Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3300U60-1

S17-3300U60-1

MATHEMATICS
UNIT 2: CALCULATOR-ALLOWED
HIGHER TIER

TUESDAY, 20 JUNE 2017 – AFTERNOON

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**5**	
3.	**4**	
4.	**3**	
5.	**3**	
6.	**3**	
7.	**5**	
8.	**5**	
9.	**2**	
10.	**2**	
11.	**7**	
12.	**5**	
13.	**5**	
14.	**3**	
15.	**3**	
16.	**5**	
17.	**1**	
18.	**5**	
19.	**2**	
20.	**4**	
21.	**4**	
Total	**80**	

ADDITIONAL MATERIALS

A calculator will be required for this paper.

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 continuation page(s) at the back of the booklet, taking care to number the question(s) correctly.

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.

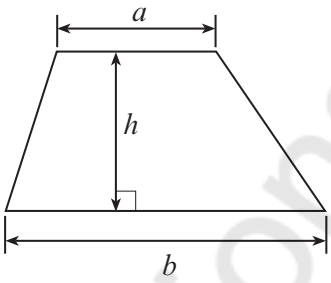
The number of marks is given in brackets at the end of each question or part-question.

In question **11**, the assessment will take into account the quality of your linguistic and mathematical organisation, communication and accuracy in writing.

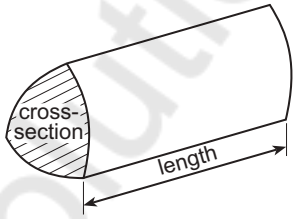
JUN173300U60101

Formula List - Higher Tier

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



Volume of prism = area of cross-section × length

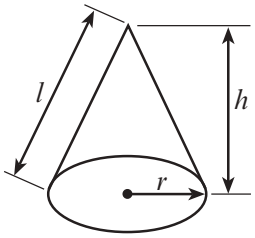


Volume of sphere $= \frac{4}{3}\pi r^3$

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

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

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

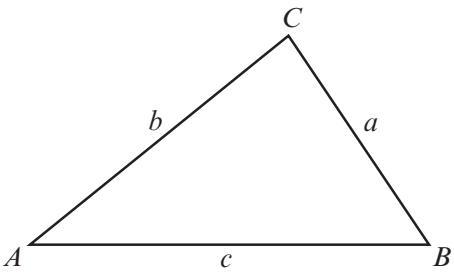


In any triangle ABC

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)* Calculate $\sqrt{8{\cdot}5^3 + (4{\cdot}5 - 0{\cdot}76)^2}$, correct to 3 significant figures. [2]

$8{\cdot}5 \times 8{\cdot}5 \times 8{\cdot}5$

$\sqrt{8{\cdot}5^3 + 3{\cdot}74^2}$

$\sqrt{614{\cdot}125 + 13{\cdot}9876} = \sqrt{628{\cdot}1126} = 25{\cdot}06247$

$25{\cdot}1$

(b) Calculate the reciprocal of $-0{\cdot}07$, correct to 1 decimal place. [2]

