Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2022

Mathematics

StemUp Model Solution

Unit M2
(With calculator)
Foundation Tier



[GMC21]

GMC21

TUESDAY 24 MAY, 9.15am–11.00am

TIME

1 hour 45 minutes.

INSTRUCTIONS TO CANDIDATES

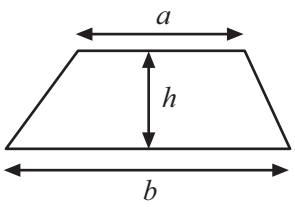
Write your Centre Number and Candidate Number in the spaces provided at the top of this page. **You are provided with Foundation Tier Additional Support Materials for use with this paper.**
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all twenty-seven** questions.
All working should be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.
You **may** use a calculator for this paper.

INFORMATION FOR CANDIDATES

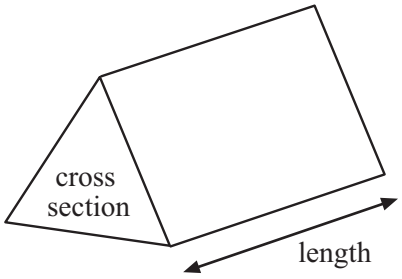
Functional Mathematics is assessed in this unit.
The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You should have a calculator, ruler, compasses and a protractor.
The Formula Sheet is on page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

Formula Sheet

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



Volume of prism = area of cross section × length



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1 **(a)** The warmest place in the world is in Ethiopia.

It has an average temperature of 34°C.



Source: © Getty Images

The coldest place in the world is in Antarctica.

It has an average temperature of –58°C.



Source: © Getty Images

What is the difference between these temperatures?

$34 - (-58) = 34 + 58 = 92$

Answer 92 °C [1]

(b) The formula below can be used to convert between temperatures in Celsius and Fahrenheit.

$$F = 1.8C + 32$$

where F is the temperature in Fahrenheit and C is the temperature in Celsius.

The average temperature in Northern Ireland is 8° Celsius.

(i) Convert this temperature into Fahrenheit.

$F = 1.8 \times 8 + 32$

$= 14.4 + 32 = 46.4$

Answer 46.4 °F [2]

(ii) Water freezes at 32° Fahrenheit.

What temperature is this in Celsius?

$32 = 1.8C + 32$

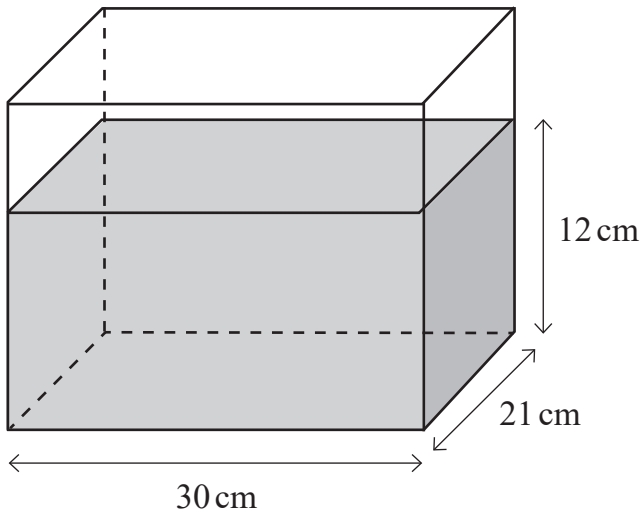
$1.8C = 0$, so $C = 0$

Answer 0 °C [1]

[Turn over

2 A chip shop keeps gravy in a tin.

The tin is a cuboid.



(a) What is the volume of gravy in the tin?

Include units with your answer.

$V = 30 \times 21 \times 12$

$= 7560 \text{ cm}^3$

Answer 7560 cm^3 [3]

(b) The gravy is sold in 120 ml tubs.

How many tubs can be filled using the gravy in the tin?

$120 \text{ ml} = 120 \text{ cm}^3$

$7560 \div 120 = 63$

Answer 63 [2]

3 **(a)** Priya earns £11.158 per hour.

Write this amount in pounds (£) correct to the nearest penny.

11.158 → 11.16

Answer £ 11.16 [1]

(b) Diesel costs 131.9p per litre.

Write this amount in pounds (£) correct to the nearest penny.

131.9p = £1.319 → £1.32

Answer £ 1.32 [1]

(c) Priya drove 11 760 miles last year.

$\frac{5}{7}$ of the miles driven were for work.

How many miles were for work?

11 760 ÷ 7 = 1680

1680 × 5 = 8400

Answer 8400 miles [2]

(d) Priya's firm pays 70% of her car service.

