New Specification

Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2018

Mathematics

StemUp Model Solution

Unit M3 **(With calculator)**
Higher Tier



[GMC31]

GMC31

THURSDAY 24 MAY, 9.15am–11.15am

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
All working should be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.
Where rounding is necessary give answers correct to **2 decimal places** unless otherwise stated.
Answer **all twenty-five** questions.

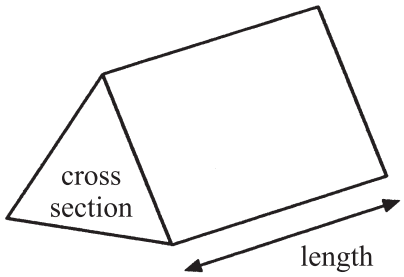
INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You may use a calculator.
You should have a calculator, ruler, compasses and a protractor.
The Formula Sheet is on page 2.

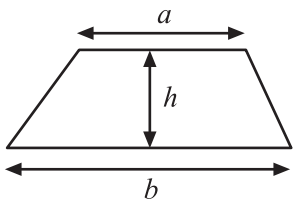
11724

Formula Sheet

Volume of prism = area of cross section × length

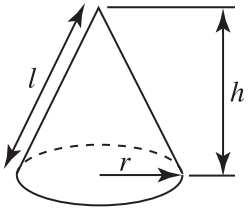


Area of trapezium = $\frac{1}{2}(a+b)h$



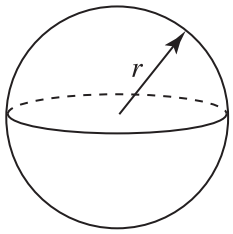
Volume of cone = $\frac{1}{3}\pi r^2 h$

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

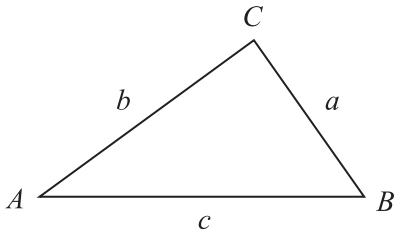


Volume of sphere = $\frac{4}{3}\pi r^3$

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



In any triangle *ABC*



Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$, are given by

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

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

1 **(a)** Write 2 **prime** numbers between 60 and 70

Answer 61 and 67 [2]

(b) Which of these is both a **square** number and a **cube** number?

8 16 36 64 100

Answer 64 [1]

(c) Write $\frac{3}{8}$ as a decimal.

$3 \div 8 = 0.375$

Answer 0.375 [1]

(d) What percentage is £9 of £16?

$\frac{9}{16} \times 100 = 56.25$

Answer 56.25 % [2]

[Turn over

2 **(a)** Bikes normally cost £b each.

In a sale they are each reduced by £30

Write an expression for the cost of a bike in the sale.

Answer $b - 30$ [1]

(b) Cycling helmets normally cost £h each.

In a sale they are each reduced to half-price.

Write an expression for the cost of a cycling helmet in the sale.

Answer $\frac{h}{2}$ [1]

(c) Write an expression for the total cost of 4 bikes and 4 cycling helmets in the sale.

$4(b - 30) + 4 \times \frac{1}{2}h$

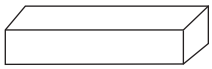
Answer $4b - 120 + 2h$ [2]

3 Solve the equation $5y + 4 = 24$

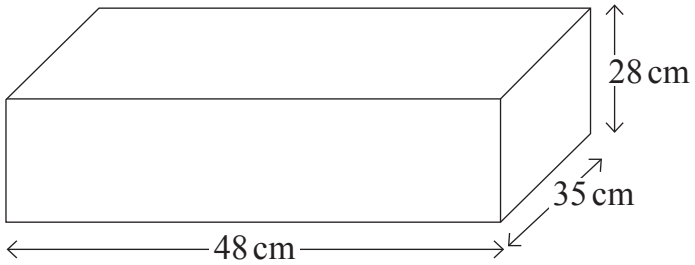
$5y = 24 - 4$
$5y = 20$
$y = 20 \div 5 = 4$

Answer 4 [2]

4 The packaging for a tube of toothpaste is a cuboid measuring 16 cm × 5 cm × 4 cm.



The manufacturer wants to be able to pack 150 of these tubes into a cardboard box.
The box is a cuboid.
The box measures 48 cm × 35 cm × 28 cm.



