WORKED SOLUTIONS

Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
|---|---|
| | |

**Pearson Edexcel**
**Level 1/Level 2 GCSE (9–1)**

Centre Number | | | | | |

Candidate Number | | | | |

LPGS Autumn Mock Exam 2020

Time: 1 hour 30 minutes | Paper Reference **1MA1/3H**

# Mathematics

## Paper 3 (Calculator)
## Higher Tier

**You must have:** Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.

Total Marks

**Instructions**

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided.
  - *there may be more space than you need.*
- You must **show all your working.**
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- **Calculators may be used.**

**Information**

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets
  - *use this as a guide as to how much time to spend on each question.*

**Advice**

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

**S66513A**

**Answer ALL questions.**

**Write your answers in the spaces provided.**

**You must write down all the stages in your working.**

**1** Calculate $\sqrt{6\sin 72° - 4\cos 39°}$

Give your answer correct to 3 significant figures.

1.61175533... = 1.61 (3s.f.)

scores M1
5.706....
or 3.108....
or 3.109....
or 2.597....
or 2.598....

M1 A1

1.61

**(Total for Question 1 is 2 marks)**

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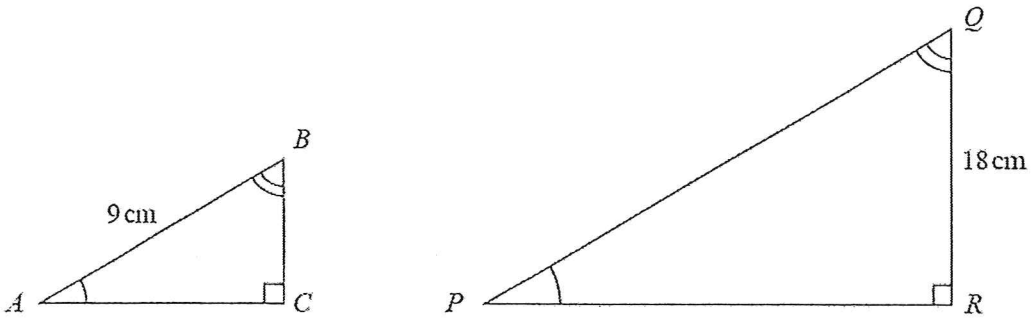
**2** *ABC* and *PQR* are similar triangles.




$AB : PQ = 2 : 5$

(i) Work out the length of *PQ*.

AB : PQ
2 : 5
×4.5 ↘ ↘ ×4.5
9 : 22.5

method to find a scale factor
M1

A1 cao

22.5 cm

**(2)**

(ii) Work out the length of *BC*.

BC : QR
2 : 5
×3.6 ↘ ↘ ×3.6
7.2 : 18

M1

A1 cao

7.2 cm

**(2)**

**(Total for Question 2 is 4 marks)**

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3 The table shows information about the distances travelled by 50 new cars before a tyre was changed.

| Distance ($d$ km) | Number of cars | midpoint |
|---|---|---|
| $5000 \leqslant d < 25\,000$ | 9 | 15000 |
| $25\,000 \leqslant d < 45\,000$ | 25 | 35000 |
| $45\,000 \leqslant d < 65\,000$ | 16 | 55000 |

Calculate an estimate for the mean distance.

M1 (find 3 products within intervals)

$$\frac{9 \times 15000 + 25 \times 35000 + 16 \times 55000}{50} = 37{,}800$$

M1 "$\Sigma fx$"

37,800 km

A1 cao

**(Total for Question 3 is 3 marks)**

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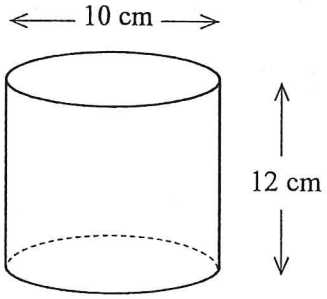
4 The diagram shows a cylinder with diameter 10 cm and height 12 cm.




Calculate the volume of this cylinder.
Give your answer correct to 3 significant figures.

Volume $= \pi r^2 h$

$= \pi \times 5^2 \times 12$ M1 complete method

$= 942.477\ldots$

$= 942\ \text{cm}^3$ (3s.f.)

A1

94.2 $\text{cm}^3$

**(Total for Question 4 is 2 marks)**

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5 Luke invested £4000 in a savings account for 3 years.
Compound interest was paid at a rate of 1.8% each year.

Alexa also invested £4000 in a savings account for 3 years.
Simple interest was paid at a rate of 1.8% each year.

