Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
November 2021

Mathematics

StemUp Model Solution

Unit M8 Paper 1
(Non-Calculator)
Higher Tier



[GMC81]

GMC81

THURSDAY 2 DECEMBER, 9.15am–10.30am

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 twelve** questions.
All working should be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.
You **must not** use a calculator for this paper.

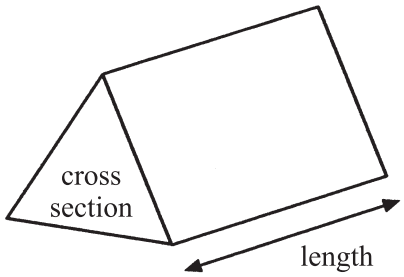
INFORMATION FOR CANDIDATES

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 ruler, compasses and a protractor.
The Formula Sheet is on page 2.

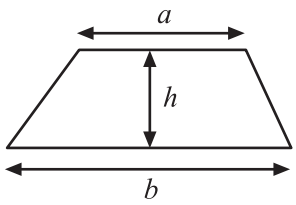
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Formula Sheet

Volume of prism = area of cross section × length

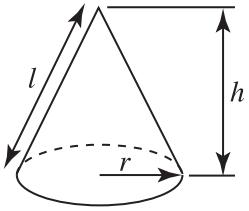


Area of trapezium = $\frac{1}{2}(a+b)h$



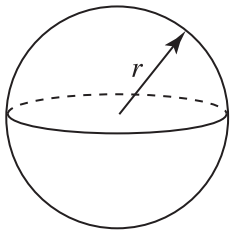
Volume of cone = $\frac{1}{3}\pi r^2 h$

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

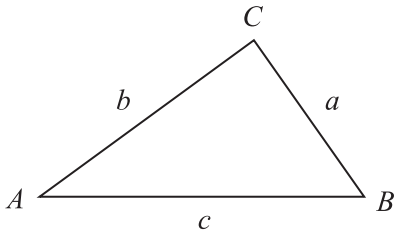


Volume of sphere = $\frac{4}{3}\pi r^3$

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

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1 **(a)** Solve $2x - 1 \leq -5$

$2x - 1 \leq -5$

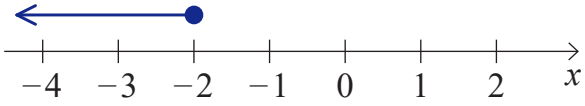
$2x \leq -5 + 1$

$2x \leq -4$

$x \leq -2$

Answer $x \leq -2$ [2]

(b) Show your solution on the number line.

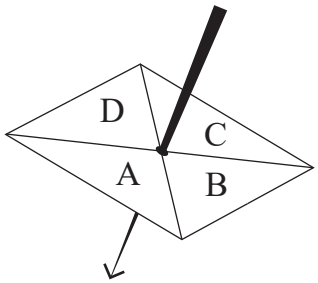


[1]

[Turn over

2 A spinner has sections labelled A, B, C and D.

The spinner is spun, and the relative frequency of landing on D is recorded after every 10 spins.



Some of the results are recorded in the table below.

Number of spins	Relative frequency of D
10	0.5
20	0.3
30	0.4
40	0.35
50	0.38
60	0.45

(a) After 50 spins the spinner had landed on D 19 times.

Fill in the missing relative frequency in the table above. [1]

19 ÷ 50 = 0.38

(b) How many times had the spinner landed on D after 60 spins?

0.45 × 60 = 27

Answer 27 [1]

(c) Do you think that the spinner is biased? Give a reason for your answer.

Answer Yes because if fair, D should come up about 1 in 4 spins (0.25)

but its relative frequency is 0.45 after 60 spins (27 times, not about 15) [2]

(d) If the spinner is spun 400 times how many times would you expect it to land on D?

