Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
November 2022

Mathematics

StemUp Model Solution

Unit M8 Paper 2
(With calculator)
Higher Tier



[GMC82]

GMC82

THURSDAY 1 DECEMBER, 10.45am–12 NOON

TIME

1 hour 15 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 Higher 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, on blank pages or tracing paper.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all thirteen** 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.

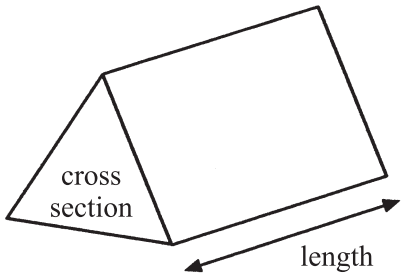
INFORMATION FOR CANDIDATES

The total mark for this paper is 50.
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.

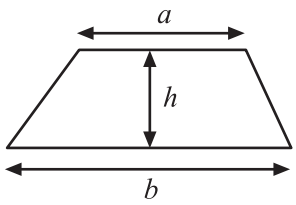
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Formula Sheet

Volume of prism = area of cross section × length

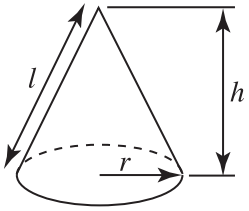


Area of trapezium = $\frac{1}{2}(a+b)h$



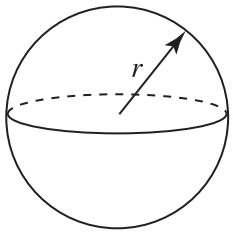
Volume of cone = $\frac{1}{3}\pi r^2 h$

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

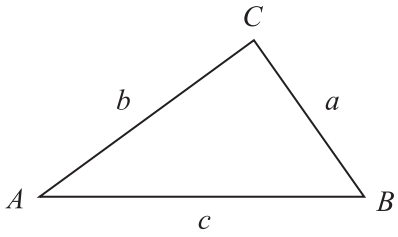


Volume of sphere = $\frac{4}{3}\pi r^3$

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

13336

1 Simplify

(a) $t^3 \times t^8$

Answer t^{11} [1]

(b) $(t^2)^3$

Answer t^6 [1]

(c) $\dfrac{t^{-3}}{t^2}$

Answer t^{-5} [1]

[Turn over

2 **(a)** Show that $20x - x^3 = 1$ has a solution between 4 and 5

$x = 4$: $20 \times 4 - 4^3 = 80 - 64 = 16$ (more than 1)

$x = 5$: $20 \times 5 - 5^3 = 100 - 125 = -25$ (less than 1)

Sign change about 1, so a solution lies between 4 and 5

[1]

(b) Use Trial and Improvement to find this solution correct to 1 decimal place.

Show all your working.

x	$20x - x^3$	
4.5	−1.125	too small
4.4	2.816	too big
4.45	0.878875	too small

4.45 is too small, so the solution is between 4.4 and 4.45

$x = 4.4$ (to 1 d.p.)

Answer 4.4 [3]

3 Rearrange $v = u + at$ to make a the subject.

$v = u + at$

$at = v - u$

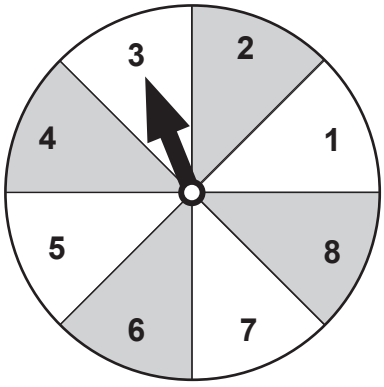
$a = \frac{v - u}{t}$

Answer $a =$ $\frac{v - u}{t}$ [2]

[Turn over



4



The spinner is spun 1000 times.

The table shows some of the number of times it landed on the number 3 and some of the calculated relative frequency values.