Luke got more interest than Alexa in total over the 3 years.

How much more?
You must show all your working.

P1 finds 1·8% of 4000

P1 complete process to deal with compound interest

Luke: $4000 \times 1.018^3 = 4219.91$

Alexa: 1.8% of 4000 = 72

$4000 + 72 \times 3 = 4216$

P1 complete process to deal with simple interest.

$4219.91 - 4216 = 3.91$

A1 (or 3·92)

£ 3.91

**(Total for Question 5 is 4 marks)**

6 The height, $h$ metres, of a tall building is 184 metres correct to the nearest metre.

Complete the following statement to show the range of possible values of $h$.

accept 184.49

B1 B1

183.5 $\leqslant h <$ 184.5

**(Total for Question 6 is 2 marks)**

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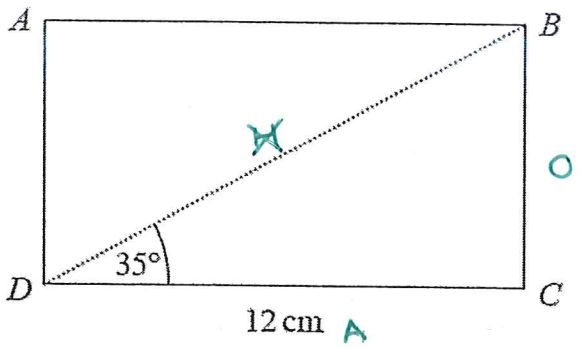
7 Here is a rectangle $ABCD$.




Work out the perimeter of the rectangle.
Give your answer correct to 3 significant figures.


P1 $O = T \times A$

$BC = \tan 35 \times 12 = 8.4024\ldots$

P1

Perimeter $= 2 \times 12 + 2 \times$ "8.4024"$\ldots$

P1

$= 40.804\ldots$

$= 40.8$ cm (3s.f.) (40.80 → 40.81)

A1

40.8 cm

**(Total for Question 7 is 4 marks)**

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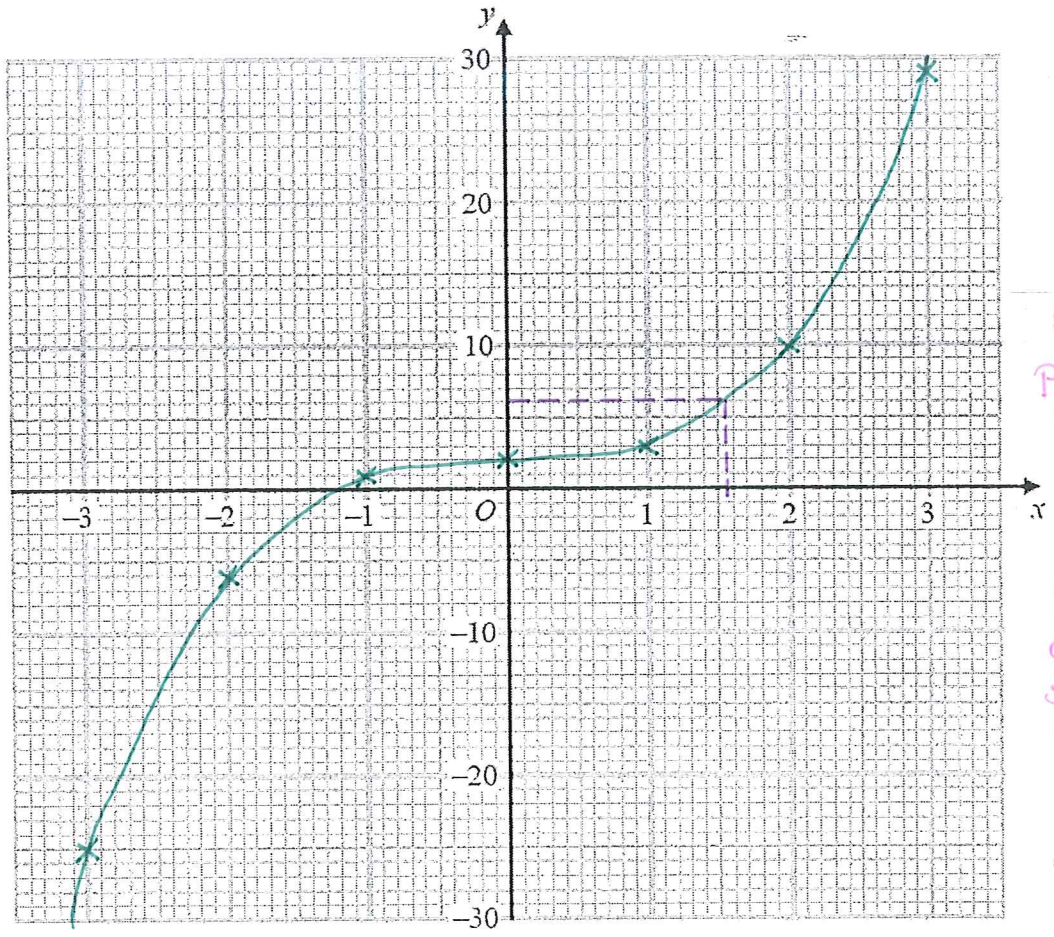
**8** (a) Complete the table of values for $y = x^3 + 2$

