1}$

$16 = 2^4$

$16^{100} = (2^4)^{100}$

$= 2^{4 \times 100}$

$= 2^{400}$ where $n = 400$

12. Calculate the perpendicular height of a cone with a volume of $5533\,cm^3$ and a base area of $825\,cm^2$. [3]

$V = \frac{1}{3}\pi r^2 h$ Since Base Area $= \pi r^2 = 825$

$\frac{5533}{1} = \frac{1}{3} \times 825 \times h$

$3 \times 5533 = 825 \times h$

$825 \quad 825$

$h = \frac{3 \times 5533}{825}$

$h = 20.1$

Examiner only

13. *(a)* Factorise $4x^2 - 81$. [2]

Given $4x^2 - 81$

$\Rightarrow 2^2x^2 - 9^2$

$\Rightarrow (2x)^2 - 9^2$

$\Rightarrow (2x)^2 - (9)^2$ $\Rightarrow$ difference of two squares

$\Rightarrow (2x - 9)(2x + 9)$

(b) Factorise $7x^2 + 10x - 8$. [2]

Given $7x^2 + 10x - 8$

$7x^2 - 4x + 14x - 8$

$x(7x - 4) + 2(7x - 4)$

$(x + 2)(7x - 4)$

$7 \times 8 \rightarrow 56$

4×-14

$-4 \times +14$

(c) Factorise $(x + 2)^3 + 5(x + 2)^2$. [2]

$\Rightarrow$ HCF $= (x+2)^2$

$\Rightarrow (x+2)^2 \left[\frac{(x+2)^3}{(x+2)^2} + \frac{5 \times (x+2)}{(x+2)^2} \right]$

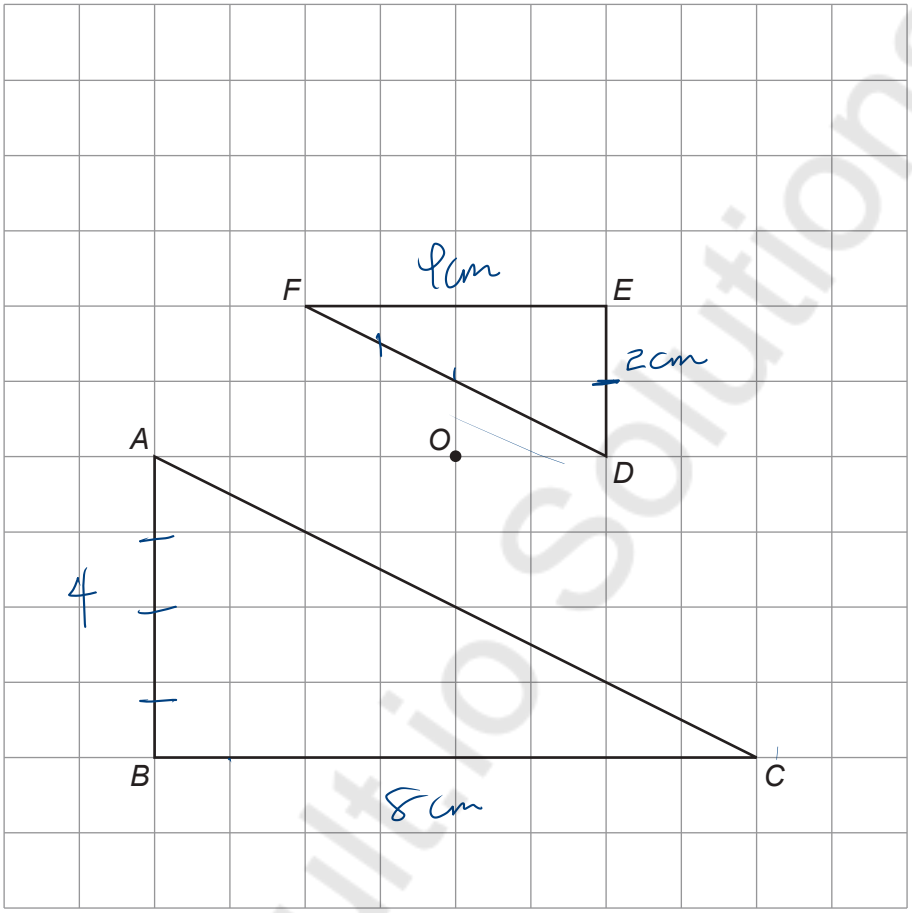
$\Rightarrow (x+2)^2 [(x+2) + 5]$

$\Rightarrow (x+2)^2 [x + 2 + 5]$

$\Rightarrow (x+2)^2 (x+7) = (x+2)(x+2)(x+7)$

Examiner only

14. In the following diagram, triangle *ABC* has been enlarged to triangle *DEF*, with the centre of enlargement at *O*.
Write down the scale factor of the enlargement. [2]



