Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

3300U50-1

A21-3300U50-1

MONDAY, 8 NOVEMBER 2021 – MORNING

MATHEMATICS
UNIT 1: NON-CALCULATOR
HIGHER TIER

1 hour 35 minutes

ADDITIONAL MATERIALS

The use of a calculator is not permitted in 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.

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 **1**, 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.	**5**	
2.	**5**	
3.	**4**	
4.	**3**	
5.	**5**	
6.	**3**	
7.	**5**	
8.	**5**	
9.	**3**	
10.	**4**	
11.	**2**	
12.	**3**	
13.	**3**	
14.	**5**	
15.	**5**	
16.	**3**	
17.	**2**	
18.	**5**	
Total	**70**	

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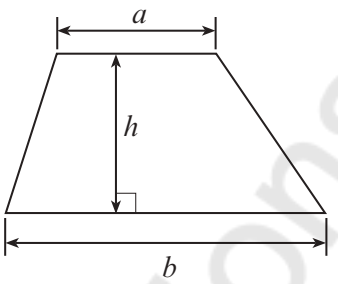
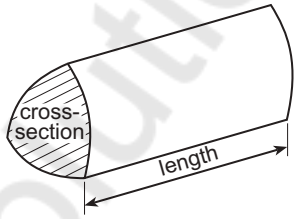
Formula List – Higher Tier

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



Volume of prism = area of cross-section × length

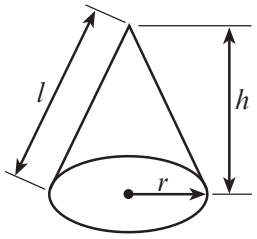


Volume of sphere = $\frac{4}{3}\pi r^3$

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

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

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

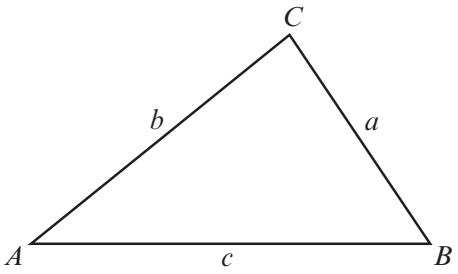


In any triangle ABC

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

The sizes of angles a and b in the triangle shown below are in the ratio 2 : 3.

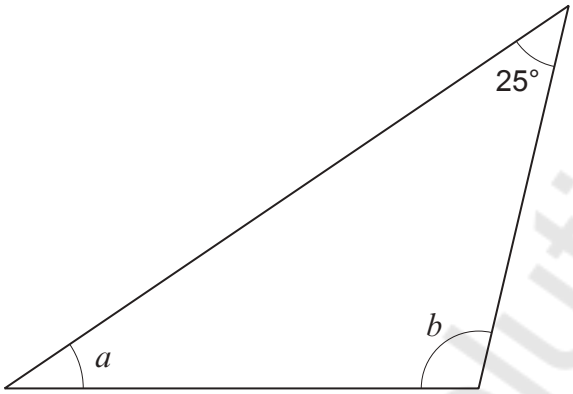


Diagram not drawn to scale

Calculate the size of each of the angles a and b.
You must show all your working. [3 + 2 OCW]

a : b = 2 : 3 Sum of angles in a triangle = 180°

Step 1: let the angle be x

a = 2x , b = 3x

25° + 2x + 3x = 180°

25° + 5x = 180° ; 5x = 180 − 25 = 155

$\frac{5x}{5} = \frac{155}{5}$ x = 31

Find a : a = 2x ; 2(31) = 62°

Find b : b = 3x ; 3(31) = 93°

Examiner only

2. *(a)* Find the Lowest Common Multiple (LCM) of 60 and 72. [2]

60 :

60 ÷ (2) = 30 ; 30 ÷ (2) = 15 ; 15 ÷ (3) = 5 ; 5 ÷ (5) = 1

$2 \times 2 \times 3 \times 5 = 2^2 \times 3 \times 5$

72 :