Expected = 400 × 0.45 = 180

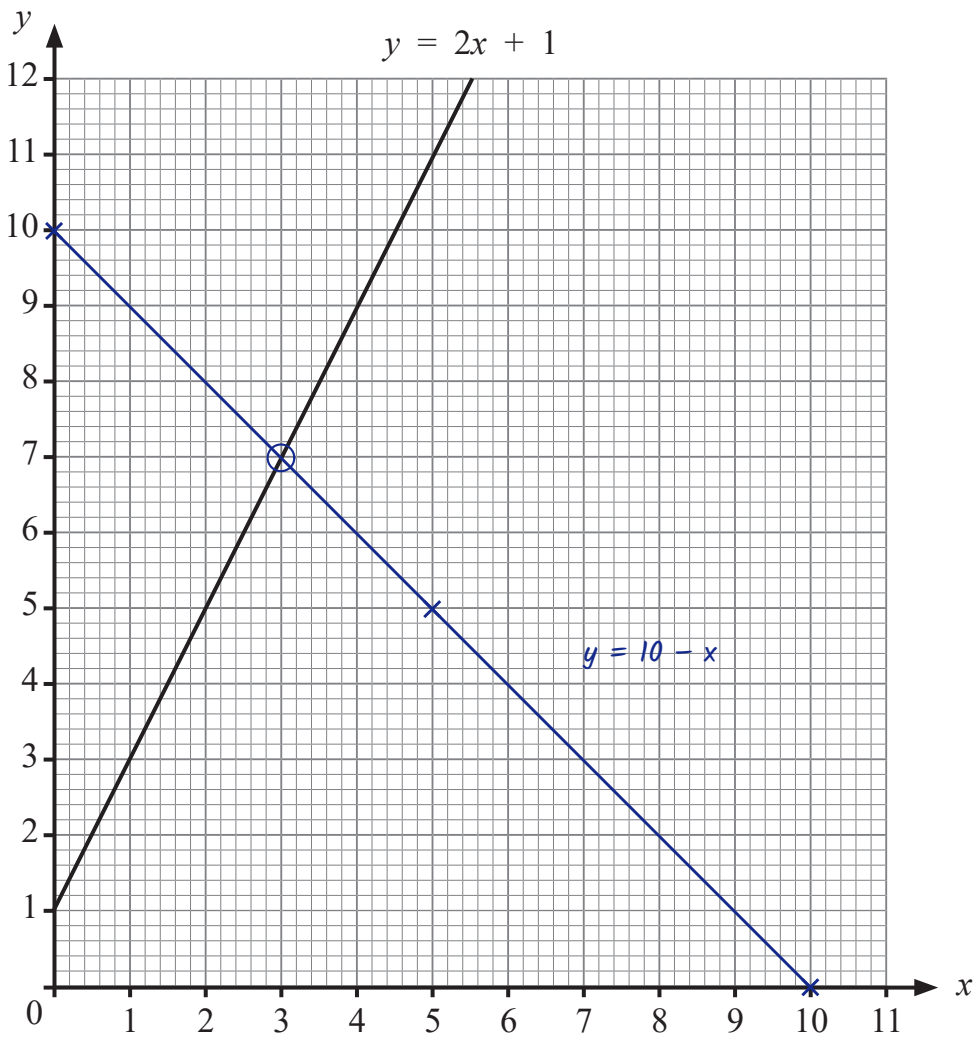
Answer 180 [2]

[Turn over

3 Use graphs to solve the simultaneous equations

$$y = 2x + 1 \quad \text{and} \quad y = 10 - x$$

The graph of $y = 2x + 1$ has already been drawn for you.



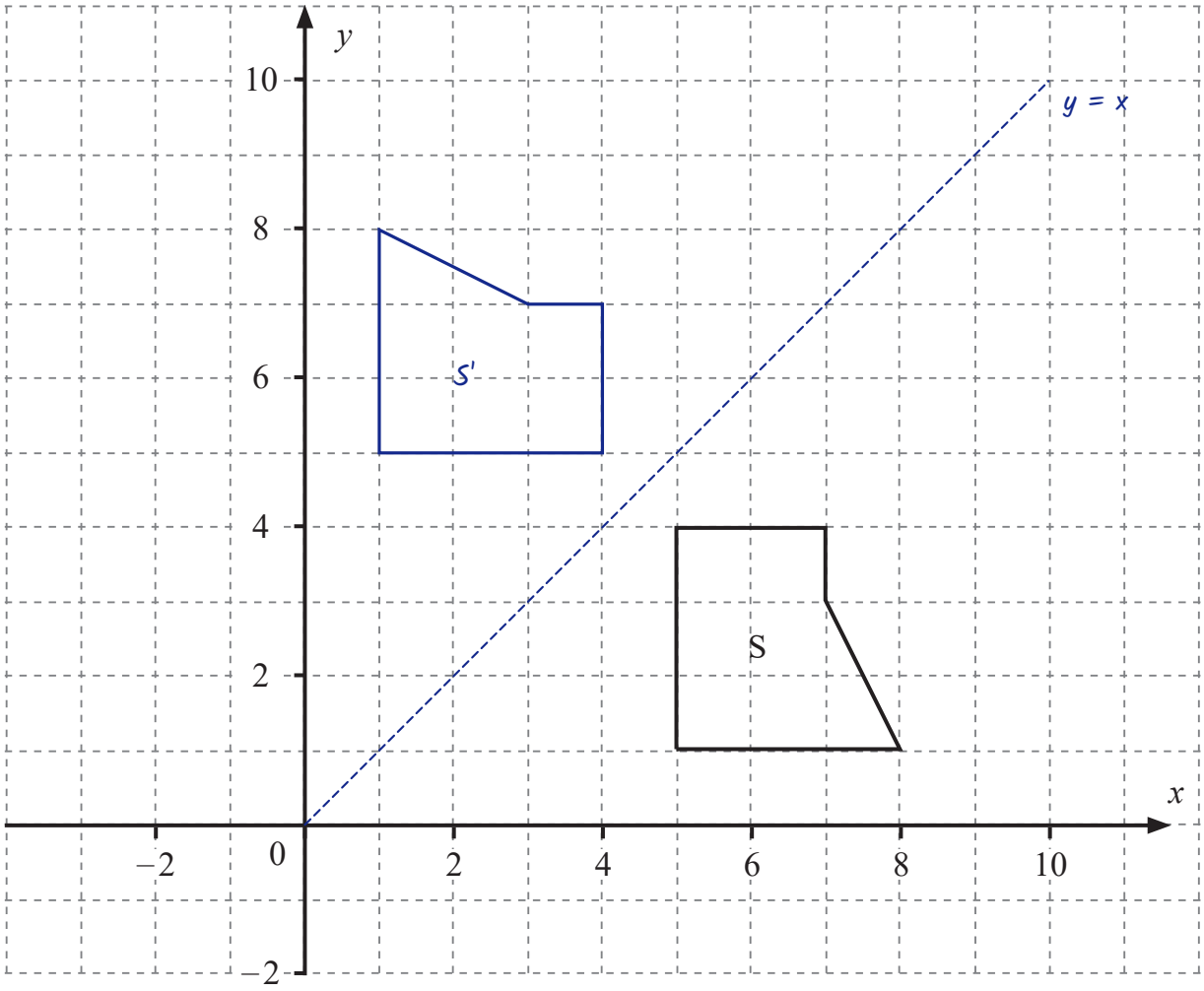
y = 10 − x: x = 0, y = 10; x = 5, y = 5; x = 10, y = 0