Generally, The reciprocal of $a = \frac{1}{a}$

Reciprocal of $-0{\cdot}07 = \frac{1}{-0{\cdot}07} = -14{\cdot}286$

$= -14{\cdot}3$

2. Show that the triangle below is **not** a right-angled triangle. [5]

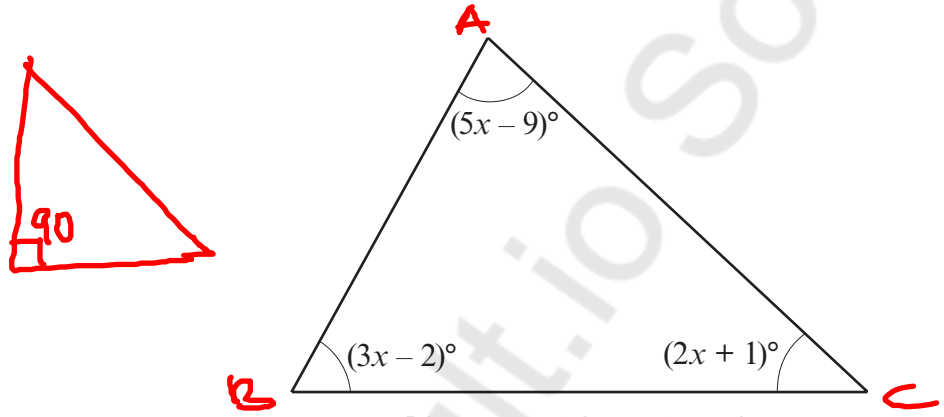


Diagram not drawn to scale

Sum of angle in a triangle $= 180°$

$5x - 9 + 3x - 2 + 2x + 1 = 180$

$10x - 10 = 180$

$10x = 180 + 10 = 190$

$x = \frac{190}{10} = 19$

$x = 19$

$\angle A = 5x - 9 = 5 \times 19 - 9 = 86°$

$\angle B = 3x - 2 = 3 \times 19 - 2 = 55°$

$\angle C = 2x + 1 = 2 \times 19 + 1 = 39°$

Since none of three angles of the triangle is $90°$. Then, the triangle is not a right angle triangle.

Examiner only

3. A solution to the equation

$$x^3 - 2x - 45 = 0$$

lies between 3 and 4.

Use the method of trial and improvement to find this solution correct to 1 decimal place.
You must show all your working. [4]

$x^3 - 2x - 45 = 0$ Solution 3 and 4

$x = 3$; $x^3 - 2x - 45 = 3^3 - 6 - 45 = 27 - 6 - 45 = -24$

$x = 3.1$; $3.1^3 - 6.2 - 45 = -21.409$

$x = 3.2$; $3.2^3 - 6.4 - 45 = -18.632$

$x = 3.3$; $3.3^3 - 6.6 - 45 = -15.663$

$x = 3.4$; $3.4^3 - 6.8 - 45 = -12.496$

$x = 3.5$; $3.5^3 - 7 - 45 = -9.125$ -1.7 0 2.3

$x = 3.6$; $3.6^3 - 7.2 - 45 = -5.544$

$x = 3.7$; $3.7^3 - 7.4 - 45 = -1.747$

$x = 3.8$; $3.8^3 - 7.6 - 45 = 2.272$

$x = 3.9$; $3.9^3 - 7.8 - 45 = 6.519$

$x = 4$; $4^3 - 8 - 45 = 11$

The solution lies between $3.7 < x < 3.8$

Check when $x = \frac{3.7 + 3.8}{2} = 3.75$

$x = 3.75$; $3.75^3 - 7.5 - 45 = 0.2343$

$x = 3.746$; $3.746^3 - 7.492 - 45 = 0.074$

x closer to 3.7 than 3.8

$x = 3.7$

Examiner only

4. A right-angled triangle *LMN* is shown below.
LN = 16·9 cm and *LM* = 6·5 cm.

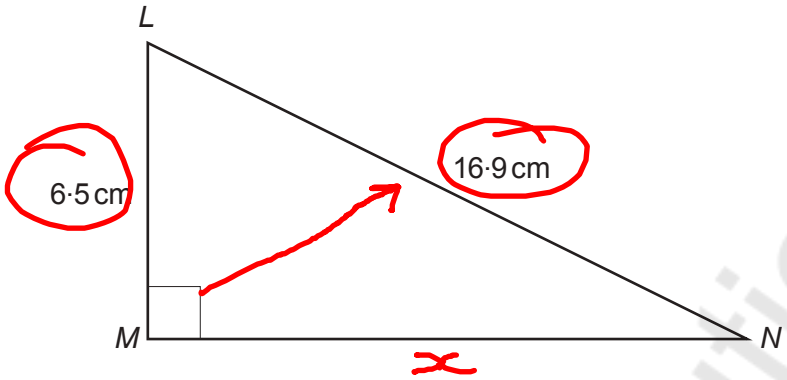


Diagram not drawn to scale

Calculate the length *MN*. [3]

Apply pythagoras theorem

$LN^2 = LM^2 + MN^2$

$16.9^2 = 6.5^2 + MN^2$

$285.61 = 42.25 + MN^2$

$285.61 - 42.25 = MN^2$

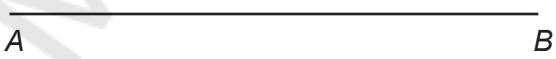
$243.36 = MN^2$

$MN = \sqrt{243.36}$

$MN = 15.6\text{ cm}$

Examiner only

5. Construct an accurate drawing of triangle *ABC,* where *AB* = 7 cm, $A\hat{B}C = 90°$ and $B\hat{A}C = 60°$.
Use only a ruler and a pair of compasses.
The side *AB* has been drawn for you.
You must show your construction arcs. [3]