72 ÷ (2) = 36 ; 36 ÷ (2) = 18 ; 18 ÷ (2) = 9 ; 9 ÷ 3 = (3) ; 3 ÷ (3) = 1

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

$2^3 \times 3^2 \times 5 = 8 \times 9 \times 5 = 360$

LCM of 60 and 72 is 360

(b) Express 882 as a product of its prime factors.
Give your answer in index form. [3]

882 ÷ (2) = 441 ; 441 ÷ (3) = 147 ; 147 ÷ (3) = 49

49 ÷ (7) = 7 ; 7 ÷ (1) = 1

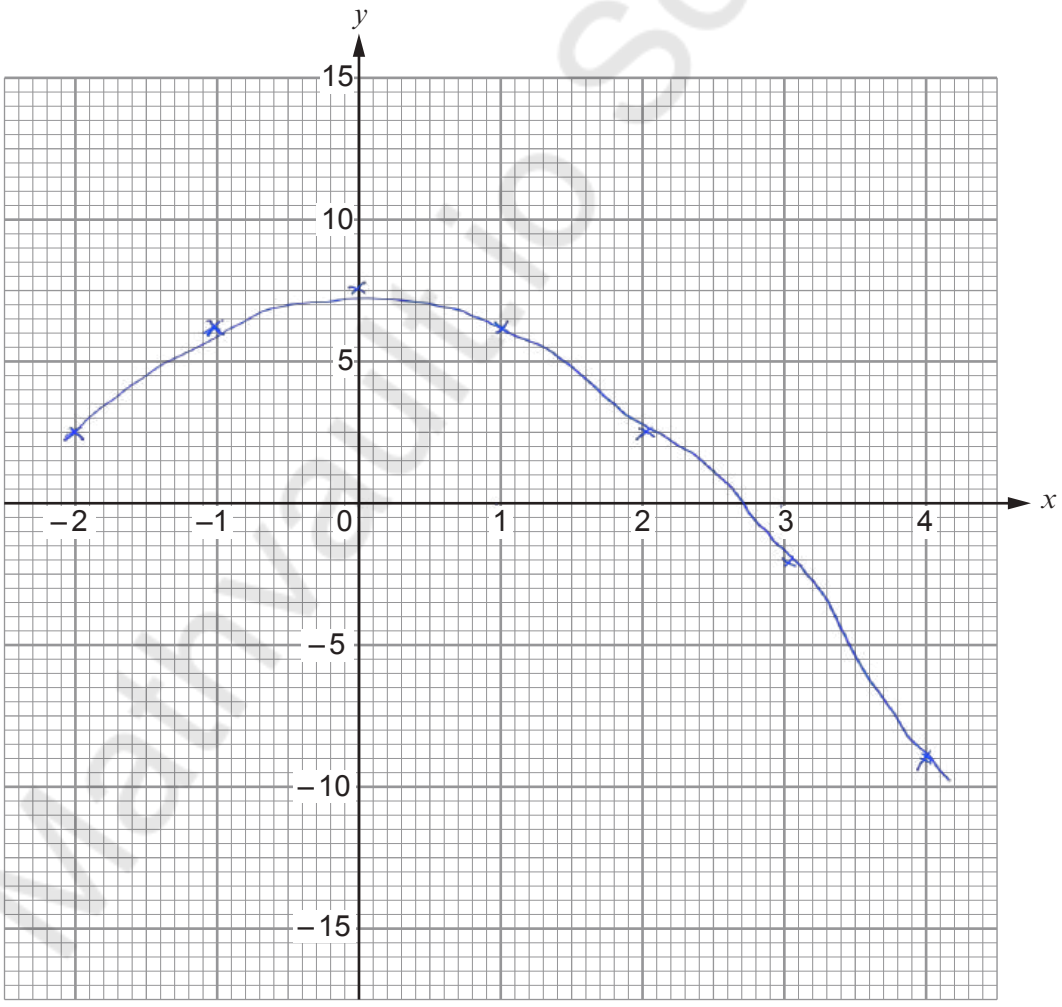
$2 \times 3 \times 3 \times 7 \times 7 = 2^1 \times 3^2 \times 7^2$