The lines cross at (3, 7)

Answer $x =$ 3 and $y =$ 7 [4]

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4 On the grid reflect shape S in the line $y = x$



[2]

[Turn over

5 Andy and Zoe have the same rates of pay.

Andy worked 12 hours normal time and 8 hours overtime and earned £238

Zoe worked 10 hours normal time and 15 hours overtime and earned £315

Calculate the rates of pay for normal time and overtime.

A solution by trial and improvement will not be accepted.

Let x = normal rate (£ per hour), y = overtime rate (£ per hour)

$12x + 8y = 238$ (1)

$10x + 15y = 315$ (2)

(1) × 10: $120x + 80y = 2380$

(2) × 12: $120x + 180y = 3780$

(2) − (1): $100y = 1400$

$y = 14$

Sub in (1): $12x + 8 \times 14 = 238$

$12x = 238 - 112 = 126$

$x = 126 \div 12 = 10.50$

Answer normal £ 10.50 per hour; overtime £ 14.00 per hour

[5]

6 $1\,000\,000\,\text{cm}^3$ of gas has mass of 1.5×10^4 g.

Giving your answer in standard form, calculate the mass of one cubic centimetre of the gas.

$1.5 \times 10^4 \div 1\,000\,000$

$= 1.5 \times 10^4 \div 10^6$

$= 1.5 \times 10^{4-6}$

Answer 1.5×10^{-2} g [2]

7 Change 0.0858585… into a fraction.

$x = 0.0858585...$

$100x = 8.5858585...$

$100x - x = 8.5858585... - 0.0858585...$

$99x = 8.5$

$x = \frac{8.5}{99} = \frac{85}{990} = \frac{17}{198}$

Answer $\frac{17}{198}$ [2]