Examiner only

6. Calculate the length of the side *QR* in the triangle *PQR* shown below. [3]

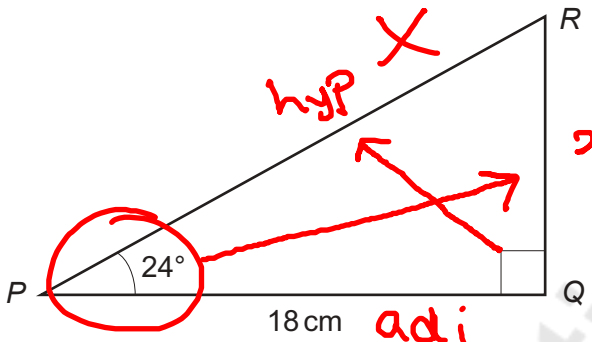


Diagram not drawn to scale

Apply SOH CAH TOA

$\tan\theta = \frac{opp}{adj}$

$\tan 24 = \frac{x}{18}$

$x = \tan 24 \times 18$

$x = 0.4452 \times 18$

$x = 8.0136\ cm$

$x = 8.01\ cm$

$QR = 8.01\ cm$

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Examiner only

7. 100 boxes each contain 10 balls.

45 of the boxes are labelled A.
They each contain 7 black balls and 3 white balls.

25 of the boxes are labelled B.
They each contain 4 black balls and 6 white balls.

The rest of the boxes are labelled C.
They each contain 8 black balls and 2 white balls.

$A+B+C=100$

$C=100-A-B$

$C=100-45-25$

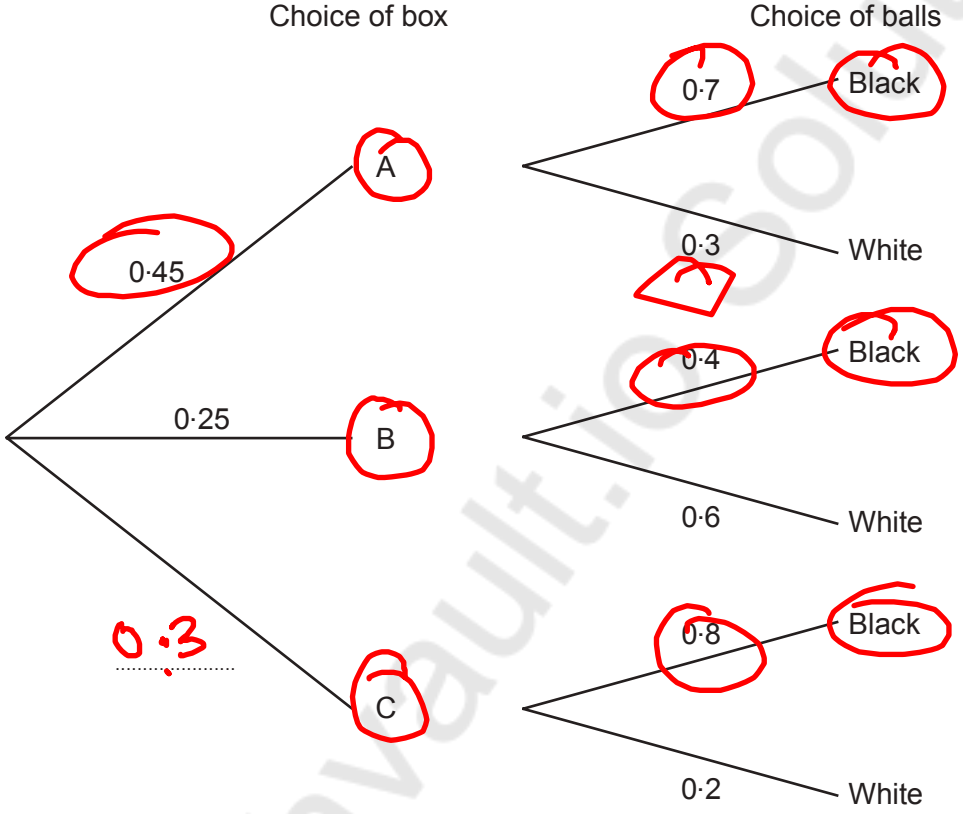
$C=30$ boxes

In a game, a player chooses a box at random, and then chooses a ball at random from that box.

