

Please write clearly in block capitals.

Centre number

Candidate number

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

H

Higher Tier

Paper 3 Calculator

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments.



Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

Advice

In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Pages	Mark
2-3	
4-5	
6-7	
8-9	
10-11	
12-13	
14-15	
16-17	
18-19	
20-21	
22-23	
24-25	
26	
TOTAL	



JUN2183003H01

Answer all questions in the spaces provided.

- 1 b is 3 more than the square root of a .

Circle the correct equation.

[1 mark]

$$b = \sqrt{a+3}$$

$$b = \sqrt{a} - 3$$

$$b = \sqrt{a+3}$$

$$b = \sqrt{a-3}$$

- 2 Circle the largest number.

[1 mark]

$$0.\dot{5}$$

$$0.55$$

$$0.545$$

$$0.5\dot{4}\dot{5}$$

- 3 A line has equation $3y = 3x - 2$

Circle the coordinates of the intercept of the line with the y -axis.

[1 mark]

$$(0, 1)$$

$$(0, -1)$$

$$\left(0, \frac{2}{3}\right)$$

$$\left(0, -\frac{2}{3}\right)$$



- 4 Factorise $x^2 - 64$
Circle your answer.

[1 mark]

$(x + 8)^2$

$(x - 8)^2$

$(x + 8)(x - 8)$

$x(x - 64)$

- 5 Six positive numbers have
a mean of 10
a range of 19

Four of the numbers are 12 7 15 3

Work out the other two numbers.

[3 marks]

$$6 \times 10 - (12 + 7 + 15 + 3) = 60 - 37 = 23$$

The numbers add to 23.

Range of the four numbers is $15 - 3 = 12$.

So the range of the two numbers is 19.

$$21 + 2 = 23 \quad \text{and} \quad 21 - 2 = 19$$

Answer 2 and 21



- 6 At a country park there is a house, a museum and a garden.
The table shows the prices per person to visit the park.

	Price per person
Garden only	Free
House and museum	£12.50
House only	£8
Museum only	£7

One day, 480 people visit the park.

67 visit the garden **only**.

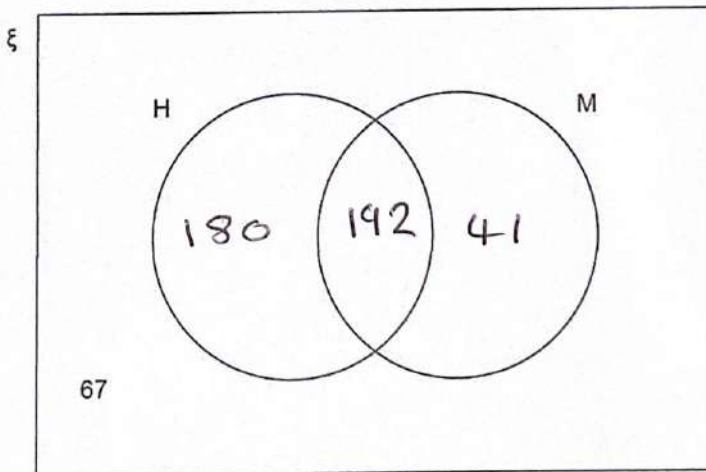
40% visit the house **and** the museum.

$\frac{3}{8}$ visit the house **only**.

The rest visit the museum **only**.

In total, how much do the 480 people pay to visit the park?
You may use the Venn diagram to help you.

[5 marks]



$$\text{House \& } \del{\text{Museum}} \text{ museum} = 480 \times 0.4 = 192$$

$$\text{House only} = 480 \times \frac{3}{8} = 180$$

$$\text{museum only} = 480 - (192 + 180 + 62) = 41$$

$$\begin{aligned} \text{Total paid} &= 192 \times 12.50 + 180 \times 8 + 41 \times 7 \\ &= \pounds 4127 \end{aligned}$$

Answer £ 4127

7 Jeff and Kaz share £270 in the ratio Jeff : Kaz = 2.6 : 1

How much **more** than Kaz does Jeff get?