Last year it cost £260 for her car service.

How much did Priya's firm pay?

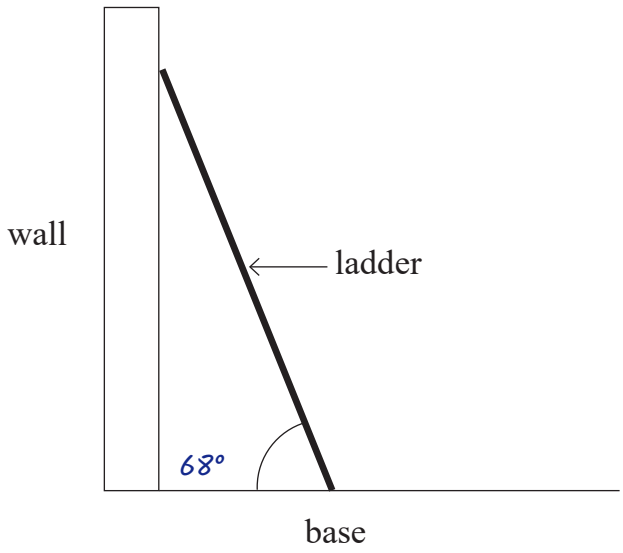
70% = 0.7

0.7 × 260 = 182

Answer £ 182 [2]

[Turn over

4 The diagram shows a ladder leaning against a wall.



In order to be safe, the angle at the base of a ladder should be between 72° and 78°

Is this ladder safe?

Explain your answer.

Measured angle at the base = 68°

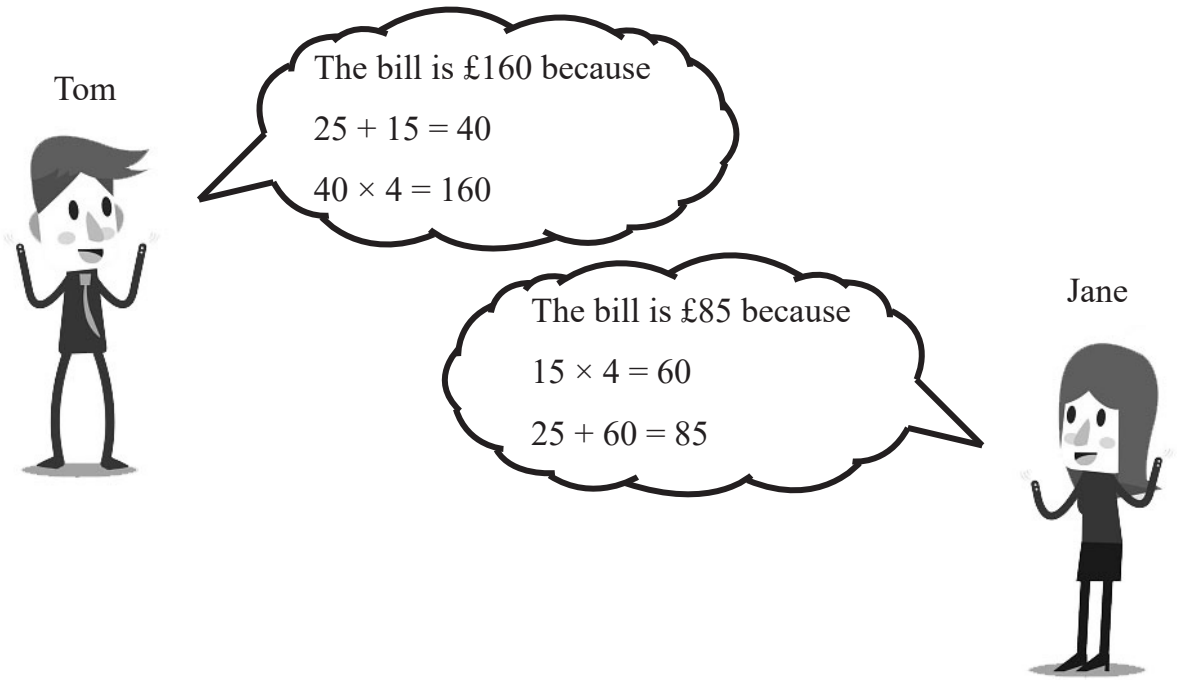
Answer *No* because *the angle is 68°, which is less than 72°* [2]

5 A plumber charges a callout fee of £25 and an hourly rate of £15

His bill for a 4 hour job is found by working out

$$25 + 15 \times 4$$

Tom thinks the bill is £160 and Jane thinks it is £85



Source: © Getty Images

(a) Who is correct and why?