(a) Complete the tree diagram shown below. [1]

$Pr(C)=\frac{30}{100}$

$=0.3$



(b) What is the probability that a player will select a black ball? [3]

$Pr(\text{Black ball}) = Pr(A \text{ and Black}) + Pr(B \text{ and Black}) + Pr(C \text{ and Black})$

$Pr(\text{black ball}) = Pr(A) \times Pr(\text{Black}) + Pr(B) \times Pr(\text{Black}) + Pr(C) \times Pr(\text{Black})$

$Pr(\text{black ball}) = 0.45 \times 0.7 + 0.25 \times 0.4 + 0.3 \times 0.8$

$Pr(\text{black ball}) = 0.315 + 0.1 + 0.24$

$Pr(\text{Black ball}) = 0.655$

Examiner only

(c) If a large number of people played the game, approximately what fraction of them would you expect to choose a white ball?
Circle your answer. [1]

$\frac{1}{10}$ 0·1 $\frac{1}{5}$ 0·2 $\frac{1}{4}$ 0·25 $\frac{1}{3}$ $0.\dot{3}$ $\frac{1}{2}$ 0·5

Pr(Black ball) + Pr(white Ball) = 1

Pr(white Ball) = 1 − Pr(Black ball)

Pr(white ball) = 1 − 0·655 = 0·345

≡ 1/3

8. (a) Factorise $x^3 - 5x$. [1]

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

(b) Expand and simplify $(2x - 3)(x + 4)$. [2]

$(2x-3)(x+4)$

$2x(x+4) - 3(x+4)$

$2x^2 + 8x - 3x - 12$

$2x^2 + 5x - 12$

(c) Factorise $x^2 - 3x - 28$. [2]

$x^2 - 3x - 28$

$1 \times -28 = -28$

Factors of −28	Add to factors
$2 \times -14 = -28$	$2 - 14 = -12$
$-2 \times 14 = -28$	$-2 + 14 = 12$
$7 \times -4 = -28$	$7 - 4 = 3$
$-7 \times 4 = -28$	$-7 + 4 = -3$
$1 \times -28 = -28$	$1 - 28 = -27$
$-1 \times 28 = -28$	$-1 + 28 = 27$

$x^2 - 7x + 4x - 28$

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

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

Examiner only

9. *(a)* Circle the equation of a straight line that is parallel to the line $3y = 2x + 6$. [1]

$3y = 2x + 7$ $\quad 2y = 3x + 6$ $\quad 3y = -2x + 6$ $\quad -3y = 2x + 6$ $\quad 2y = -3x + 6$

(b) Circle the equation of a straight line that is perpendicular to the line $y = 5x - 3$. [1]

$y = \frac{x}{5} + 3$ $\quad y = 5x + 3$ $\quad y = 5x + \frac{1}{3}$ $\quad y = -5x + 3$ $\quad y = \frac{-x}{5} + 3$

Examiner only

10. Points *A*, *B* and *C* lie on the circumference of a circle, centre *O*.
$A\hat{C}B = 37°$.

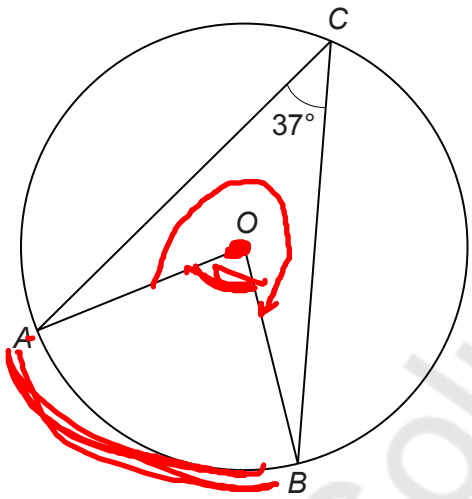


Diagram not drawn to scale

Calculate the size of the **reflex** angle $A\hat{O}B$. [2]

Acute $\angle AOB = 2 \times \angle ACB$

Acute $\angle AOB = 2 \times 37 = 74°$ ✓

Acute $\angle AOB$ + reflex $\angle AOB = 360°$

reflex $\angle AOB = 360 -$ Acute $\angle AOB$

reflex $\angle AOB = 360 - 74$

reflex $\angle A\hat{O}B = 286°$

reflex angle
$180 < \theta < 360$

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11

Examiner only

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

The area of triangle *ABD*, shown in the diagram below, is 35 cm^2.
AD = 5 cm and *BC* = 32 cm.
D is on the line *AC*, and *BD* is perpendicular to *AC*.