B1 3 or 4 correct
B1 all correct

| $x$ | −3 | −2 | −1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| $y$ | −25 | −6 | 1 | 2 | 3 | 10 | 29 |

**(2)**

(b) On the grid, draw the graph of $y = x^3 + 2$ for values of $x$ from −3 to 3




M1 plotting "values" (dep B1)
A1 correct smooth curve

**(2)**

(c) Use your graph to find the value of $x$ when $y = 6$

B1
1.5 → 1.7 ft (b)
1.55

**(1)**

**(Total for Question 8 is 5 marks)**

9 Here is some information about the population and the land area of England, Scotland and Wales in 2016

| | Population | Land area (km$^2$) |
|---|---|---|
| **England** | $5.5 \times 10^7$ | $1.3 \times 10^5$ |
| **Scotland** | $5.4 \times 10^6$ | $8.0 \times 10^4$ |
| **Wales** | $1.9 \times 10^6$ | $2.1 \times 10^4$ |

(a) Calculate the total population of England, Scotland and Wales in 2016

$62,300,000 = 6.23 \times 10^7$

either form ok

B1

$6.23 \times 10^7$

**(1)**

(b) Calculate the average number of people per km$^2$ in England, Scotland and Wales in 2016
Give your answer correct to the nearest whole number.

P1 process to find total area

Total area = $231,000 = 2.31 \times 10^5$

Average = $\frac{"6.23 \times 10^7"}{"2.31 \times 10^5"} = 269.69\ldots$

P1

$= 270$ (3s.f.)

A1
269 → 270

270

**(3)**

**(Total for Question 9 is 4 marks)**

**10** There are $n$ adults in a club.
54 of the adults are over 30 years of age.

20 of the adults in the club are chosen at random.
8 of these 20 adults are over 30 years of age.

Work out an estimate for the value of $n$.

$\frac{54}{n} = \frac{8}{20}$

$\times n$] $54 = \frac{8n}{20}$ P1

$\times 20$] $1080 = 8n$

$\div 8$] $135 = n$

OR $\frac{54}{n} = \frac{8}{20}$

$\frac{n}{54} = \frac{20}{8}$ [$\times 54$

$n = \frac{20}{8} \times 54$

$= 135$

A1 cao

.....135.....

**(Total for Question 10 is 2 marks)**

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**11** Solve $\frac{8-3x}{4} = 8-2x$

M1 $\times 4$] $8 - 3x = 32 - 8x$

$+8x$] $8 + 5x = 32$ M1 (dep M1) isolating terms in $x$

$-8$] $5x = 24$

$\div 5$] $x = 4.8$

A1

$x =$ ....4.8....

**(Total for Question 11 is 3 marks)**

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**12** Mrs Atkins is going to choose two students from her class to take part in a competition.
She can choose from 16 girls and 14 boys.

(a) Work out the number of different ways of choosing one girl and one boy.

$16 \times 14 = 224$

B1

224

**(1)**

(b) Work out the number of different ways of choosing two boys.