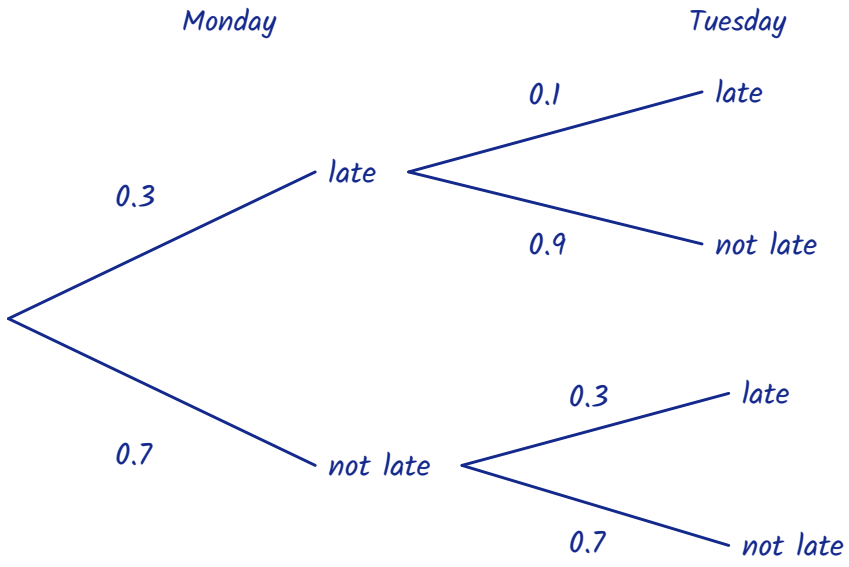
[Turn over

8 The probability that Jo will be late for work on any Monday is 0.3

If Jo is late on Monday, the probability that she will be late on Tuesday is 0.1

If Jo is not late on Monday, the probability that she will be late on Tuesday is 0.3

(a) Draw a tree diagram to show this information.



[3]

(b) Use the tree diagram to work out the probability that Jo is late on Monday or Tuesday, but not both days.

P(late Mon, not late Tue) + P(not late Mon, late Tue)

= 0.3 × 0.9 + 0.7 × 0.3

= 0.27 + 0.21 = 0.48

Answer 0.48 [2]

9 P (2, 3) lies on the circumference of the circle $x^2 + y^2 = a^2$

(a) Work out the value of a, giving your answer in surd form.

$2^2 + 3^2 = a^2$

$a^2 = 4 + 9 = 13$

Answer $\sqrt{13}$ [2]

(b) Work out the equation of the tangent to this circle at P.

Gradient of radius OP $= \frac{3 - 0}{2 - 0} = \frac{3}{2}$

Tangent $\perp$ radius, so gradient of tangent $= -\frac{2}{3}$

$y = -\frac{2}{3}x + c, \quad 3 = -\frac{2}{3} \times 2 + c = -\frac{4}{3} + c$

$c = 3 + \frac{4}{3} = \frac{13}{3}$

Answer $y = -\frac{2}{3}x + \frac{13}{3}$ [4]

(c) Work out the equation of the other tangent to this circle which is parallel to the tangent at P.

Other end of the diameter through P is $(-2, -3)$

Parallel, so gradient $= -\frac{2}{3}$: $y = -\frac{2}{3}x + c$

$-3 = -\frac{2}{3} \times (-2) + c = \frac{4}{3} + c$

$c = -3 - \frac{4}{3} = -\frac{13}{3}$

Answer $y = -\frac{2}{3}x - \frac{13}{3}$ [3]

[Turn over

10 A fair dice is rolled three times.

What is the probability of getting 6 exactly once?

$P(6) = \frac{1}{6}$, $P(\text{not } 6) = \frac{5}{6}$ 6XX, X6X, XX6 (3 ways)

$P(6XX) = \frac{1}{6} \times \frac{5}{6} \times \frac{5}{6} = \frac{25}{216}$

$P(\text{exactly one } 6) = 3 \times \frac{25}{216} = \frac{75}{216} = \frac{25}{72}$

Answer $\frac{25}{72}$ [3]

11 $$\frac{\sqrt{2}}{3^b} = 3 \times (2^a)^3$$

Work out the values of a and b.

$\sqrt{2} = 2^{1/2}$, $(2^a)^3 = 2^{3a}$, $1 \div 3^b = 3^{-b}$

So $2^{1/2} \times 3^{-b} = 3^1 \times 2^{3a}$

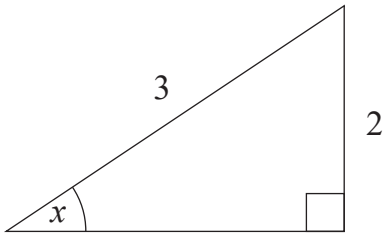
Powers of 3: $-b = 1$, so $b = -1$

Powers of 2: $3a = \frac{1}{2}$, so $a = \frac{1}{6}$

Answer $a = \frac{1}{6}$, $b = -1$ [4]



12



√5

Show that $\cos x + \tan x = \frac{11\sqrt{5}}{15}$

Base^2 = $3^2 - 2^2 = 9 - 4 = 5$ (Pythagoras)

Base = √5

$\cos x = \frac{adj}{hyp} = \frac{\sqrt{5}}{3}$

$\tan x = \frac{opp}{adj} = \frac{2}{\sqrt{5}} = \frac{2\sqrt{5}}{5}$

$\cos x + \tan x = \frac{\sqrt{5}}{3} + \frac{2\sqrt{5}}{5}$

$= \frac{5\sqrt{5}}{15} + \frac{6\sqrt{5}}{15}$

$= \frac{11\sqrt{5}}{15}$ as required

[5]

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