Will the box be big enough to hold 150 tubes of toothpaste in their packaging?
You must show working to explain your answer.

48 ÷ 16 = 3 tubes along the length
35 ÷ 5 = 7 tubes along the width
28 ÷ 4 = 7 tubes up the height
3 × 7 × 7 = 147 tubes
147 < 150, so the box is not big enough

Answer No [3]

[Turn over

5 Male and female care assistants work in a nursing home.

Some can work weekdays only, some can work weekends only and some can work both.

(a) Complete the two-way table below.

	Weekdays only	**Weekends only**	**Both**	**Total**
Male	1	5	2	8
Female	2	3	8	13
Total	3	8	10	21

[2]

(b) How many male care assistants can work on weekends?

5 + 2 = 7

Answer 7 [1]

6 John has a telephone with the following costs.

Line rental: £18.99 per month
Call charge: 5.8p per minute

Last month John made calls lasting 385 minutes.

Work out his telephone bill for last month.

385 × 5.8 = 2233p = £22.33
22.33 + 18.99 = 41.32

Answer £ 41.32 [3]

[Turn over

7

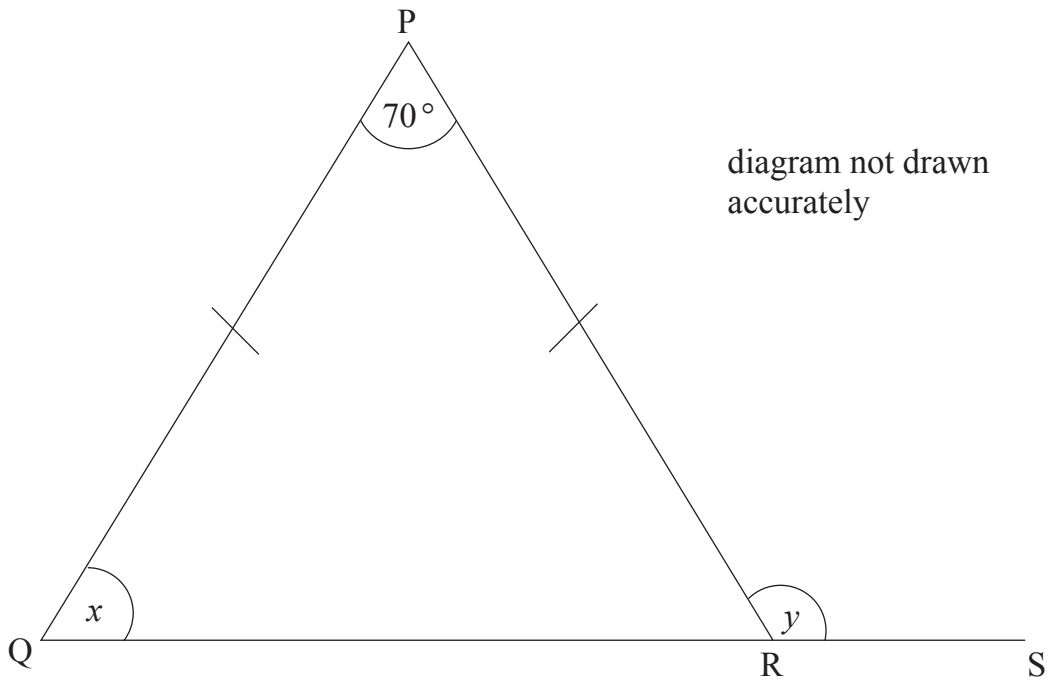


diagram not drawn accurately

PQR is an isosceles triangle with PQ = PR.
QRS is a straight line.

(a) Work out the size of the angle marked x.

(180 − 70) ÷ 2
= 110 ÷ 2 = 55

Answer 55 ° [2]

(b) Work out the size of the angle marked y.