Answer Jane because she multiplied before adding (BODMAS)

so 15 × 4 = 60 is done first, then 25 + 60 = £85 [2]

(b) The plumber has taps for sale with 10% off.

How much would be saved on a tap costing £12.50?

10% of 12.50 = 12.50 ÷ 10

= 1.25

Answer £ 1.25 [1]

[Turn over

6 The weights, in kg, of members of a rowing crew are

92.4	91.7	93.5	96.2	88.9	94.1

(a) Calculate the mean weight of the members.

92.4 + 91.7 + 93.5 + 96.2 + 88.9 + 94.1 = 556.8

556.8 ÷ 6 = 92.8

Answer 92.8 kg [3]

(b) Work out the range of the weights.

96.2 − 88.9 = 7.3

Answer 7.3 kg [1]

(c) The manager of the rowing crew says

"I cannot find the median weight of my crew because there are 6 of them, so none of their weights can be the middle value."

Is the manager correct?

Answer No because with 6 values the median is halfway between the 3rd and 4th values when put in order:

88.9, 91.7, 92.4, 93.5, 94.1, 96.2 so median = 92.95 kg [1]

7



Source: © Getty Images

Belfast Zoo has 120 different species of animals.

One quarter of the species are birds.

40% of the species are mammals.

What **fraction** of the species are neither birds nor mammals?

Birds: $120 \div 4 = 30$

Mammals: 40% of $120 = 0.4 \times 120 = 48$

Neither: $120 - (30 + 48) = 120 - 78 = 42$

Fraction $= \frac{42}{120} = \frac{7}{20}$

Answer $\frac{7}{20}$ [4]

[Turn over

8 Work out the size of angle y in the diagram below.

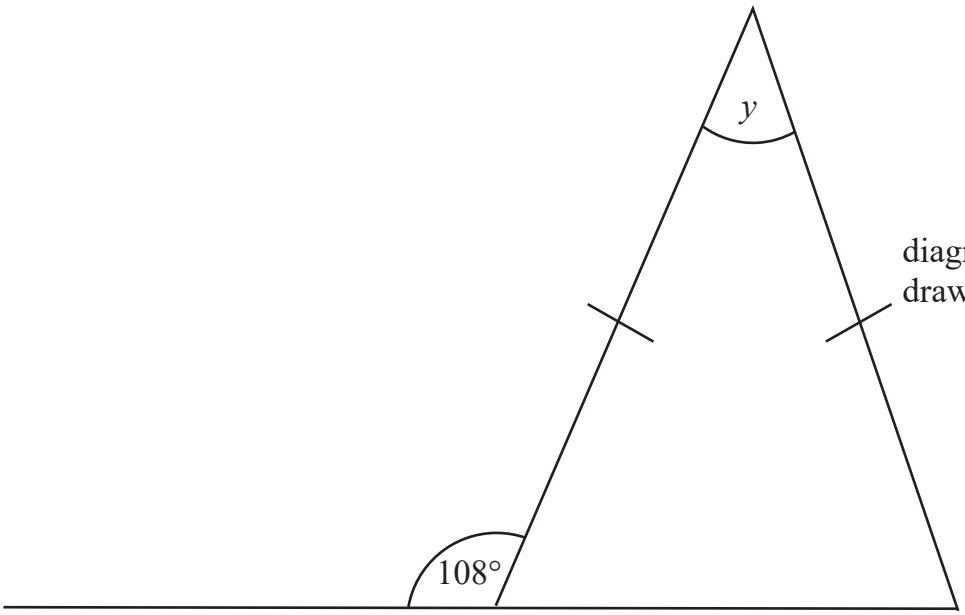


diagram not drawn accurately

Angles on a straight line add up to 180°: 180 − 108 = 72°

Isosceles triangle, so the base angles are equal: 72° and 72°

Angles in a triangle add up to 180°

y = 180 − (72 × 2) = 180 − 144 = 36°

Answer y = 36 ° [3]

9 **(a)** Which of these is correct?

Circle the answer.

$2^3 = 6$ $3^3 = 81$ $5^3 = 125$

[1]

(b) **(i)** Calculate 8.5^3

$8.5 \times 8.5 \times 8.5 = 614.125$

Answer 614.125 [1]

(ii) Round this answer to 1 significant figure.

$614.125 \rightarrow 600$ (1 s.f.)

Answer 600 [1]

[Turn over

10 A building firm needs to put fencing around the perimeter of a rectangular site.

The dimensions of the site are shown in the diagram.