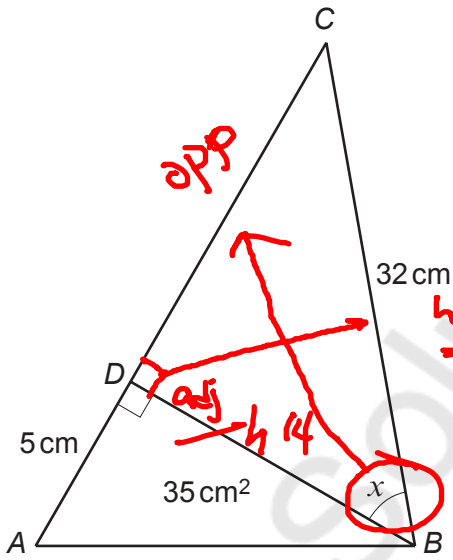


Diagram not drawn to scale

Calculate the size of angle x.
You must show all your working. [5 + 2 OCW]

Area of a triangle = $\frac{1}{2}$ b x h

Area of $\triangle$ ABD = $\frac{1}{2}$ x AD x BD

$35 = \frac{1}{2} \times 5 \times BD$

$35 = \frac{5 \times BD}{2}$

$35 \times 2 = 5 \times BD$

$\frac{35 \times 2}{5} = \frac{5 \times BD}{5}$

$BD = 14\text{cm}$

Apply SOH CAH TOA

$\cos\theta = \frac{adj}{hyp}$

$\cos x = \frac{14}{32}$

$\cos x = 0.4375$

$x = \cos^{-1}(0.4375)$

$x = 65.1°$

Examiner only

12. Make c the subject of the following formula.
Give your answer in its simplest form. [5]

$$c - 5 = \frac{3c - 7}{d}$$

$\frac{c-5}{1} = \frac{3c-7}{d}$

Cross multiply

$(c-5) \times d = (3c-7) \times 1$

$cd - 5d = 3c - 7$

Collect like terms i.e bring all "c" together

$cd - 3c = -7 + 5d$

$c[d-3] = -7 + 5d$

$\frac{c(d-3)}{(d-3)} = \frac{-7+5d}{d-3}$

$c = \frac{-7+5d}{d-3}$

Examiner only

13.

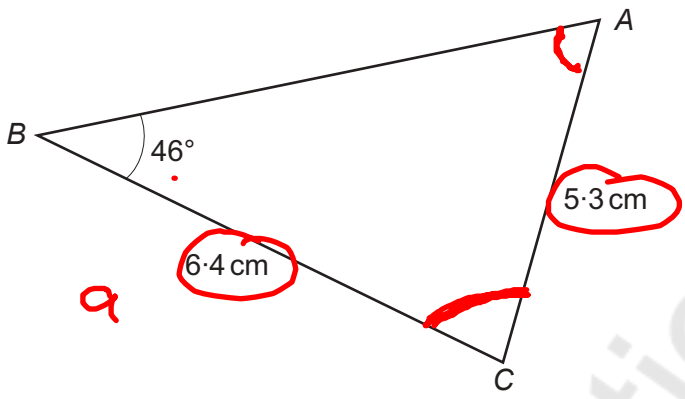


Diagram not drawn to scale

By first calculating the size of $B\hat{A}C$, calculate the area of triangle *ABC*.
You must show all your working. [5]

Applying Sine Rule

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

$\frac{6.4}{\sin A} = \frac{5.3}{\sin 46}$

Cross multiply

$6.4 \times \sin 46 = 5.3 \times \sin A$

$\frac{6.4 \times \sin 46}{5.3} = \sin A$

$\frac{6.4 \times 0.7193}{5.3} = \sin A$

4dp

$\sin A = 0.8686$

$A = \sin^{-1}(0.8686)$

$A = 60.296°$

$A = 60.3°$

$\angle A + \angle B + \angle C = 180$

$\angle C = 180 - \angle A - \angle B$

$\angle C = 180 - 60.3 - 46$

$\angle C = 73.7°$

$A = \frac{1}{2} ab \sin C$

$A = \frac{1}{2} \times 6.4 \times 5.3 \times \sin 73.7$

$A = \frac{1}{2} \times 6.4 \times 5.3 \times 0.9598$

$A = 16.29 \text{ cm}^2$

Examiner only

14. The region between two rectangles is shaded, as shown in the diagram below.
All of the measurements shown are given **correct to the nearest cm**.