M1

$\frac{14 \times 13}{2} = 91$ A1

| | $B_1$ | $B_2$ | $B_3$ | $B_4$ | $B_5$ | $B_6$ | $B_7$ | $B_8$ | $B_9$ | $B_{10}$ | $B_{11}$ | $B_{12}$ | $B_{13}$ | $B_{14}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $B_1$ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| $B_2$ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| $B_3$ | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| $B_4$ | | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| $B_5$ | | | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| $B_6$ | | | | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| $B_7$ | | | | | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| $B_8$ | | | | | | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| $B_9$ | | | | | | | | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| $B_{10}$ | | | | | | | | | | | ✓ | ✓ | ✓ | ✓ |
| $B_{11}$ | | | | | | | | | | | | ✓ | ✓ | ✓ |
| $B_{12}$ | | | | | | | | | | | | | ✓ | ✓ |
| $B_{13}$ | | | | | | | | | | | | | | ✓ |
| $B_{14}$ | | | | | | | | | | | | | | |

91

**(2)**

**(Total for Question 12 is 3 marks)**

$\frac{n \text{ boys } (n \text{ boys} - 1)}{2}$

**13** (a) Show that the equation $x^4 - 3x - 1 = 0$ has a solution between $x = 1$ and $x = 2$

$x = 1$: $1^4 - 3 \times 1 - 1 = -3$ C1

$x = 2$: $2^4 - 3 \times 2 - 1 = 9$

change of sign means there is a solution to $x^4 - 3x - 1 = 0$ between $x = 1$ and $x = 2$. C1

**(2)**

(b) Show that for $x > 0$ the equation $x^4 - 3x - 1 = 0$ can be arranged to give $x = \sqrt[4]{3x + 1}$

$x^4 - 3x - 1 = 0$

$+3x + 1$ ] $x^4 = 3x + 1$

$\sqrt[4]{\ }$ ] $x = \sqrt[4]{3x + 1}$ C1

**(1)**

(c) Starting with $x_0 = 1$, use the iteration formula $x_{n+1} = \sqrt[4]{3x_n + 1}$ once to find an estimate for a solution of $x^4 - 3x - 1 = 0$

$x_0 = 1$

$x_1 = \sqrt[4]{3 \times 1 + 1} = 1.41421\ldots$

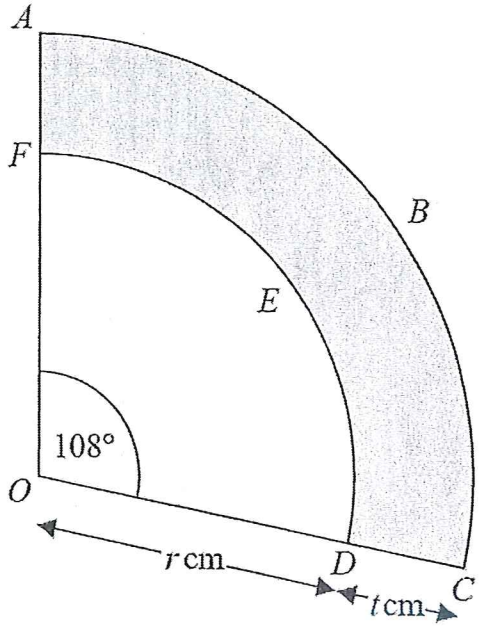
B1

1.414 (3dp)

**(1)**

**(Total for Question 13 is 4 marks)**

**14**




*ABC* and *DEF* are two arcs of circles, centre *O*.
*OFA* and *ODC* are straight lines.

(a) Show that the perimeter of the shaded region is given by $\frac{6\pi r + 3\pi t + 10t}{5}$ cm

Length DEF $= \frac{108}{360} \times \pi \times 2r$

$= \frac{3}{5}\pi r$

Length ABC $= \frac{108}{360} \times \pi \times 2(r+t)$

$= \frac{3}{5}\pi(r+t)$

Perimeter $= \frac{3}{5}\pi r + \frac{3}{5}\pi(r+t) + 2t$

$= \frac{3\pi r + 3\pi r + 3\pi t + 10t}{5}$

$= \frac{6\pi r + 3\pi t + 10t}{5}$

Arc length $= \frac{\theta}{360} \times 2\pi r$

P1 use of $\frac{108}{360}$ or $2\pi r$ or $2\pi(r+t)$

P1 complete process to find perimeter

P1 process to use a common denominator

P1 collect like terms.

**(5)**

C1 completion of processes to get result.

(b)(i) Find the exact value of $\frac{6\pi r + 3\pi t + 10t}{5}$ when $r = 0$ and $t = 10$

Give your answer in its simplest form.

$\frac{3\pi \times 10 + 10 \times 10}{5} = 6\pi + 20$

B1

$6\pi + 20$

**(1)**

(ii) Explain what your value in part (b)(i) represents.

The perimeter of a sector, segment, radius 10, angle 108°.

C1

**(1)**

**(Total for Question 14 is 7 marks)**

**15** $c$ is inversely proportional to $d$.
$c = 0.5$ when $d = 6$

Find a formula for $c$ in terms of $d$.