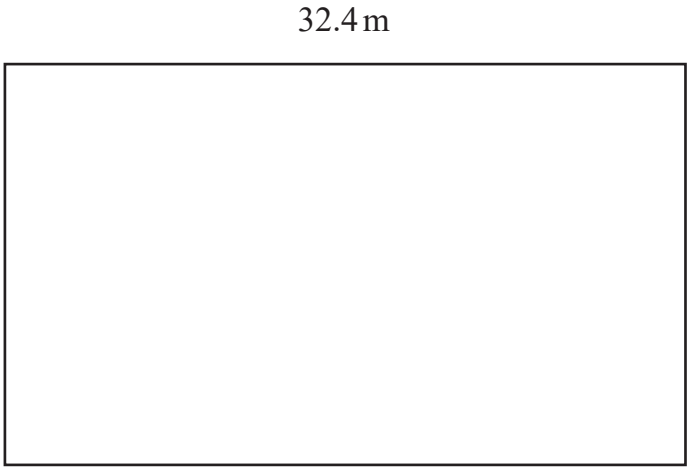


diagram not drawn to scale

(a) Calculate the total perimeter of the site.

32.4 + 22.8 + 32.4 + 22.8 = 110.4

Answer 110.4 m [1]

(b) Each section of fencing is 180 cm wide.

How many sections are needed to go around the perimeter of the site?

180 cm = 1.8 m

110.4 ÷ 1.8 = 61.333...

so 62 sections are needed (round up)

Answer 62 [2]

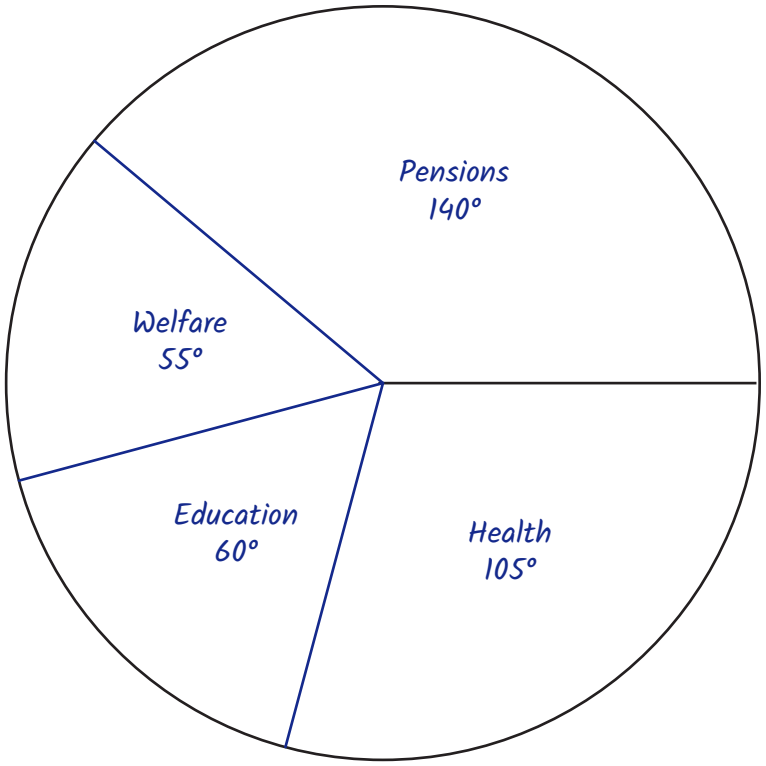
11 The table below shows how an organisation spent its annual budget.

Spending area	£ (millions)	Angle
Health	21	21 × 5 = 105°
Education	12	12 × 5 = 60°
Welfare	11	11 × 5 = 55°
Pensions	28	28 × 5 = 140°

Draw a labelled pie chart to show this information.

Total = 21 + 12 + 11 + 28 = 72

360 ÷ 72 = 5° per £1 million



[4]

[Turn over

12 Debbie earns £9.50 an hour.

She is paid **double time** for overtime.

Robbie earns £12 an hour.

He is paid overtime at a rate of **time and a half**.

They both worked 6 hours on Saturday at their normal rate and 2 hours overtime.

Who earned more and how much more?

Debbie: normal pay 6 × 9.50 = £57

overtime rate 2 × 9.50 = £19, 2 × 19 = £38

total 57 + 38 = £95

Robbie: normal pay 6 × 12 = £72

overtime rate 1.5 × 12 = £18, 2 × 18 = £36

total 72 + 36 = £108

108 − 95 = £13

Answer Robbie earned £ 13 more [3]

13 A club shop sold T-shirts and polo shirts in sizes small, medium and large.

They sold

- 4 small T-shirts
- 9 large polo shirts
- 8 medium T-shirts
- a total of 21 polo shirts
- a total of 11 small items
- a total of 15 large items

Use this information to complete the two-way table below.