Examiner only

3. Complete the table below.
Draw the graph of $y = 7 - x^2$ for values of x between −2 and 4.
Use the graph paper below. [4]

x	−2	−1	0	1	2	3	4
$y = 7 - x^2$	3	6	7	6	3	−2	−9

where $x = -2$; $y = 7 - x^2 = 7 - (-2)^2 = 7 - 4 = 3$
$x = -1$; $y = 7 - x^2 = 7 - (-1)^2 = 7 - 1 = 6$
$x = 3$; $y = 7 - x^2 = 7 - (3)^2 = 7 - 9 = -2$



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4. Calculate the total perimeter of a semicircle of radius 4 cm.
Take π to be 3·14. [3]

$r = 4\text{cm}$
$\pi = 3.14$

Total perimeter of a semi-circle $= \pi r + 2r$

$\pi r = 3.14 \times 4 = 12.56\text{cm}$

$2r = 2 \times 4 = 8\text{cm}$

$12.56 + 8 = 20.56\text{cm}$

Examiner only

5. *(a)* Rearrange the following formula to make k the subject.

$$p = 3k + 2$$ [2]

$P = 3K + 2$; $\frac{P - 2}{3} = \frac{3K}{3}$

$K = \frac{P-2}{3}$

(b) Does the midpoint of the straight line joining points (3, 15) and (7, 19) lie on the line $y = 3x + 2$?
You must show all your working. [3]

x_1, y_1 x_2, y_2

Midpoint $= \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

$= \left(\frac{3 + 7}{2}, \frac{15 + 19}{2}\right) = \left(\frac{10}{2}, \frac{34}{2}\right) = (5, 17)$ $x\ y$

$y = 3x + 2$; where $x = 5$

$= 3(5) + 2 = 15 + 2 = 17$

Yes, the midpoint (5, 17) lies on the line $y = 3x + 2$

6. *(a)* Express 0·0058 in standard form. [1]

5.8×10^{-3}

(b) Calculate the value of $\frac{1{\cdot}4 \times 10^9}{2 \times 10^3}$.

Give your answer in standard form. [2]

$\frac{1.4}{2} = 0.7$ $\frac{10^9}{10^3} = 10^{9-3} = 10^6$

$0.7 \times 10^6 = 7.0 \times 10^5$

Examiner only

7. A group of people have put their names forward to carry the Welsh flag at a sporting event. Each person lives in North Wales, Mid Wales or South Wales.

One person from the group is chosen at random.
The probability of choosing a person who lives in North Wales is 0·3.
The probability of choosing a person who lives in Mid Wales is 0·25.