$c \propto \frac{1}{d}$

$c = \frac{k}{d}$ M1

$0.5 = \frac{k}{6}$ M1

$\times 6$ $\quad 3 = k$

$c = \frac{3}{d}$ A1

.....

**(Total for Question 15 is 3 marks)**

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**16** There are some counters in a box.
Each counter is blue or green or red or yellow.

The total number of blue and green counters is twice the total number of red and yellow counters.

The number of green counters is $\frac{1}{6}$ of the number of blue counters.

Show that, to the nearest percent, the percentage of blue counters in the box is 57 %

$b + g = 2(r + y)$

$g = \frac{1}{6}b$

$\frac{2}{3}$ of counters are blue or green.

$\frac{6}{7}$ of blue or green counters are blue.

$\frac{2}{3} \times \frac{6}{7} = \frac{4}{7} = 57.14\ldots\%$

$= 57\%$ (nearest percent). C1

OR

B+G | B+G | R+Y $\frac{2}{3}$ of counters are B or G M1

B | B | B | B | B | B | G $\frac{6}{7}$ of B or G counters are B M1

Blue

$\frac{6}{7}$ of $\frac{2}{3}$

$= \frac{6 \times 2}{7 \times 3}$ M1

$= \frac{14}{21}$

$\times 100$ to give %

**(Total for Question 16 is 4 marks)**

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OR Let there be 2100 counters

B and G : R and Y

2 : 1

1400 : 700

now share the 1400 B and G counters

B : G

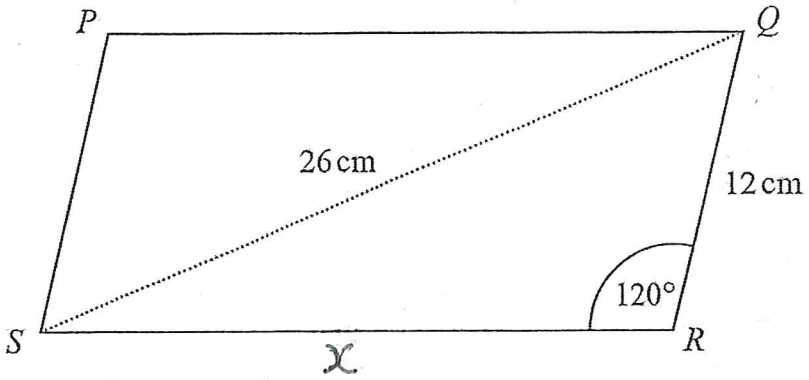
G : 1

B : G

1200 : 200

so we have $\frac{1200}{2100}$ Blue counters, 57%

17




Calculate the area of the parallelogram $PQRS$.
Give your answer correct to 3 significant figures.
You must show all your working.

cosine rule to find side SR

$a^2 = b^2 + c^2 - 2bc\cos A$ $\quad \cos 120^\circ = -\frac{1}{2}$

$26^2 = x^2 + 12^2 - 2 \times x \times 12\cos 120$ P1

$676 = x^2 + 144 + 12x$

$0 = x^2 + 12x - 532$ P1

$x = \frac{-12 + \sqrt{12^2 - 4 \times -532}}{2} = 17.832\ldots$ P1

Use Sine Rule to find area of triangle QRS then double

Area PQRS $= 2 \times \frac{1}{2} \times 17.832\ldots \times 12 \sin 120$ P1

$= 185.323\ldots$

$= 185\ \text{cm}^2$ (3s.f.)