	T-shirt	Polo shirt	Total
Small	4	7	11
Medium	8	5	13
Large	6	9	15
Total	18	21	39

[3]

Small polo = 11 − 4 = 7, Large T-shirt = 15 − 9 = 6

Medium polo = 21 − 7 − 9 = 5, T-shirts = 4 + 8 + 6 = 18

Medium total = 8 + 5 = 13, Total = 18 + 21 = 39

14 Clare buys some buns and a gift box for them.

The buns cost 55p each.

The gift box costs 80p.

She pays with a £10 note and receives £2.60 change.

How many buns did Clare buy?

Show all your working.

Spent: £10 − £2.60 = £7.40

Buns: £7.40 − £0.80 = £6.60

660p ÷ 55p = 12

Answer 12 [3]

15 Jenny has p paintbrushes and c crayons.

(a) Kev has twice as many paintbrushes and three times as many crayons as Jenny.

Write an expression for Kev's total, in terms of p and c.

Answer $2p + 3c$ [1]

(b) Lily has the same number of paintbrushes and three-quarters of the number of crayons that Jenny has.

Write an expression for Lily's total, in terms of p and c.

Answer $p + \frac{3}{4}c$ [1]

(c) Dan has 3 fewer paintbrushes and 4 more crayons than Jenny.

Write an expression for Dan's total, in terms of p and c.

Give your answer in its simplest form.

$(p - 3) + (c + 4) = p + c + 1$

Answer $p + c + 1$ [1]

[Turn over

16 20 patients were asked how many weeks they had been waiting for an appointment to see a consultant.

Their answers were

38	15	4	3	56
42	28	21	39	12
8	17	47	58	43
30	16	34	29	39

Display these results in a stem and leaf diagram.

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

Key: 3 | 8 means 38 weeks

[3]

17 In a class, 3 of the 10 girls wear glasses.

In the same class, 3 of the 18 boys wear glasses.

What percentage of the class wear glasses?

Give your answer correct to 2 decimal places.

Glasses: $3 + 3 = 6$ Class: $10 + 18 = 28$

$\frac{6}{28} \times 100 = 21.428571...$

$= 21.43\%$ (2 d.p.)

Answer 21.43 % [3]

[Turn over

18 Gail wants to do some research into people's spending on food.

(a) She decides to use the following question in her survey.

How much money do you spend on food?

£0–10 ☐ £20–30 ☐ £40–50 ☐ over £50 ☐

Give two possible reasons why people may be confused by this question.

Reason 1 *no time period is given, e.g. per week*

or per month, so people do not know what to include

Reason 2 *there are gaps between the groups, e.g.*

there is no box for £10–20 or £30–40 [2]

(b) Gail decides to survey 10 people.

Why might this lead her to make unreliable conclusions?

Answer *the sample size of 10 people is too small* [1]

19 I spent $2\frac{1}{2}$ hours on my homework last night.

One third of that time was spent on Geography and half of the time spent on Geography was on map work.

What **fraction** of my homework time was spent on map work?

2.5 hours = 150 minutes

Geography: 150 ÷ 3 = 50 minutes

Map work: 50 ÷ 2 = 25 minutes

Fraction = $\frac{25}{150} = \frac{1}{6}$

Answer $\frac{1}{6}$ [3]

20 Solve $5(p - 3) = 20$

$5p - 15 = 20$

$5p = 20 + 15$

$5p = 35$

$p = 35 \div 5 = 7$

Answer $p =$ 7 [3]

[Turn over

21 The diagram shows a "figure of 8" shaped race track, which has a semi-circular section at either end.

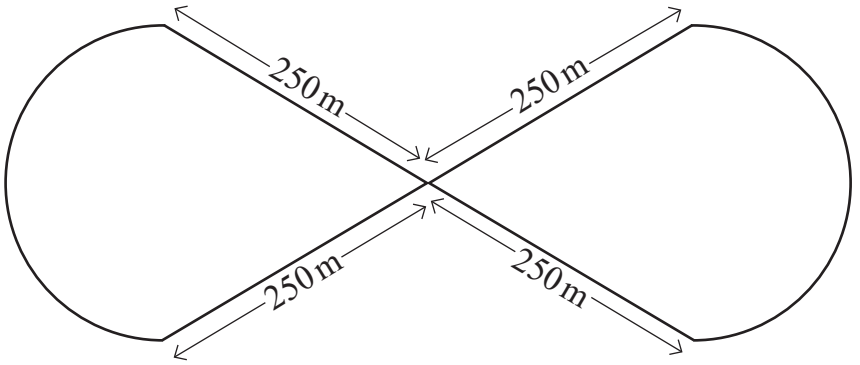


diagram not drawn accurately

(a) Calculate the total distance travelled during one complete lap of the track.