Scale factor: $\frac{1}{2}$

Examiner only

15. The first four terms of a sequence are

3, 9, 19, 33, ...

Find the 100th term of the sequence. [3]

Given 3, 9, 19, 33

6 10 14

4 4

$(2+1)$, $8+1$, $18+1$, $32+1$

$(2)+1$, $(8)+1$, $(18)+1$, $(32)+1$

$2(1)+1$, $2(4)+1$, $2(9)+1$, $2(16)+1$

$2(1^2)+1$, $2(2^2)+1$, $2(3^2)+1$, $2(4^2)+1$, ..., $2(n^2)+1$

$T_n = 2(n^2)+1$

$T_{100} = 2(100^2)+1$

$= 2 \times 10000 + 1$

$= 20000 + 1$

$= \underline{20,001}$

Examiner only

16. An amount written correct to the nearest £10 is £7180.
This amount is increased by 23·5%, correct to the nearest 0·1%.
Calculate the **least** possible value of the increased amount.
Give your answer correct to the nearest pound. [3]

* Original amount = £7180
⇒ Since £7180 is correct to the nearest £10
Actual Value could be between:
* Lower Bound ⇒ £7175
Upper Bound ⇒ £7184

$LB_{23.5} = 23.45$

By Formula:

Increased Amount = Original × (1 + Percentage Increase)

$= £7175 \times (1 + 23.45\%)$

$= £7175 \times \left(1 + \frac{23.45}{100}\right)$

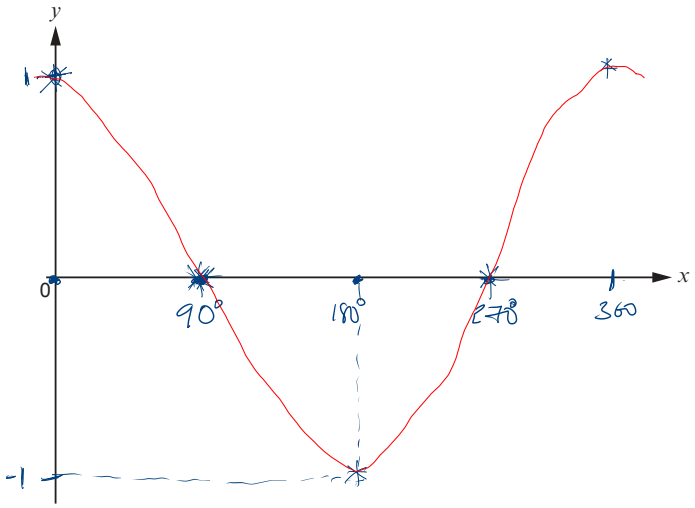
$= £7175 \times (1 + 0.2345)$

$= £8859.788$

$= £8858$

Examiner only

17. *(a)* Sketch the curve $y = \cos x$, for values of x in the range $x = 0°$ to $x = 360°$.
You must indicate any important values on the axes. [2]



(b) Solve the equation $\cos x = 0{\cdot}7$.
Give all solutions in the range $x = 0°$ to $x = 360°$. [2]

$\cos x = 0{\cdot}7$

$\cos^{-1} \times \cos x = \cos^{-1}(0{\cdot}7)$

$x = \cos^{-1}(0{\cdot}7)$

$x = 45{\cdot}57$

This is the first solution

2nd | 1st
S | A
3rd | 4th
T | C

In the fourth quadrant, the cosine value is symmetric about the x-axis:

$x = 360 - (45{\cdot}57) = 314{\cdot}43$

$\Rightarrow x = 45{\cdot}57$ and $314{\cdot}43$

$y = \cos x$

When $x = 0°$
$y = \cos(0)$
$y = 1$

When $x = 90°$
$y = \cos(90°)$
$y = 0$

When $x = 180°$
$y = \cos(180°)$
$y = -1$

When $x = 270$
$y = \cos(270)$
$y = 0$

When $x = 360°$
$y = \cos(360°)$
$y = 1$

Examiner only

18. A large number of people took part in a survey that was carried out to find the popularity of three different walks in West Wales.
Each person surveyed was asked, independently, to select their one favourite walk.
The table below shows the results of the survey.