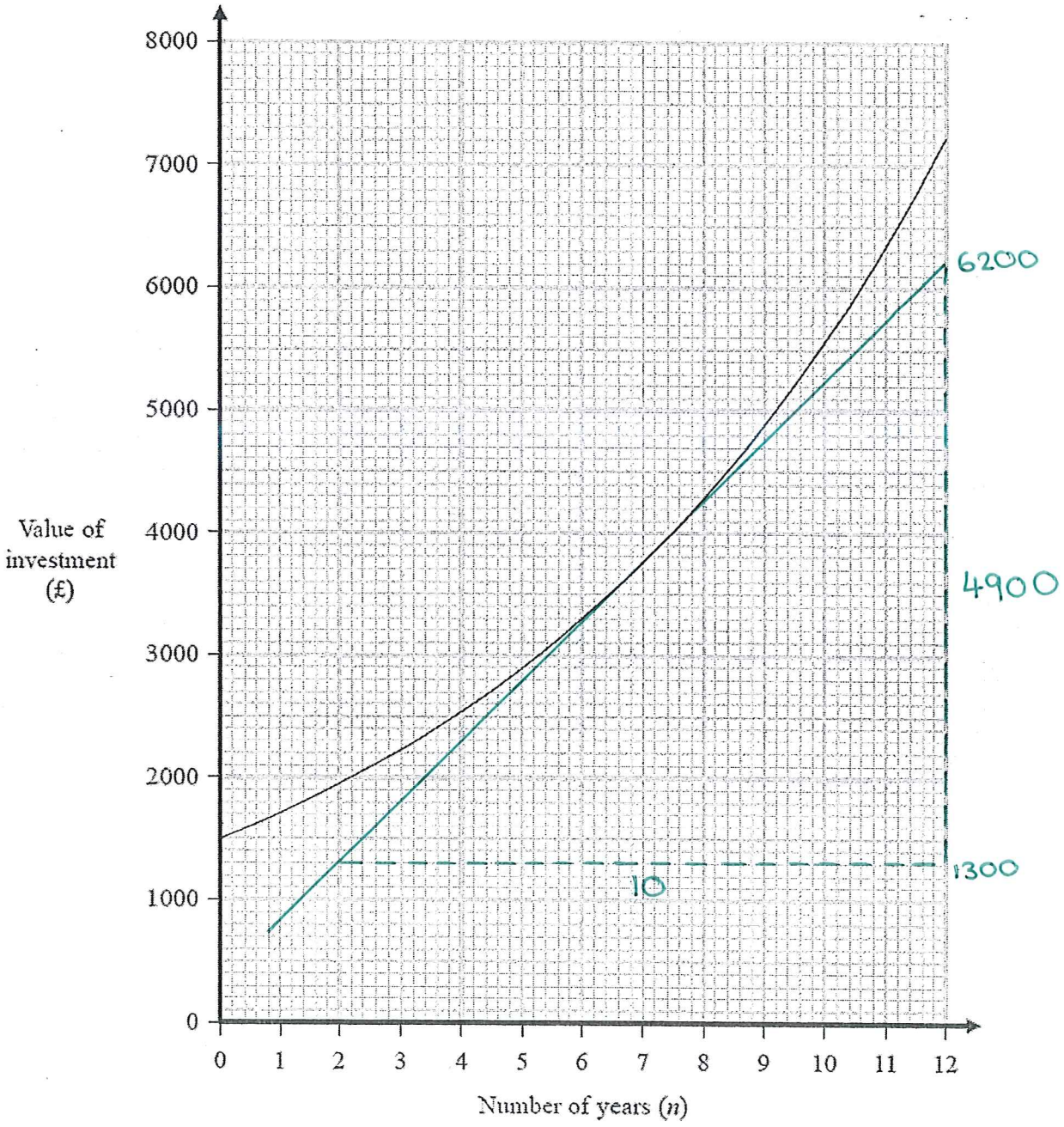
A1

.....185..... cm²

**(Total for Question 17 is 5 marks)**

**18** Frank invested an amount of money for 12 years.

The graph shows the value of Frank's investment over the 12 year period.




(a) (i) Write down the amount of money that Frank invested.

B1 cao

£ 1500

**(1)**

Frank said that 12 years after he had made his investment, it was worth more than five times its original value.

(ii) Was Frank correct?
Give a reason for your answer.

$\frac{7200}{1500} = 4.8$ He was not correct. It was worth 4.8 times its original value. C1

**(1)**

(b) (i) Find an estimate for the gradient of the curve at $n = 7$

$\frac{4900}{10} = 490$

M1 suitable tangent at $n=7$
M1 full method to find gradient at $n=7$
A1 answer in range 450 to 500 (or ft from "tangent")