The two semicircles make one circle of diameter 250 m

Circumference = π × 250 = 785.3981...

Straight sections = 4 × 250 = 1000

Total = 1000 + 785.3981... = 1785.3981...

Answer 1785.4 m [3]

(b) A horse runs 2000 metres at an average speed of 14.5 m/s.

How long does this take?

Give your answer in minutes and seconds, to the nearest second.

time = distance ÷ speed

= 2000 ÷ 14.5 = 137.9310... seconds

137.9310... − 120 = 17.93... seconds

= 2 minutes 18 seconds (nearest second)

Answer 2 minutes 18 seconds [3]

[Turn over

22 Shares were bought with an original value of £1600

The value increased by 5% each year.

Calculate the value after three years.

Year 1: 5% of 1600 = 80 → 1600 + 80 = £1680

Year 2: 5% of 1680 = 84 → 1680 + 84 = £1764

Year 3: 5% of 1764 = 88.20 → 1764 + 88.20 = £1852.20

Answer £ 1852.20 [3]



23 P is the smallest number which has prime factors of 2, 3 and 5

Q is the number 24

Work out the LCM (lowest common multiple) of P and Q.

$P = 2 \times 3 \times 5 = 30$

Multiples of 30: 30, 60, 90, 120, 150, ...

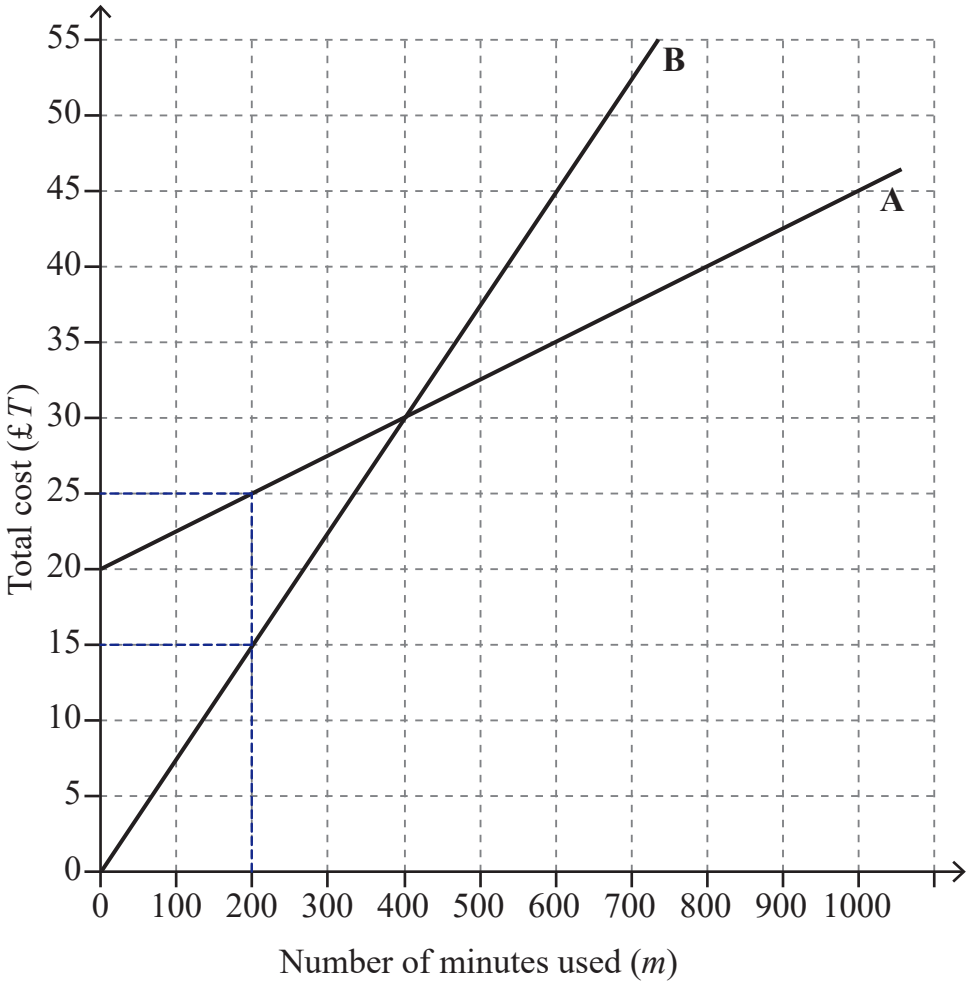
Multiples of 24: 24, 48, 72, 96, 120, 144, ...