180 − 55 = 125

Answer 125 ° [1]

(c)

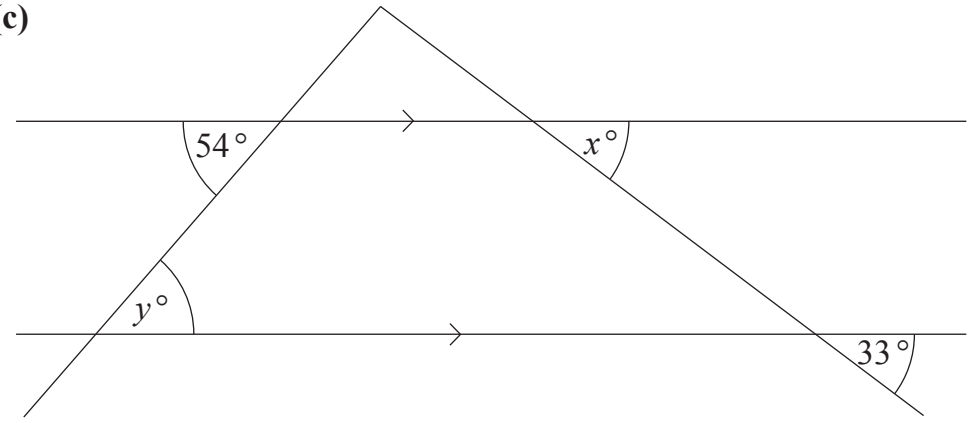


diagram not drawn accurately

Write down the values of x and y.

$x = 33°$ (alternate angles)
$y = 54°$ (corresponding angles)

Answer $x =$ 33 [1]

Answer $y =$ 54 [1]

[Turn over

8 The life expectancy for males in 12 countries in Africa for 2015 is shown in the following stem and leaf diagram.

4	9					
5	0	5	5	6	8	8
6	0	2	4			
7	1	3				

Key: 5 | 3 means 53 years

(a) How many of these countries had a life expectancy for males of less than 58 years?

49, 50, 55, 55, 56

Answer 5 [1]

(b) For the above data work out

(i) the median,

6th and 7th values: 58 and 58
(58 + 58) ÷ 2 = 58

Answer 58 years [1]

(ii) the range.

73 – 49 = 24

Answer 24 years [1]

(c) In **1975** the life expectancy for males in the same 12 countries had a median of 49 years and a range of 30 years.

Compare the life expectancy for males in these 12 countries in **2015** with the life expectancy for males in **1975**

In 2015 the median was higher (58 > 49), so on average males lived longer. The range was smaller in 2015 (24 < 30), so the life expectancies were less spread out. [2]

[Turn over

9 Sue is training to compete in a 10 km walk.

A diagram of her local athletics track is shown below.

The track consists of a rectangle and two semicircles.

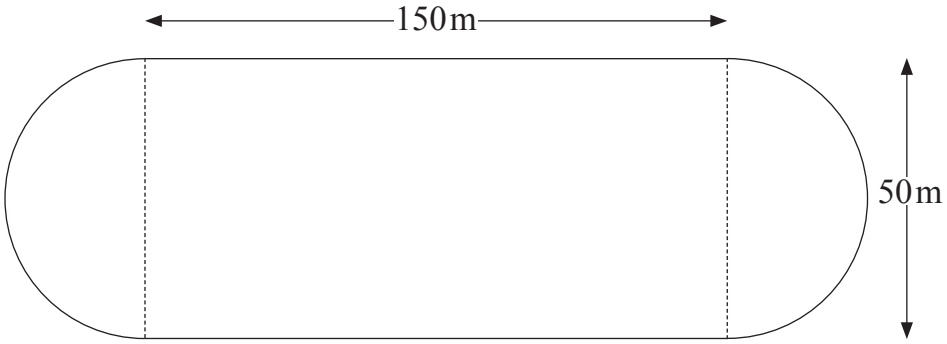


diagram not drawn accurately

How many complete laps are needed to ensure she walks 10 km?

You must show all your working.

Two semicircles = one circle of diameter 50 m
π × 50 = 157.0796... m
One lap = 157.0796... + 150 + 150 = 457.0796... m
10 km = 10000 m
10000 ÷ 457.0796... = 21.878...
21 laps is not enough, so she needs 22 laps

Answer 22 [4]

10 **(a)** Pat buys 30 boxes of crisps.

Each **box** contains 48 **packets** of crisps.

He sells 80% of the crisps at 60p a packet.

(i) How many packets does he sell at this price?

30 × 48 = 1440 packets
0.8 × 1440 = 1152

Answer 1152 [2]

(ii) How much in total does he sell them for?

1152 × 60p = 69120p = £691.20

Answer £ 691.20 [1]

(b) He sells the rest at 20p a packet.
Pat paid £25 for each box of crisps.

Does Pat make a profit or loss, and how much is this profit or loss?