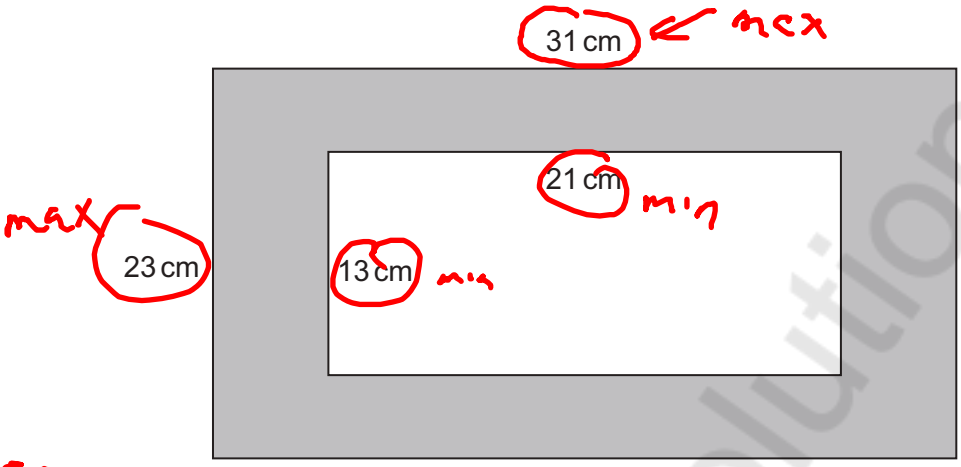


Diagram not drawn to scale

Calculate the greatest possible area of the shaded region. [3]

The Big rectangle Dimension is 31cm by 23cm

The greatest Dimension is 31.5cm by 23.5cm

Area of the Big rectangle = 31.5×23.5

$= 740.25 cm^2$

The least Dimension of the small rectangle is 20.5cm by 12.5cm

Area of the small rectangle = 20.5×12.5

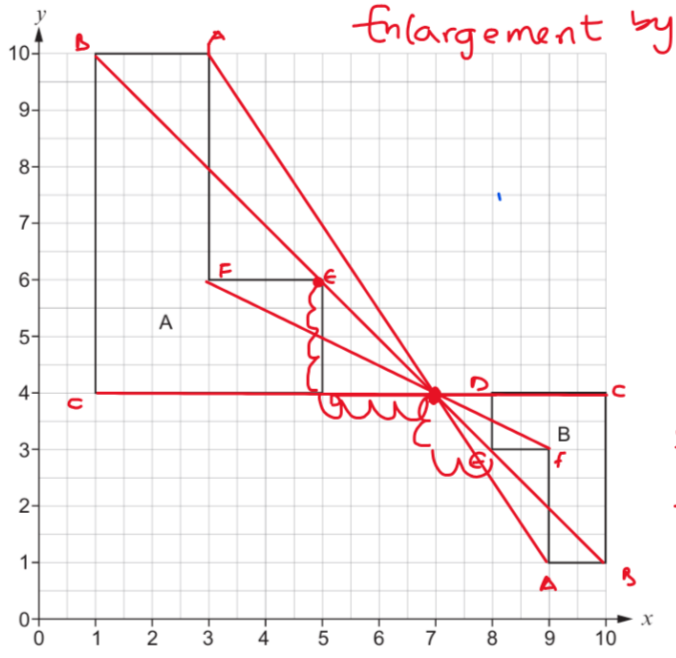
$= 256.25 cm^2$

The greatest shaded region = Area of Big rectangle − Area of small rectangle

The greatest shaded region = $740.25 - 256.25$

$= 484 cm^2$

15. Describe fully a **single** transformation that transforms shape A onto shape B. [3]



Enlargement by

↓ 4, → 4

2, 2

$= \frac{1}{2}$

Enlargement by a scale factor of $-\frac{1}{2}$ about the point (7, 4).

only

Examiner only

16. The table below shows the three-day rain forecast for Monday, Tuesday and Wednesday in Eglwyswrw.

Day	Probability of rain
Monday	80% ✓
Tuesday	80% ✓
Wednesday	80% ✓

not rain
20%
20%
20%

For these three days,

(a) calculate the probability that it will rain on all three days. [2]

Pr (rain on all three days) = Pr(monday ∩ Tues ∩ Weds)

Pr (rain all three days) = Pr(M) × Pr(T) × P(W)

$= \frac{80}{100} \times \frac{80}{100} \times \frac{80}{100}$

Pr (rain all three days) = 0.512 or 51.2%

(b) calculate the probability that it will rain on exactly 2 consecutive days. [3]