LCM = 120

Answer 120 [3]

[Turn over

24 The graph below illustrates two different monthly tariffs, A and B, for a mobile phone.



(a) Max uses 200 minutes per month.

Which tariff is cheaper for him and by how much?

At 200 minutes: A = £25, B = £15, 25 − 15 = £10

Answer Tariff ___B___ is cheaper by £ ___10___ [1]

(b) Tariff **A** has a fixed charge per month plus a charge per minute for phone calls.

(i) What is the fixed charge per month?

A starts at £20 when m = 0

Answer £ 20 [1]

(ii) What is the charge per minute?

200 min costs 25 − 20 = £5 = 500p, 500 ÷ 200 = 2.5p

Answer 2.5 p [2]

(iii) Hence write a formula for the total cost T of tariff **A** for m minutes.

Answer T = 20 + 0.025m [2]

T = fixed charge + cost per minute × m

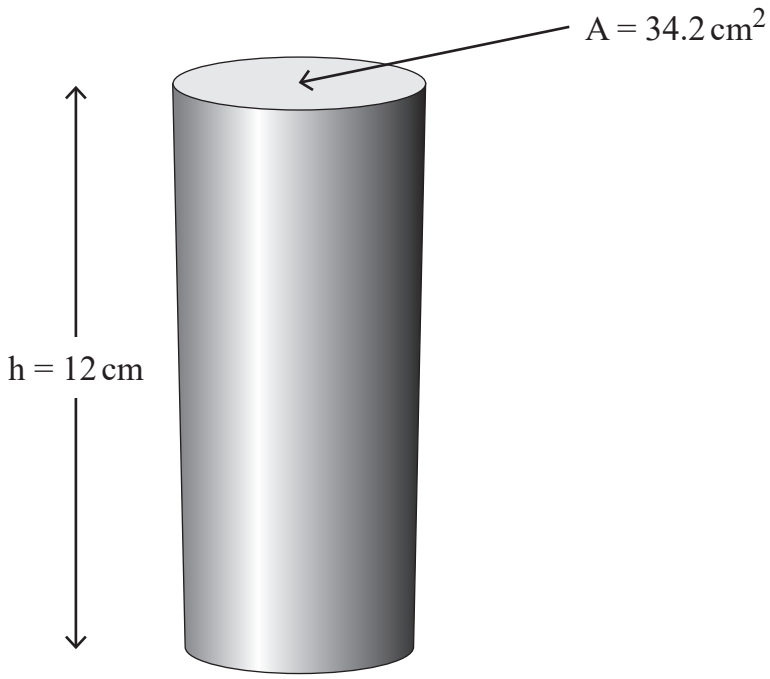
2.5p = £0.025

[Turn over

25 A solid cylinder has a height of 12 cm and a circular cross-sectional area of 34.2 cm^2

The density is 0.83 g/cm^3

Find the mass of the cylinder.



Volume = 34.2 × 12 = 410.4 cm^3

Mass = density × volume

= 0.83 × 410.4 = 340.632

Answer *340.632* g [3]

26 The number of flights delayed at an airport were recorded over a 24-hour period.

The number of minutes they were delayed is shown in the table below.

Minutes delayed (t)	**Number of flights**	Mid-point	Mid-point × f
$0 < t \leq 20$	31	10	10 × 31 = 310
$20 < t \leq 40$	19	30	30 × 19 = 570
$40 < t \leq 60$	10	50	50 × 10 = 500
$60 < t \leq 80$	14	70	70 × 14 = 980
$80 < t \leq 100$	12	90	90 × 12 = 1080
$100 < t \leq 120$	6	110	110 × 6 = 660

(a) Calculate an estimate for the mean number of minutes the flights were delayed.

Total flights = 31 + 19 + 10 + 14 + 12 + 6 = 92

Σfx = 310 + 570 + 500 + 980 + 1080 + 660 = 4100

Mean = 4100 ÷ 92 = 44.5652...

Answer 44.57 minutes [4]

(b) Write down the modal class interval.

Answer $0 < t \leq 20$ [1]

(c) Write down the class interval in which the median lies.

Median is the 46.5th value; 31 + 19 = 50

Answer $20 < t \leq 40$ [1]

[Turn over

27 Two cyclists start from the same location.

One cyclist travels due North at an average speed of 22 km / h and the other travels due East at an average speed of 26 km / h.

How far apart are the cyclists after 2 hours?