Rest: 1440 − 1152 = 288 packets
288 × 20p = 5760p = £57.60
Total sales = 691.20 + 57.60 = £748.80
Cost = 30 × £25 = £750
750 − 748.80 = £1.20 loss

Answer Pat makes a loss of £ 1.20 [3]

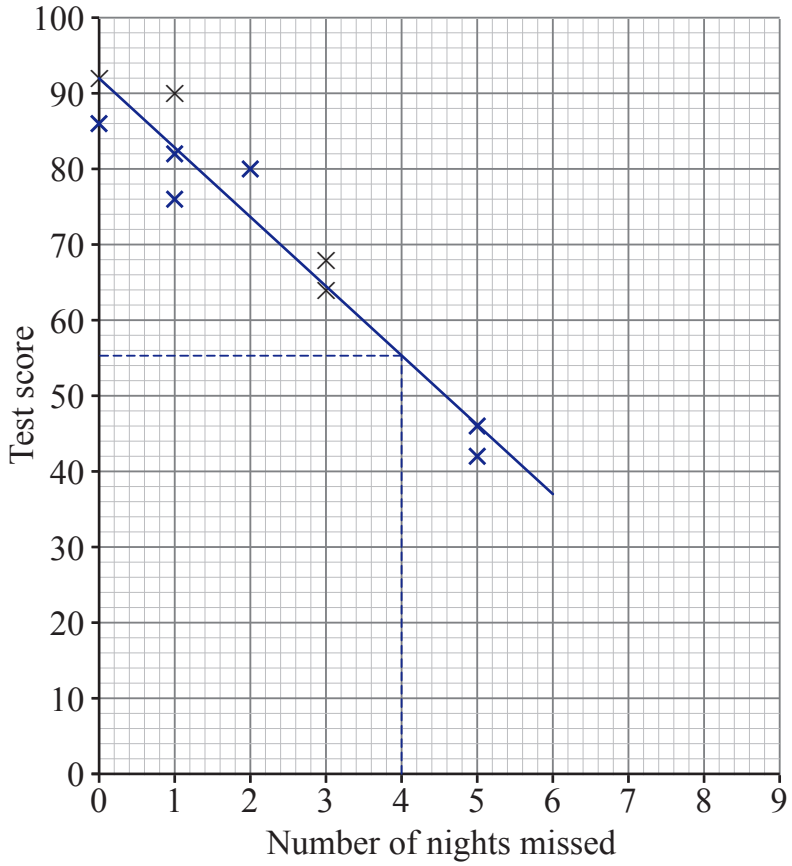
[Turn over

11 A group of pupils do a first aid course over 8 nights.
There is a test at the end of the course.

The table shows the number of nights each pupil misses and their test score.

Pupil	A	B	C	D	E	F	G	H	I	J
Number of nights missed	**0**	**3**	**1**	**3**	2	1	0	5	1	5
Test score	**92**	**64**	**90**	**68**	80	82	86	42	76	46

(a) The first 4 points are plotted on the scatter graph.
Plot the last 6 points.



[2]

(b) Draw the line of best fit. [1]

(c) Another pupil missed 4 nights of the course.
Use the graph to estimate their test score.

Answer 55 [1]

(d) What type of correlation does your graph show?

Answer negative [1]

[Turn over

12 Each player in a group of 15 players scored either 2 or x goals.

Number of goals	Frequency
2	10
x	5

The mean number of goals per player was 3

Calculate x.