Pr (rained 2 consecutive days) = MTW' + M'TW

Pr (rained 2 consecutive days) = P(M ∩ T ∩ W') + P(M' ∩ T ∩ W)

Pr (rained 2 consecutive days) = P(M) × P(T) × P(W') + P(M') × P(T) × P(W)

$= \frac{80}{100} \times \frac{80}{100} \times \frac{20}{100} + \frac{20}{100} \times \frac{80}{100} \times \frac{80}{100}$

= 0.128 + 0.128

= 0.256 or 25.6%

From indices ① $a^{m/n} = (\sqrt[n]{a})^m$ * ② $a^{-n} = \frac{1}{a^n}$ *

Examiner only

17. Circle the expression that is equivalent to $w^{-\frac{3}{5}}$. [1]

$-\left(\sqrt[3]{w}\right)^5$ $\quad -\frac{3}{5}w$ $\quad -\left(\sqrt[5]{w}\right)^3$ $\quad \frac{1}{\left(\sqrt[5]{w}\right)^3}$ $\quad \frac{1}{\left(\sqrt[3]{w}\right)^5}$

$w^{-3/5} = \frac{1}{w^{3/5}} = \frac{1}{(\sqrt[5]{w})^3}$

18. Solve the equation $x = \frac{7}{5x-3}$.

Give your answers correct to 2 decimal places. [5]

$\frac{x}{1} = \frac{7}{5x-3}$

Cross multiply

$x(5x-3) = 1 \times 7$

$5x^2 - 3x = 7$

$5x^2 - 3x - 7 = 0$

Formula method

$ax^2 + bx + c = 0$

$a = 5 \quad b = -3 \quad c = -7$

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

$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4 \times 5 \times -7}}{2 \times 5}$

$x = \frac{3 \pm \sqrt{9 + 140}}{10}$

$x = \frac{3 \pm \sqrt{149}}{10}$

$x = \frac{3 \pm 12.21}{10}$

$x = \frac{3 + 12.21}{10}$ OR $\frac{3 - 12.21}{10}$

$x = \frac{15.21}{10}$ OR $\frac{-9.21}{10}$

$x = 1.521$ OR -0.921

To 2dp

$x = 1.52$ OR -0.92

Examiner only

19. *(a)* Give one example to show that the square of an irrational number is **not** always rational. [1]

$\sqrt[3]{4}$ is an irrational number

$(\sqrt[3]{4})^2$ is also an irrational number

Number = $\sqrt[3]{4}$ Square of the number = $\sqrt[3]{16}$

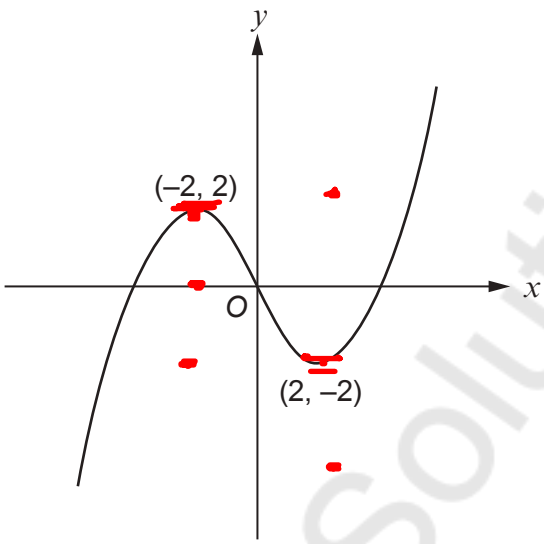
(b) Find two **different** irrational numbers to make the answer to the calculation below rational. Complete the calculation by filling in the three boxes. [1]

$\boxed{\sqrt{3}} \times \boxed{\sqrt{12}} = \boxed{\sqrt{36}} \rightarrow 6$

$\sqrt{3}$ irrational, $\sqrt{12}$ irrational, $\sqrt{36}$ rational number

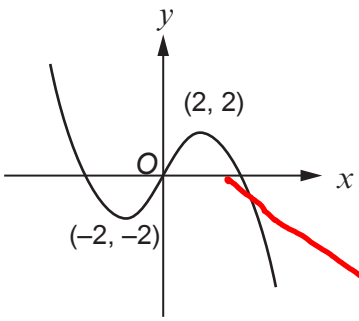
Examiner only

20. A sketch of the graph $y = f(x)$ is shown below.
Two specific points are shown on the graph. They are called a maximum point and a minimum point.
The maximum point shown is (–2, 2) and the minimum point shown is (2, –2).