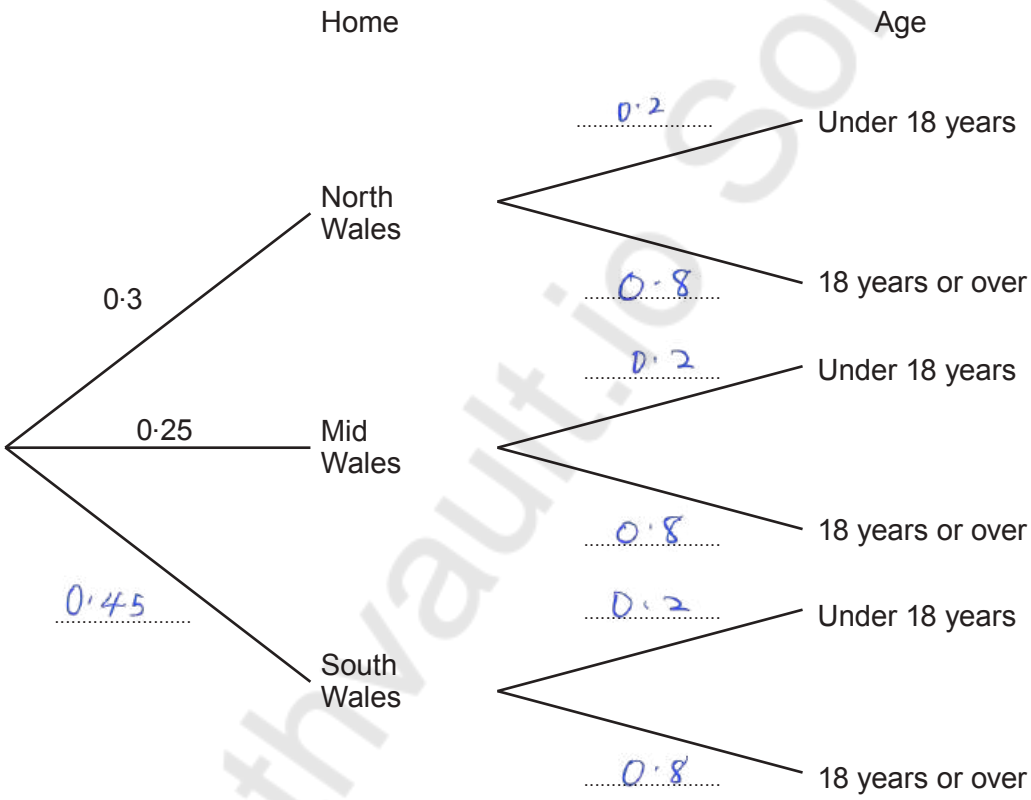
The probability of choosing a person who is under 18 years old is 0·2.

The people's ages are independent of where they live.

(a) Complete the tree diagram shown below. [3]

$P(NW) + P(MW) + P(SW) = 1$; $0.3 + 0.25 + P(SW) = 1$; $P(SW) = 1 - 0.3 - 0.25$
$= 0.45$

$P(18 \text{ or over}) = 1 - 0.2 = 0.8$

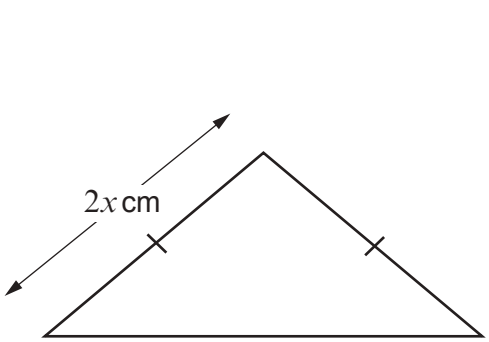


(b) What is the probability of choosing a person who lives in South Wales and is under 18 years old? [2]

$P(SW) \times P(\text{under } 18) = 0.45 \times 0.2$
$= 0.09$

Examiner only

8. The diagram below shows an isosceles triangle and a square.



Perimeter of triangle = 19 cm

Diagram not drawn to scale

Use an algebraic method (not trial and improvement) to find the value of x and the value of y. You must show all your working. [5]