490

**(3)**

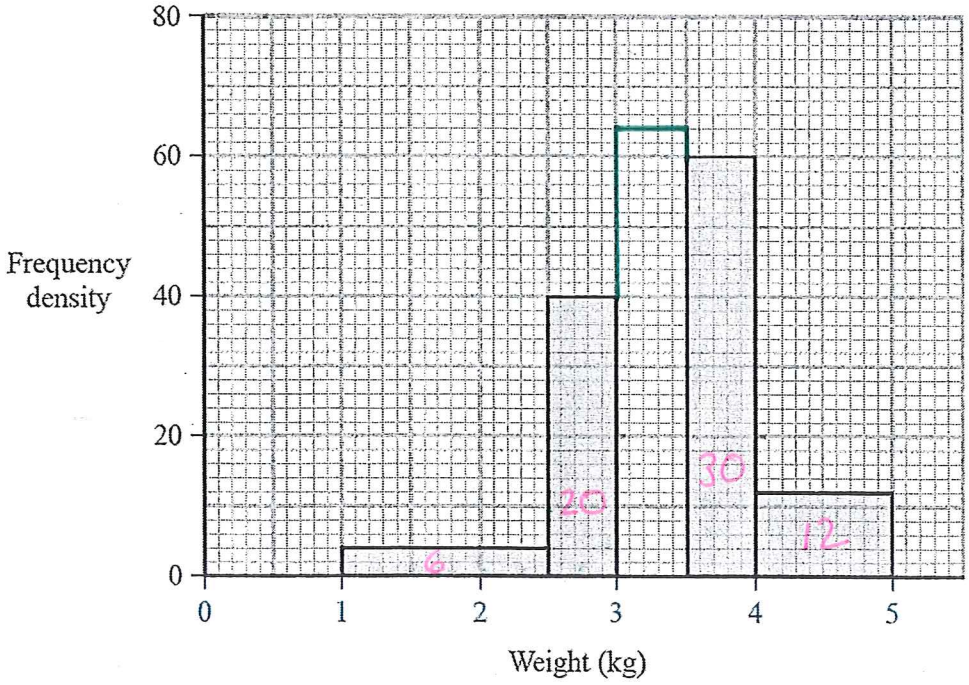
(ii) Explain what this gradient represents.

When $n=7$, the value of the investment is increasing by £490 per year. C1

**(1)**

**(Total for Question 18 is 6 marks)**

**19**




The incomplete histogram shows information about the weights of 100 babies.
All 100 babies have a weight between 1 kg and 5 kg.

6 of the babies have a weight between 1 kg and 2.5 kg.

Complete the histogram.
You must show all your working.

1 - 2.5 kg : 6

2.5 - 3 kg : 0.5 × 40 = 20

3 - 3.5 kg : ?

3.5 - 4 kg : 0.5 × 60 = 30

4 - 5 kg : 1 × 12 = 12

32 babies 3 - 3.5 kg.

32 ÷ 0.5 = 64.

M1 any correct frequency

M1 find all correct frequencies (20, 30, 12)

M1 finds missing frequency 32

C1 bar correctly drawn

6 + 20 + 30 + 12 = 68

**(Total for Question 19 is 4 marks)**

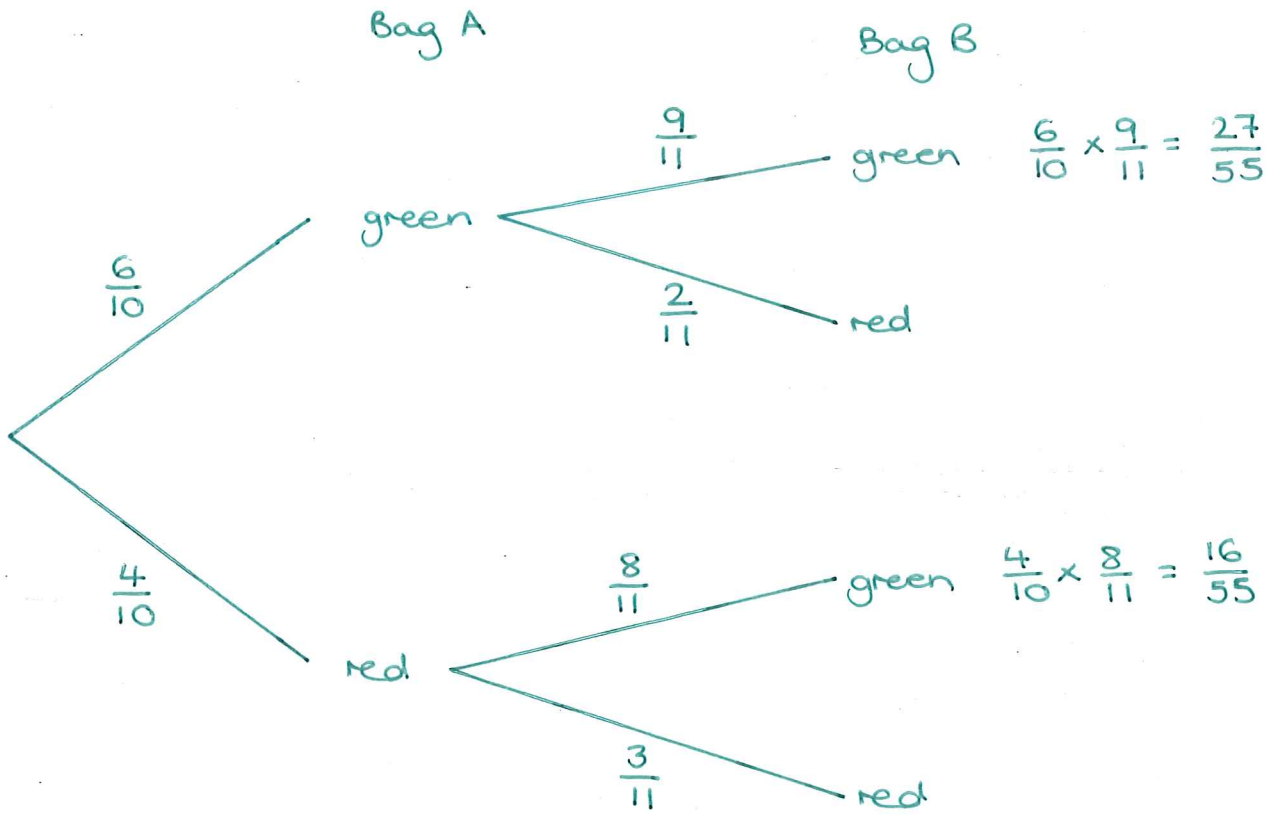
**20** Two bags, **A** and **B**, each contain only green marbles and red marbles.