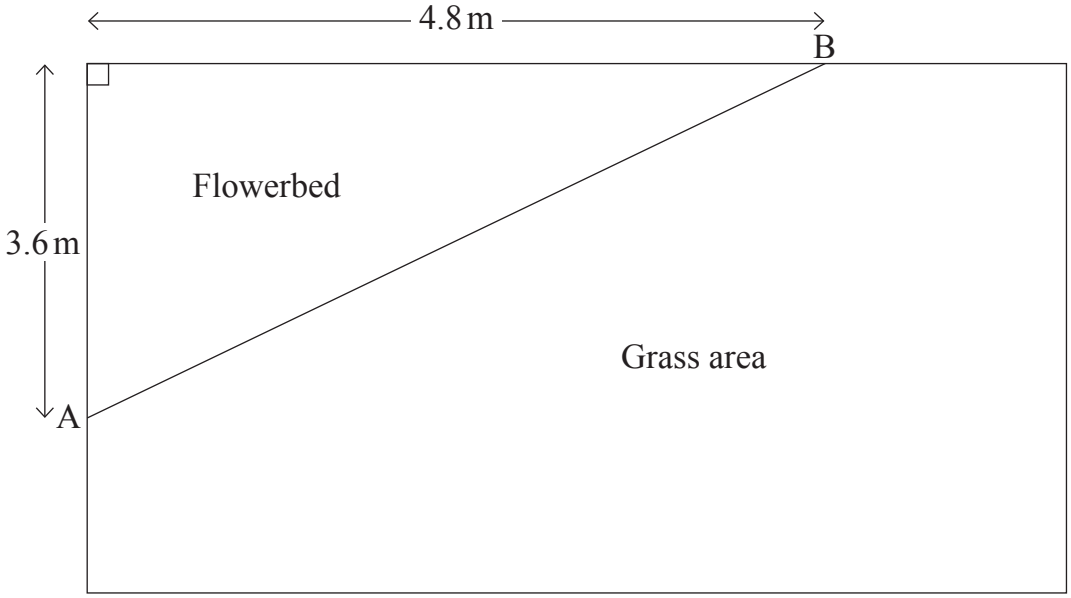
$$\text{Mean} = \frac{2 \times 10 + 5x}{15} = 3$$

$$20 + 5x = 45$$
$$5x = 25$$
$$x = 5$$

Answer $x =$ 5 [3]

13 A garden has a flowerbed in the corner.

A diagram of the garden is shown below.



(a) Calculate the area of the flowerbed.

Area = (3.6 × 4.8) ÷ 2
= 17.28 ÷ 2 = 8.64

Answer 8.64 m^2 [2]

(b) There is a small fence along the line AB separating the flowerbed from the grass area.

How long is the fence?

$AB^2 = 3.6^2 + 4.8^2 = 12.96 + 23.04 = 36$
$AB = \sqrt{36} = 6$

Answer 6 m [3]

[Turn over

14 Last year a company spent a total of £2400 on advertising.

This year they spent £2796

What was the percentage increase in their spending on advertising?

$2796 - 2400 = 396$

$\frac{396}{2400} \times 100 = 16.5$

Answer 16.5 % [3]

15 Solve the equation $p + 15 = 2(4p - 3)$

$p + 15 = 8p - 6$
$15 + 6 = 8p - p$
$21 = 7p$
$p = 3$

Answer $p =$ 3 [3]

16 Best Bank offers a 3 year investment account with a fixed compound interest rate of 1.75 % per annum.

Mr Lucas invests £8000 in this account.

What is the value of his investment at the end of the 3 year period?

Multiplier = 1 + 0.0175 = 1.0175
8000×1.0175^3
= 8427.392875
= £8427.39 (to 2 d.p.)

Answer £ 8427.39 [4]

[Turn over

17 At a concert 40% of the audience are children.

One third of the **rest** of the audience are men.

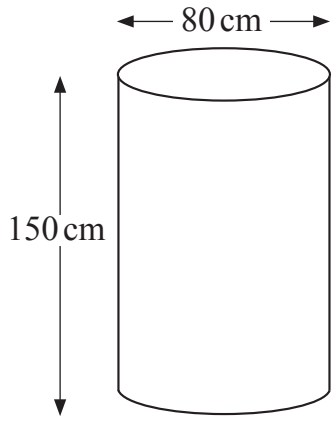
There are 120 women in the audience.

Work out the total number of people in the audience.

Rest = 100% − 40% = 60%
Men = ⅓ of 60% = 20%
Women = 100% − 40% − 20% = 40%
40% = 120, so 1% = 3, so 100% = 300

Answer 300 [3]

18 A cylindrical tank has a diameter of 80 cm and a height of 150 cm as shown.



Calculate the volume of water the tank can hold when full.

Give your answer correct to the nearest litre.

$r = 80 \div 2 = 40$ cm
$V = \pi \times 40^2 \times 150$
$= 753982.2369$ cm^3
1 litre $= 1000$ cm^3
$753982.2369 \div 1000 = 753.98... = 754$ litres

Answer 754 litres [4]

[Turn over

stemup.co.uk

19 Peter, John and Matthew are three brothers.

Peter is 10 years old.

John is x years old.

Matthew is a year younger than twice John's age.

The mean of their ages is 7 years.

Work out John's age.