$2x, 2x, 3y = 19 \quad = 2x+2x+3y=19; \; 4x+3y=19$ ①

$6x - y = 12 \; ; \; y = 6x - 12$ ②

Substitute: $4x + 3y = 19; \; 4x + 3(6x-12) = 19$

$4x + 18x - 36 = 19 \quad = 22x = 19 + 36 \quad = 55$

$\frac{22x}{22} = \frac{55}{22} \quad = 2.5$

To find y: $y = 6x - 12$

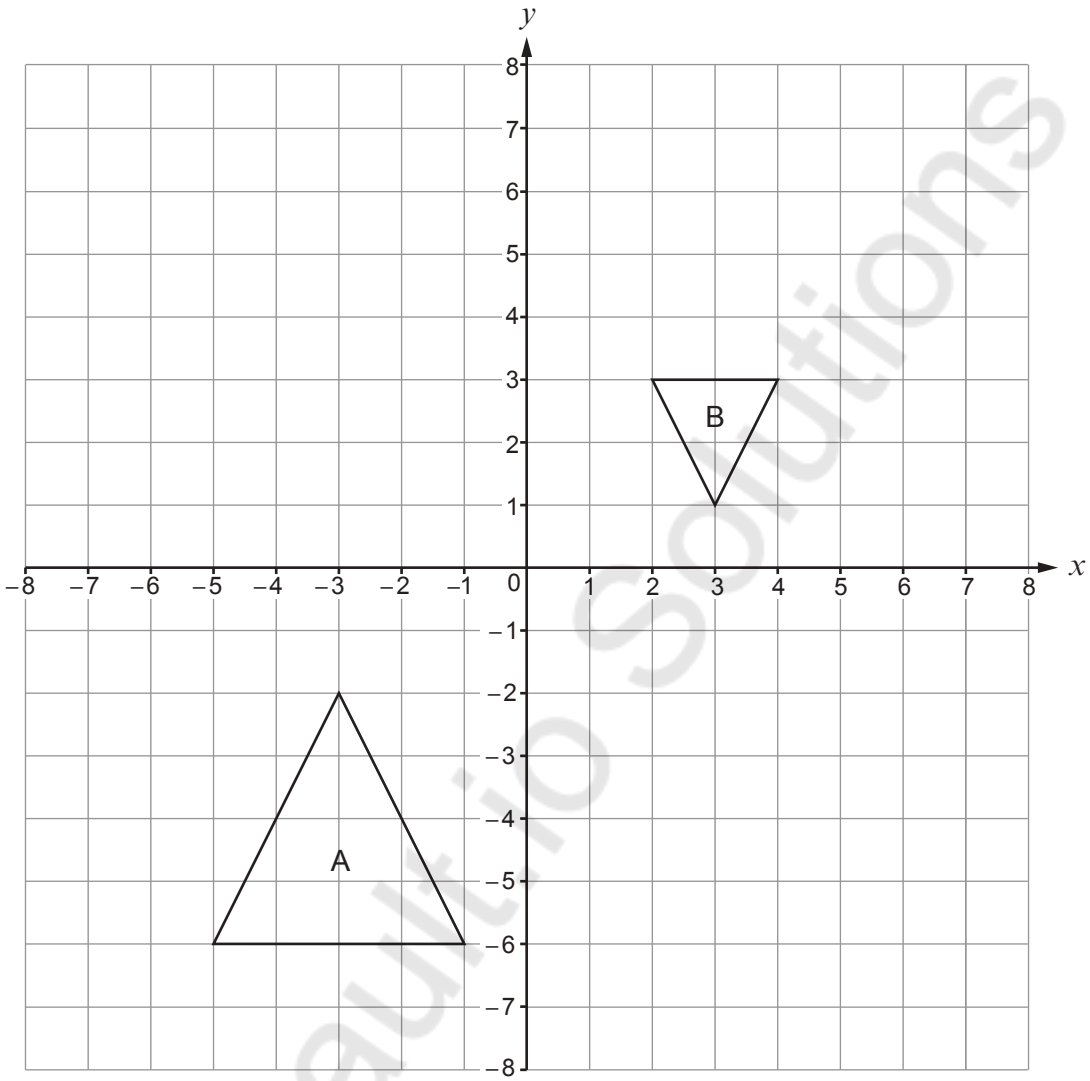
$y = 6(2.5) - 12$

$= 15 - 12 = 3$

$x =$ 2·5 or 2½ $\quad y =$ 3

Examiner only

9. Describe fully the **single** transformation that transforms shape A onto shape B. [3]



Enlargement with scale factor $-\frac{1}{2}$ & centre (1, 0)

Examiner only

10. Express $\frac{5x}{2x-1} - \frac{4x}{4x+3}$ as a single fraction in its simplest form. [4]

$(2x-1)(4x+3)$;