There are 6 green marbles and 4 red marbles in bag **A**.
There are 8 green marbles and 2 red marbles in bag **B**.

One marble is going to be taken at random from bag **A** and placed in bag **B**.

A marble is then going to be taken at random from bag **B**.

Work out the probability that this marble will be a green marble.




$P(\text{green}) = \frac{27}{55} + \frac{16}{55} = \frac{43}{55}$

P1 either $\frac{9}{11}$ or $\frac{8}{11}$

P1 any product from tree

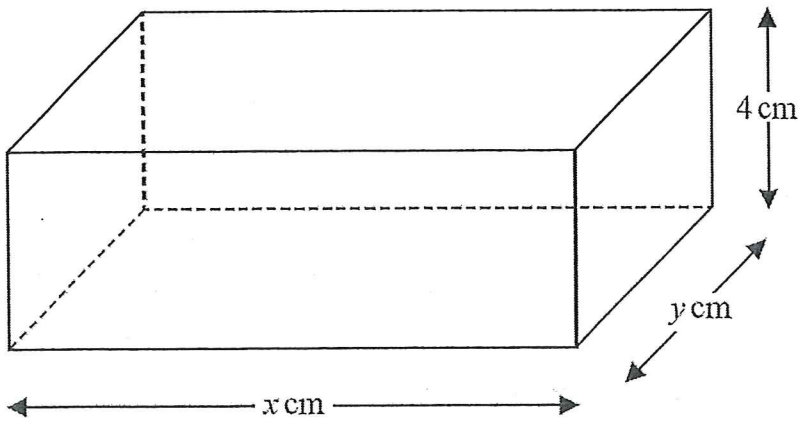
P1 complete process

$\frac{43}{55}$ A1 oe

0.781

**(Total for Question 20 is 4 marks)**

**21** Here is a solid cuboid.




The volume of the cuboid is 119 cm³
The total surface area of the cuboid is 155.5 cm²

Given that $x > y$, work out the value of $x$ and the value of $y$.
You must show all your working.

Volume = 119

$4xy = 119$ M1

$y = \frac{119}{4x}$

Surface area = 155.5

$2 \times 4y + 2 \times xy + 2 \times 4x = 155.5$

$8y + 2xy + 8x = 155.5$ M1

Substitute: $8 \times \frac{119}{4x} + 2x \times \frac{119}{4x} + 8x = 155.5$ M1 find equation in one variable

$\frac{238}{x} + \frac{119}{2} + 8x = 155.5$

$\times 2x$ $476 + 119x + 16x^2 = 311x$

$-311x$ $16x^2 - 192x + 476 = 0$

$4x^2 - 48x + 119 = 0$ M1 (or in terms of y)

$(2x - 7)(2x - 17) = 0$

$x = \frac{7}{2}$ or $x = \frac{17}{2}$

$y = \frac{17}{2}$ $y = \frac{7}{2}$

$x =$ 17/2 A1

$y =$ 7/2

**(Total for Question 21 is 5 marks)**

**TOTAL FOR PAPER IS 80 MARKS**