Number of spins	Number of threes	Relative frequency
20	2	0.1
200	26	0.13
500	64	
1000		0.122

(a) Calculate the missing relative frequency value.

$\frac{64}{500} = 0.128$

Answer 0.128 [1]

(b) Calculate the number of times it landed on a 3 for the 1000 spins.

$1000 \times 0.122 = 122$

Answer 122 [1]

(c) Use the best relative frequency value from the table to calculate the number of threes you would expect to get in 2500 spins.

Best value 0.122 (most spins): $2500 \times 0.122 = 305$

Answer 305 [2]

5 **(a)** Calculate $(3.6 \times 10^5) \times (4.9 \times 10^{-4})$ giving your answer in standard form.

$= 176.4$

Answer 1.764×10^2 [1]

(b) $(2.5 \times 10^6) \times (4.8 \times 10^x) = A \times 10^4$

Find the values of A and x

$2.5 \times 4.8 = 12$, so $A = 1.2$

$12 \times 10^{6+x} = 1.2 \times 10^4 = 12000$

$6 + x + 1 = 4$

$x = -3$

Answer $A =$ 1.2 , $x =$ −3 [3]

6 For his morning run, Tony goes to the park by one of three different routes.

In the park he chooses one of eight different circuits to run.

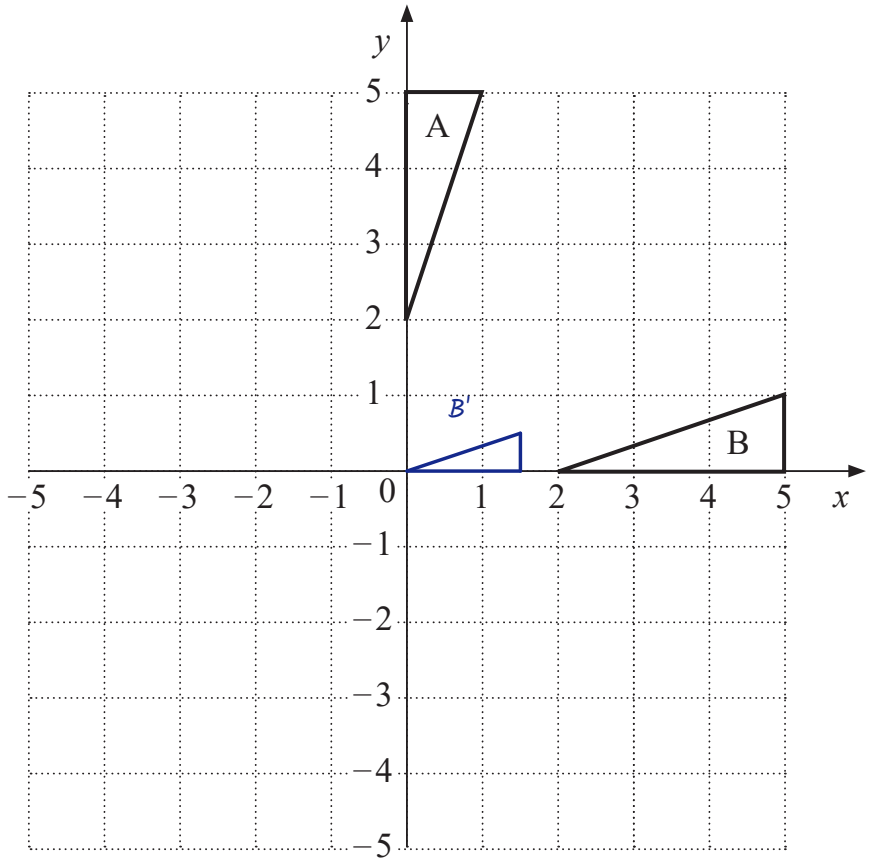
In how many ways can he go to the park and complete a circuit?