$\frac{4x}{4x+3} = \frac{4x(2x-1)}{(2x-1)(4x+3)}$

$\frac{5x(4x+3) - 4x(2x-1)}{(2x-1)(4x+3)}$

$= 12x^2 + 19x$

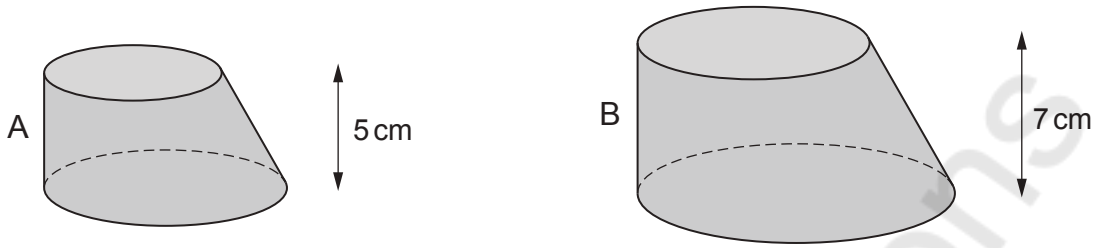
$\frac{5x}{2x-1} = \frac{5x(4x+3)}{(2x-1)(4x+3)}$

$= (20x^2 + 15x) - (8x^2 - 4x)$

$= \frac{12x^2 + 19x}{(2x-1)(4x+3)}$

Examiner only

11. Two **similar** solids are shown below.



Diagrams not drawn to scale

Solid A has a height of 5 cm.
Solid B has a height of 7 cm.

Mari claims that the surface area of solid B is more than double the surface area of solid A.
Is Mari correct?
You must justify your answer. [2]

Scale factor (k) ; $k = \frac{7}{5}$

Surface area scale factor $= \left(\frac{7}{5}\right)^2 = \frac{49}{25} = 1.96$

Mari is incorrect. The SA of solid B is only 1.96 times that of solid A, which is less than double.

Examiner only

12. Rearrange the following formula to make w the subject.

$$xw + 4 = 3y - 8w$$ [3]

$xw + 8w + 4 = 3y$

$w(x + 8) + 4 = 3y$; subtract 4 from both sides

$\frac{w(x+8)}{x+8} = \frac{3y-4}{x+8}$

$w = \frac{3y-4}{x+8}$

Examiner only

13. Solve the equation

$$4x^2 - x - 3 = 0.$$

(a = 4, b = −1, c = −3)

You must use an algebraic method and show all your working. [3]

$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ ✓ Quadratic formula

$a = 4$, $b = -1$, $c = -3$

$x = \dfrac{-(-1) \pm \sqrt{(-1)^2 - 4(4)(-3)}}{2(4)} = \dfrac{1 \pm \sqrt{1 + 48}}{8} = \dfrac{1 \pm \sqrt{49}}{8}$

$= \dfrac{1 \pm 7}{8}$

$x = \dfrac{1+7}{8} = \dfrac{8}{8} = 1$

$x = \dfrac{1-7}{8} = \dfrac{-6}{8} = -\dfrac{3}{4}$

$x = -1$ or $x = -3/4$

Examiner only

14. *(a)* Evaluate $4^{-\frac{3}{2}}$. [2]

$\frac{1}{4^{3/2}}$

$9^{m/n} = (\sqrt{4})^m = (\sqrt{4})^3 = 2^3 = 8$

$4^{-3/2} = \frac{1}{8}$

(b) Evaluate $\frac{1}{3} + 0{\cdot}0\dot{2}$.

Express your answer as a fraction. [3]

convert $0{\cdot}0\dot{2}$ to a fraction

$\frac{1}{3} + \frac{0.2}{9}$

$\frac{30+2}{90} = \frac{32}{90}$ 16 $= \frac{16}{45}$

Examiner only

15. A solid object is made out of a hemisphere and a cylinder.

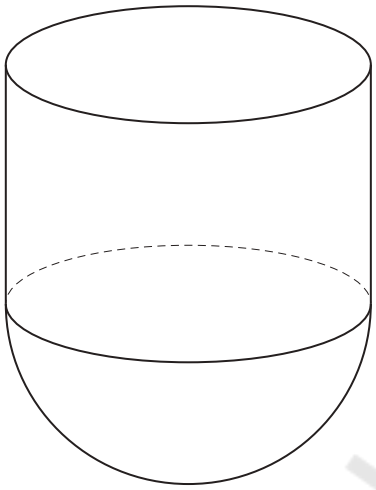


Diagram not drawn to scale

The radius of the common circular surface is 3 cm.
The volume of the whole object is $63\pi\,cm^3$.