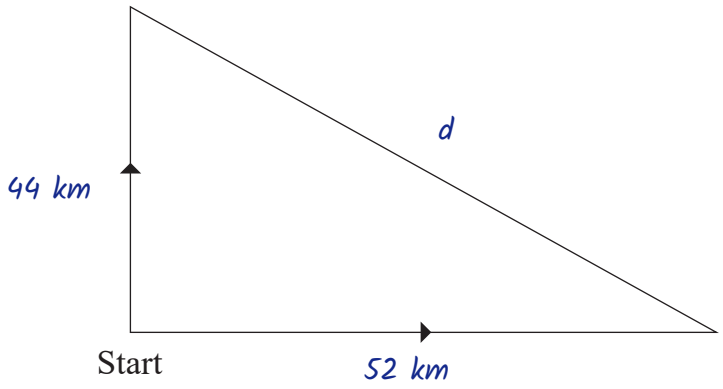


diagram not drawn accurately

North: $22 \times 2 = 44$ km East: $26 \times 2 = 52$ km

$d^2 = 44^2 + 52^2$

$d^2 = 1936 + 2704 = 4640$

$d = \sqrt{4640} = 68.1175...$

Answer 68.1 km [4]

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Rewarding Learning

General Certificate of Secondary Education
Summer 2022

GCSE Mathematics

FOUNDATION TIER
ADDITIONAL SUPPORT MATERIALS
(For use in Summer 2022)

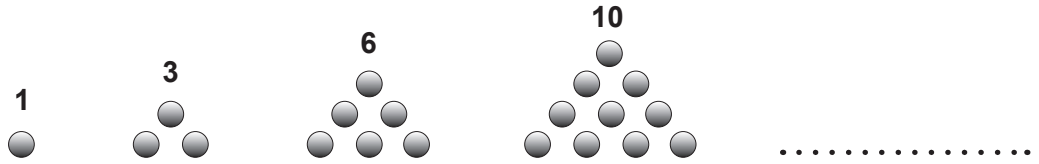
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FOUNDATION TIER ADDITIONAL SUPPORT MATERIALS (Summer 2022)

Numbers

Lowest common multiple (LCM): The lowest common multiple is the lowest multiple shared by 2 or more numbers.

Triangular numbers – are a pattern of numbers which form triangles. Each number in the sequence adds a new row of dots to the triangle.



Trial and Improvement

This is a method of trying different values in an equation until you get a suitable solution (e.g to 1 decimal place).

Measures

Conversion from metric to imperial units

1 kg = 2.2 pounds (lb)

Metric units

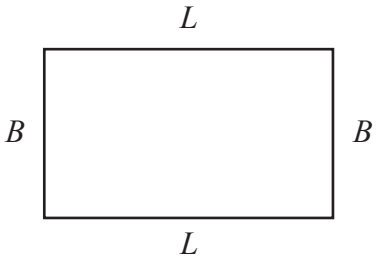
1 ml = 1 cm^3

Compound Measures

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\text{Average Speed} = \frac{\text{Distance}}{\text{Time}}$$

Perimeter and Volume



The perimeter of a rectangle is the distance around the outside of the rectangle. It is found by adding the lengths of the 4 sides of the rectangle.

$P = 2L + 2B$ where P is perimeter, L is length and B is breadth.

The volume of a cuboid is found by multiplying the length by the breadth by the height of the cuboid.

$V = L \times B \times H$ where V is volume, L is length, B is breadth and H is height.

The circumference (perimeter) of a circle is $C = 2\pi r$ where r is the radius of the circle. An alternative formula is $C = \pi d$ where d is the diameter of the circle.

Geometry and Angles

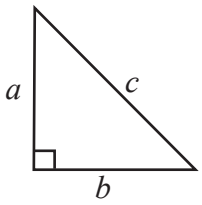
There are 180° on a straight line.
There are 180° inside a triangle.
An isosceles triangle is a triangle with 2 equal sides and 2 equal angles.
The sum of all the angles inside a polygon is given by $180(n - 2)$ where n is the number of sides in the polygon.

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Pythagoras' Theorem

If *a, b* and *c* are the sides of a right angled triangle shown below, then

$$a^2 + b^2 = c^2$$



Range

The range of a set of data is the difference between the largest value and the smallest value in the data set.

Mean

The mean of a set of data is the sum of all the data values divided by the number of data values.

Estimate for the mean of a grouped frequency distribution

Estimated mean = sum of (mid interval values multiplied by their frequency) divided by the sum of all the frequencies.

Pie Chart

In a pie chart, the total angle that corresponds to the entire data set is 360°

Probability

The sum of the probabilities of all outcomes equals 1

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