$3 \times 8 = 24$

Answer 24 [2]

[Turn over

7



(a) Describe fully the single transformation which maps triangle A to triangle B.

Answer *Reflection in the line y = x* [2]

(b) Draw the enlargement of triangle B using scale factor $\frac{1}{2}$ and centre (–2, 0) [2]

8 Simplify $\left(x^{-\frac{1}{2}}\right)\left(x^{5}\right)^{\frac{1}{2}}$

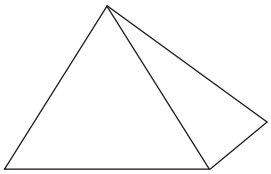
$x^{-½} \times x^{5/2}$

$= x^{-½ + 5/2}$

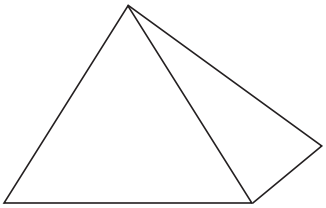
$= x^{4/2} = x^{2}$

Answer x^2 [2]

9



A



B

A and B are similar models of a pyramid.

The base area of B is 21% larger than the base area of A.

By what percentage is the height of B larger than the height of A?

Area scale factor = 100% + 21% = 121% = 1.21

Length scale factor = $\sqrt{1.21}$ = 1.1

so the height is 10% larger

Answer 10 % [3]

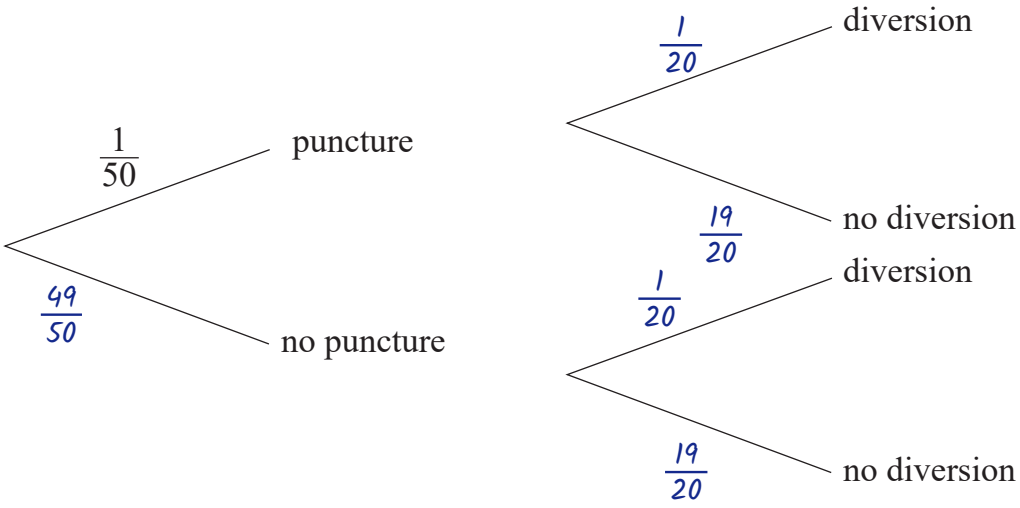
[Turn over

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10 The probability that Orla has a puncture on her cycle ride to school is $\frac{1}{50}$

The probability that there is a traffic diversion is $\frac{1}{20}$

(a) Complete the tree diagram to show this information. [2]



(b) What is the probability that Orla will be delayed by **at least one** of these two causes?