Calculate the total height of the object. [5]

$R = 3cm$, Total Volume $= 63\pi\,cm^3$

Hemisphere $= \frac{2}{3}\pi r^3 = \frac{2}{3}\pi(3)^3 = \frac{2}{3}\pi \times 27 = 18\pi\,cm^3$

Cylinder $= \pi r^2 h = \pi \times 3^2 \times h = 9\pi h$

Total volume $= 18\pi + 9\pi h = 63$

$9h = 63 - 18 = 45$

$\frac{9h}{9} = \frac{45}{9}$ $\quad h = 5cm$

Total height = Cylinder height + radius

$= 5 + 3 = 8cm$

Examiner only

16. You are given that $c = \sqrt{18}$, $d = \sqrt{12}$ and $e = \sqrt{3}$.
Circle the correct answer in each of the following:

(a) c is equal to [1]

$2\sqrt{3}$ $3\sqrt{2}$ 4·5 9 $9\sqrt{2}$

$C = \sqrt{18} = 3\sqrt{2} = 3 \times 1.414 = 4.242$

(b) $\frac{d}{e}$ is equal to [1]

$d = \sqrt{12}$, $e = \sqrt{3}$

$\frac{1}{2}$ $\sqrt{2}$ 2 $\sqrt{6}$ 4

$\sqrt{12}/\sqrt{3} = \frac{3.464}{1.732} = 2$

(c) e^5 is equal to [1]

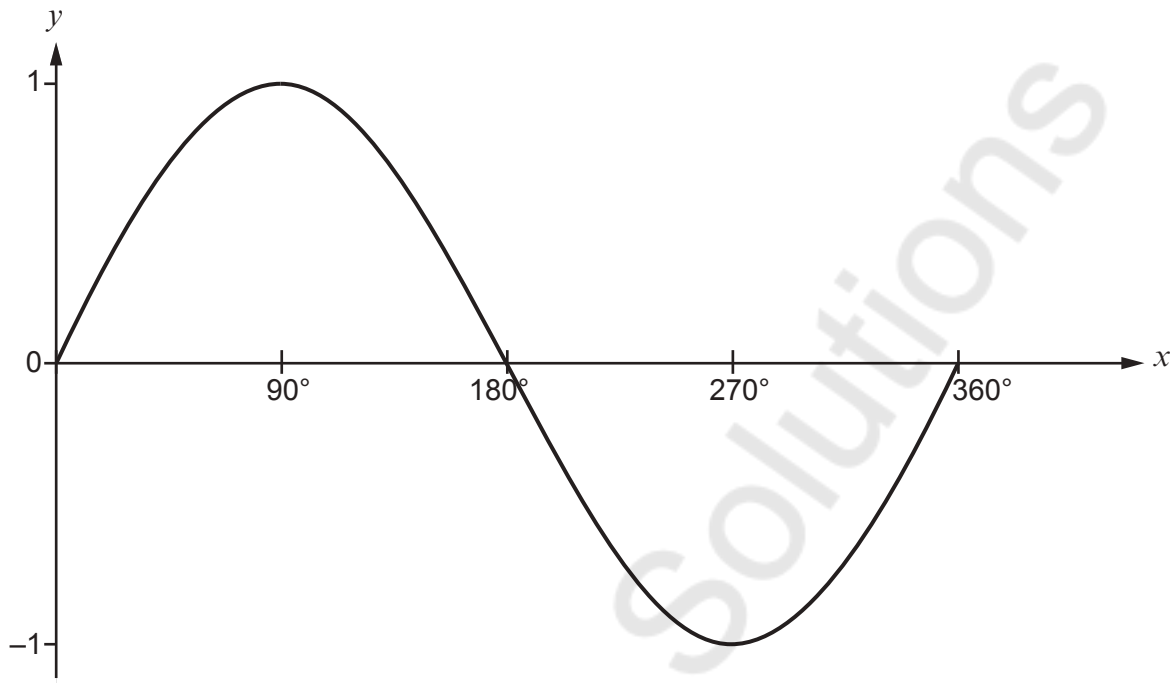
$\sqrt{15}$ 5 $5\sqrt{3}$ $9\sqrt{3}$ 15