Matthew = $2x - 1$

$$\frac{10 + x + 2x - 1}{3} = 7$$

$3x + 9 = 21$
$3x = 12$
$x = 4$

Answer 4 years [4]

20 Which average (mean, mode or median) would be most suitable for each set of data?

Explain your choice.

(a) One value appears much more frequently than the others and it is not at the upper or lower end of the data.

Answer mode because it is the most common value and it represents the data set best. [1]

(b) The data is fairly evenly spread but there is one extreme value at the upper end.

Answer median because the extreme value would affect the mean, but not the median. [1]

[Turn over

21 A school timetable is being arranged.

The day can be arranged in 30-minute classes or 50-minute classes or 60-minute classes.

No matter which of the three choices is made, the total daily teaching time will be the same.

Ignoring the time for break or lunch, what is the daily teaching time?

You must show all your working.

$30 = 2 \times 3 \times 5$
$50 = 2 \times 5 \times 5$
$60 = 2 \times 2 \times 3 \times 5$
$LCM = 2 \times 2 \times 3 \times 5 \times 5 = 300$
300 minutes = 5 hours

Answer 300 minutes [4]

22 Solve the equation

$$\frac{2x-1}{3} + \frac{x+2}{2} + \frac{x}{6} = 8$$

Show all your working clearly.

A solution by trial and improvement will not be accepted.

Multiply every term by 6:
$2(2x - 1) + 3(x + 2) + x = 48$
$4x - 2 + 3x + 6 + x = 48$
$8x + 4 = 48$
$8x = 44$
$x = 44 \div 8 = 5.5$

Answer $x =$ 5.5 [5]

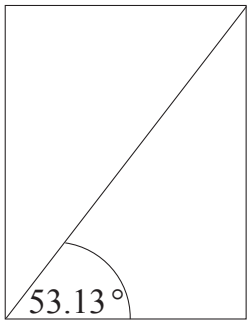
[Turn over

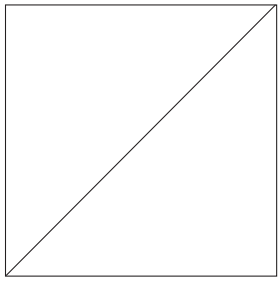
23 Factorise $y^2 - 6y + 8$

$(y - 2)(y - 4)$

Answer $(y - 2)(y - 4)$ [2]

24 A rectangle and a square have the same length of diagonal.





diagrams not drawn accurately

Calculate the length of the side of the square.

Give your answer correct to 1 decimal place.

Diagonal of rectangle = d:

$\cos 53.13° = \frac{9}{d}$ so $d = \frac{9}{\cos 53.13°} = 14.99996... = 15$ cm

Square side x: $x^2 + x^2 = 15^2$

$2x^2 = 225$

$x^2 = 112.5$

$x = \sqrt{112.5} = 10.6066... = 10.6$ cm

Answer 10.6 cm [6]

25

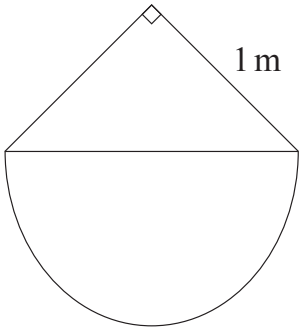


diagram not
drawn accurately

The composite shape consists of a right-angled isosceles triangle and a semicircle.

(a) Show that the area of the composite shape is approximately $1.285\,m^2$

$d^2 = 1^2 + 1^2 = 2$, $d = 1.4142...$ m (diameter)
radius $= 1.4142... \div 2 = 0.7071...$ m
Triangle $= \frac{1}{2} \times 1 \times 1 = 0.5\ m^2$
Semicircle $= \frac{1}{2} \times \pi \times 0.7071...^2 = 0.7853...\ m^2$
Total $= 0.5 + 0.7853... = 1.2853... \approx 1.285\ m^2$

[4]

(b) Find the force applied to the area of the composite shape when the pressure is $5\ N/m^2$

$F = P \times A = 5 \times 1.2854$
$= 6.4269... = 6.43$

Answer 6.43 N [2]

THIS IS THE END OF THE QUESTION PAPER

DO NOT WRITE ON THIS PAGE

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
Total Marks	

Examiner Number

Permission to reproduce all copyright material has been applied for.
In some cases, efforts to contact copyright holders may have been unsuccessful and CCEA will be happy to rectify any omissions of acknowledgement in future if notified.

stemup.co.uk