P(at least one) = 1 − P(neither)

$= 1 - \frac{49}{50} \times \frac{19}{20} = 1 - \frac{931}{1000} = \frac{69}{1000}$

Answer $\frac{69}{1000}$ [3]

11

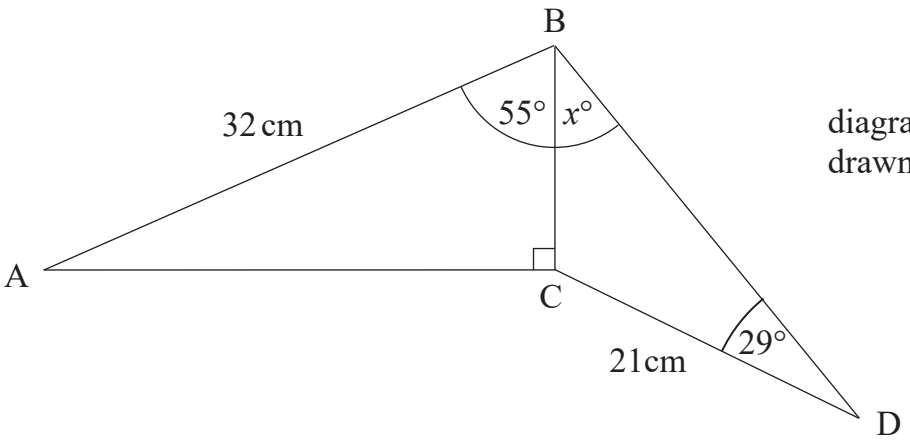


diagram not drawn accurately

AB = 32 cm and angle ABC = 55°

CD = 21 cm and angle BDC = 29°

Calculate the size of angle CBD.

Triangle ABC: BC = 32 cos 55° = 18.35444596

Triangle BCD (sine rule):

$$\frac{\sin x}{21} = \frac{\sin 29°}{18.35444596}$$

$\sin x = 21 \times \sin 29° \div 18.35444596 = 0.5546886...$

$x = 33.68926935... = 33.7°$

Answer 33.7 ° [5]

[Turn over

12

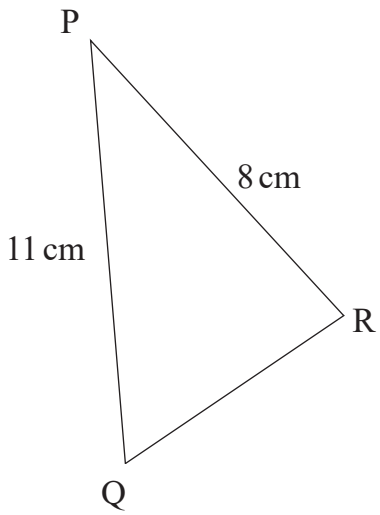


diagram not drawn accurately

In the triangle PQR, the angle P is acute, PQ = 11 cm and PR = 8 cm

The area of PQR is 22 cm^2

Calculate the length of QR.

$\frac{1}{2} \times 11 \times 8 \times \sin P = 22$

$44 \sin P = 22$, $\sin P = 0.5$, so $P = 30°$ (acute)

$QR^2 = 11^2 + 8^2 - 2 \times 11 \times 8 \times \cos 30°$

$QR^2 = 185 - 152.4204707 = 32.57952893$

$QR = \sqrt{32.57952893} = 5.707848013 = 5.71$

Answer 5.71 cm [5]

13 An envelope contains 6 yellow paper clips, 4 red paper clips and 2 white paper clips.

Two paper clips are taken at random from the envelope.

(a) What is the probability that they are both red?

$P(RR) = \frac{4}{12} \times \frac{3}{11} = \frac{12}{132} = \frac{1}{11}$

Answer $\frac{1}{11}$ [3]

(b) What is the probability that the two paper clips are different colours from each other?

$P(YY) = \frac{6}{12} \times \frac{5}{11} = \frac{30}{132} = \frac{5}{22}$

$P(WW) = \frac{2}{12} \times \frac{1}{11} = \frac{2}{132} = \frac{1}{66}$

$P(same) = \frac{1}{11} + \frac{5}{22} + \frac{1}{66} = \frac{44}{132} = \frac{1}{3}$

$P(different) = 1 - \frac{1}{3} = \frac{2}{3}$

Answer $\frac{2}{3}$ [4]

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Question Number	**Marks**
1	
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Total Marks	

Examiner Number

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GCSE Mathematics

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Numbers

Highest Common Factor (HCF): The highest common factor is the largest number that divides evenly into two or more numbers, e.g. 4 is the HCF of 8 and 20

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).