$e = \sqrt{3} = (\sqrt{3})^5 = (3^{\frac{1}{2}})^5 = 3^{5/2}$

$e^5 = 3^{5/2} = 3^2 \times 3^{1/2} = 9\sqrt{3}$

Examiner only

17. The following diagram shows a sketch of $y = \sin x$ for values of x from 0° to 360°.



Given that $\sin 38° = 0{\cdot}6157$, correct to 4 decimal places, write down all the solutions of the equation

$$\sin x = -0{\cdot}6157$$

for values of x from 0° to 360°. [2]

Find the reference angle: $\sin 38^0 = 0.6157 \quad = 38^0$

$\sin x = -0.6157$

Q3 = $x = 180^0 + 38^0 = 218^0$

Q4 = $x = 360 - 38 = 322$

So $x = 218^0$ & $x = 322^0$

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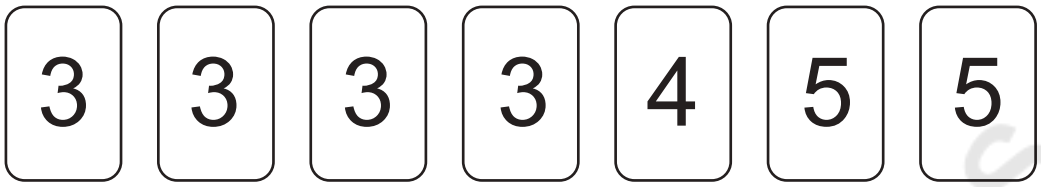
18.



Three of the seven cards shown above are selected at random, **without** being replaced.

(a) Find the probability that the first card selected is a 3, the second is a 4 and the third is a 5. [2]

P(1st card is a 3) = $\frac{4}{7}$

P(2nd card is a 4) = $\frac{1}{6}$

P(3rd card is a 5) = $\frac{2}{5}$

$\frac{4}{7} \times \frac{1}{6} = \times\frac{2}{8} = \frac{8}{210} = \frac{4}{105}$

(b) Find the probability that the sum of the numbers selected is greater than 9. [3]

1) 3+3+4 = 10 $\binom{4}{2}$ = 6 ways ; $\binom{1}{1}$ = 1 way = 6×1 = 6

2) 3+3+5 = 11 $\binom{4}{2}$ = 6 ways ; $\binom{2}{1}$ = 2 ways = 6×2 = 12

3) 3+4+5 = 12 $\binom{4}{1}$ = 4 , $\binom{1}{1}$ = 1 , $\binom{2}{1}$ = 4×1×2 = 8

4) 3+3+5 = 13 $\binom{4}{1}$ = 4 , $\binom{2}{2}$ = 4 × 1 = 4

5) 4+5+5 = 14 $\binom{1}{1}$ = 1 , $\binom{2}{2}$ = 1×1 = 1

6) 3+3+3 = 7 ✗

6 + 12 + 8 + 4 + 1 = 31

Total possible card selections $\binom{7}{3}$ = 35 ← Based off of Permutation & Combination

= $\frac{31}{35}$ //

$\frac{7!}{3! \times (7-3)!} = \frac{7\times6\times5\times4\times3\times2\times1}{3\times2\times1 \times 4\times3\times2\times1} = \frac{7\times6\times5}{3\times2\times1} = \frac{210}{6} = 35$

END OF PAPER

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

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