Walk	The percentage of people who selected the walk
The Preseli Ridge	70 %
Ramsey Sound	20 %
Laugharne	10 %

Three girls, Constance, Scarlett and Clementine, were chosen at random from all of the people surveyed.
They were asked which walk they had selected.

Calculate the probability that the three girls had each selected a different walk. [3]

P(Preseli Ridge) = 70% = $\frac{70}{100}$ = 0.7

P(Ramsey) = 20% = $\frac{20}{100}$ = 0.2

P(Laugharne) = 10% = $\frac{10}{100}$ = 0.1

P(3 Girls → different ideas) = 6 × (0.7 × 0.2 × 0.1)

= 0.084

Examiner only

19. Use the quadratic formula to solve $(5x + 3)(5x - 3) = 19x$.
Give your answers correct to 2 decimal places.
You must show all your working. [5]

$\Rightarrow$ Given $(5x+3)(5x-3) = 19x$

$(5x \times 5x) + (3 \times -3) = 19x$

$25x^2 + -9 = 19x$

$25x^2 - 9 = 19x$

$25x^2 - 19x - 9 = 0$

Using the Quadratic formula:

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

where $ax^2 + bx + c = 0$

$a = 25, \; b = -19, \; c = -9$

$$x = \frac{-(-19) \pm \sqrt{(-19)^2 - 4(25)(-9)}}{2(25)}$$

$$x = \frac{19 \pm \sqrt{1261}}{50}$$

$x = 1.09$ or $= 0.33$

Examiner only

20. *ACB* is a sector of a circle with radius x cm and centre A, as shown below.

$C\hat{E}A = 34°$, $A\hat{C}E = 100°$, $C\hat{A}E = 46°$ and $CE = 12$ cm.

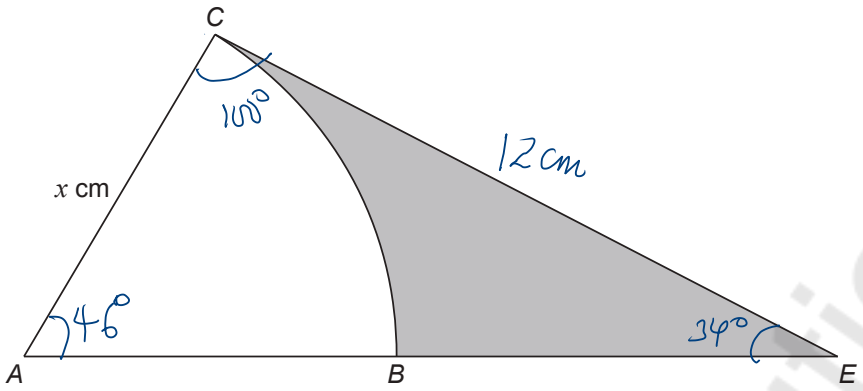


Diagram not drawn to scale

Calculate the area of the shaded region *BCE*.
You must show all your working. [8]

$\frac{AC}{\sin 34} = \frac{x}{\sin 46} = \frac{CE}{\sin 46} \times \sin(34)$

$= \frac{12}{\sin 46} \times \sin 34$

$= \frac{9.328}{}$

Area of sector $ABC = \frac{\theta}{360} \times \pi r^2$

$= \frac{46°}{360} \times \pi \times (9.328)^2$. $\pi = 3.14$

$= 34.93$

Area of $ACE = \frac{1}{2} \times 9.328 \times 12 \times \sin 100$

$= 55.12$

Area of BCE = Area of ACE − Area ABC

END OF PAPER

Area of the shaded region = 55.12 − 34.93

= 20.188

≈ 20.2

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

Examiner only