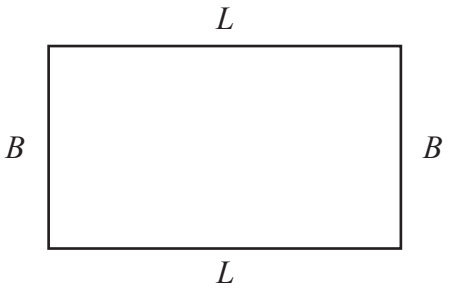
Range

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.

Area and Volume



The area of a rectangle is found by multiplying the length of the rectangle by the breadth.

$A = L \times B$ where A is area, L is length and B is breadth.

The area of a triangle is found by multiplying half the length of the base by the perpendicular height of the triangle.

$A = \frac{1}{2}bh$ where b is the base and h is the perpendicular height of the triangle.

The area of a circle is $A = \pi r^2$ where r is the radius of the circle.

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.

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.

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

Compound Measures

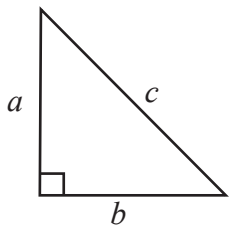
$$\text{Average Speed} = \frac{\text{Distance}}{\text{Time}}$$

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

Pythagoras' Theorem

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

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



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Midpoint of a line

If (x_1, y_1) and (x_2, y_2) are the end points of a line, then the coordinates of the midpoint M of the line are

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

Gradient of a line

If (x_1, y_1) and (x_2, y_2) are two points on a line, then the gradient m of the line is

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Lines

Parallel lines have the same gradient.

If a straight line has gradient m, then a line which is perpendicular to this line has a gradient $-\frac{1}{m}$

Equation of a circle

The equation of a circle of radius r and centre, the origin (0, 0), is given by $x^2 + y^2 = r^2$ where (x, y) are the coordinates of any point on the circumference of the circle.

Tangent/Radius property

The tangent to a circle is perpendicular to the radius at the point of contact with the circle.

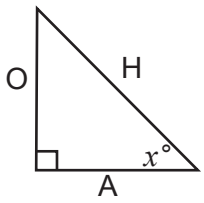
Cyclic Quadrilateral property

The opposite angles of a cyclic quadrilateral add up to 180°

Alternate Segment Theorem

In a circle, the angle between a chord and a tangent through one of the end points of the chord is equal to the angle in the alternate segment.

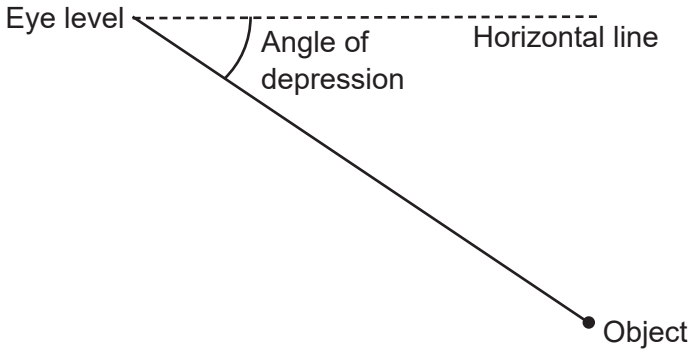
Trigonometric ratios in right angled triangles



$\sin x° = \frac{O}{H}$ $\cos x° = \frac{A}{H}$ $\tan x° = \frac{O}{A}$

Angle of depression

If a person stands and looks down at an object, the **angle of depression** is the angle between the horizontal line of sight and the object.



Frequency density in histograms

$\text{Frequency density} = \frac{\text{Frequency}}{\text{Class width}}$