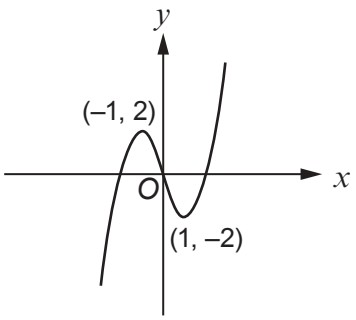
The graphs on the opposite page are transformations of $y = f(x)$.
Draw a line connecting each graph to the equation describing the transformation.
One has been done for you. [4]

Examiner only



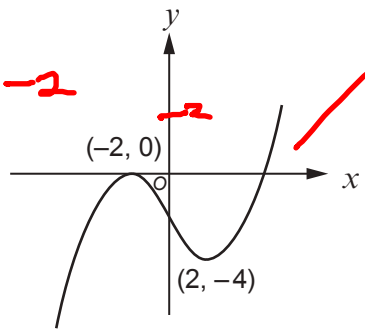
$y = f(x) - 2$

$y = -f(x)$



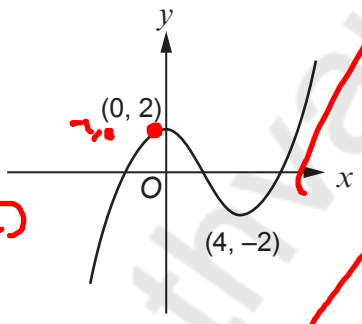
$y = f(x + 2)$

$y = -f(x)$



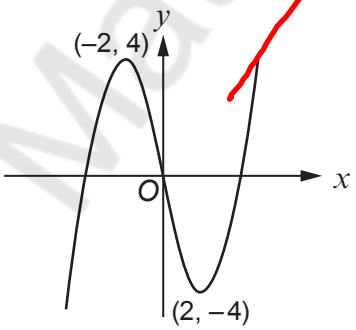
$y = f(x) - 2$

$y = 2f(x)$



$y = f(x + 2)$

$y = f(2x)$



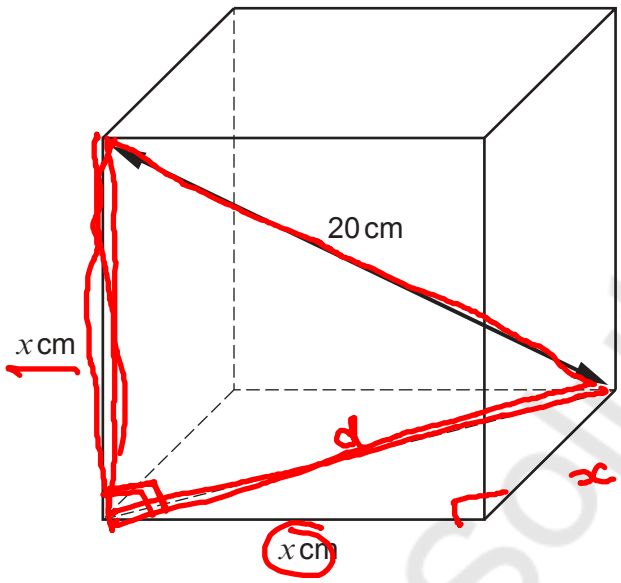
$y = \frac{1}{2} f(x)$

$y = 2f(x)$

$y = f(x - 2)$

Examiner only

21. The cube below has an internal diagonal of length 20 cm.
Each edge of the cube is of length x cm.



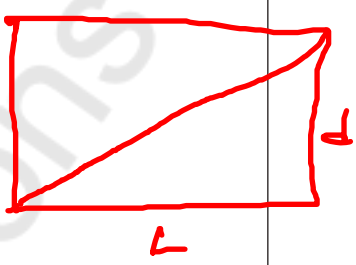


Diagram not drawn to scale

Calculate the value of x.
You must use an algebraic method and show all your working. [4]

Applying pythagoras theorem

$d^2 = x^2 + x^2$

$d^2 = 2x^2$

Applying pythagoras theorem

$x^2 + d^2 = 20^2$

$x^2 + 2x^2 = 400$

$3x^2 = 400$

$x^2 = \frac{400}{3} = 133.3\dot{3}$

$x = \sqrt{133.3\dot{3}} = 11.55$ cm

END OF PAPER

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PLEASE DO NOT WRITE ON THIS PAGE

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

Examiner only