[3 marks]

$$2.6 + 1 = 3.6 \quad 270 \div 3.6 = 75$$

$$75 \times 2.6 = \pounds 195 \text{ for Jeff.}$$

$$75 \times 1 = \pounds 75 \text{ for Kaz.}$$

$$195 - 75 = \pounds 120 \text{ more}$$

Answer £ 120



8 The heel of a shoe exerts a pressure of 198 pounds per square inch.

Convert this pressure into kilograms per square centimetre.

Use

$$1 \text{ pound} = 0.45 \text{ kilograms}$$

$$1 \text{ square inch} = 6.25 \text{ square centimetres}$$

[3 marks]

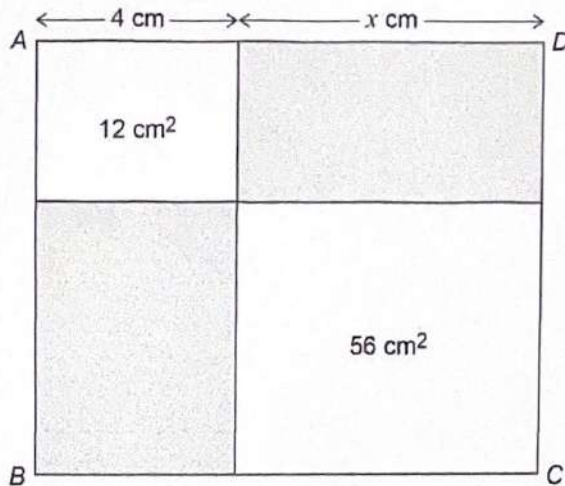
$$198 \times 0.45 = 89.1 \text{ kg per square inch.}$$

$$89.1 \div 6.25 = 14.256 \text{ kg per square cm}$$

Answer 14.256 kg/cm²



- 9 Rectangle $ABCD$ is split into four smaller rectangles.
Two of the smaller rectangles are shaded.



Not drawn
accurately

$$4 : x = 1 : 2$$

For rectangle $ABCD$, work out the ratio shaded area : unshaded area

Give your answer in its simplest form.

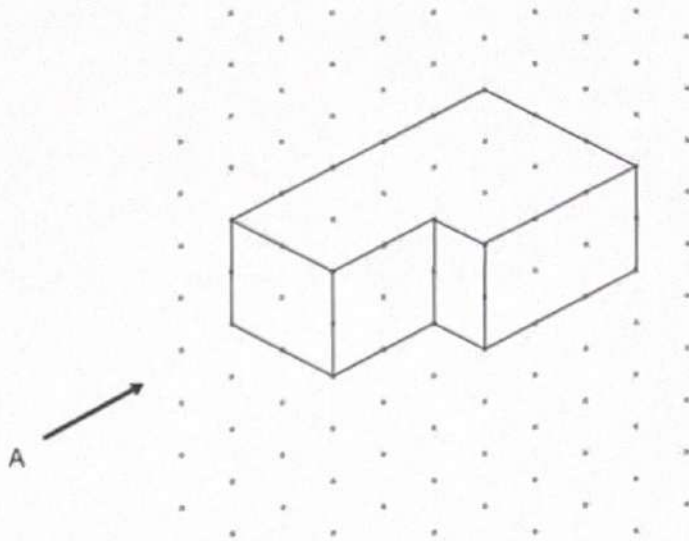
[4 marks]

$1:2=4:8$, $x=8$. Top shaded rectangle has twice the width, but the same height as top unshaded, so twice the area, $12 \times 2 = 24 \text{ cm}^2$. Bottom left rectangle has the same height as bottom right, but half the width, so half the area, $56 \div 2 = 28 \text{ cm}^2$.
Total shaded area = $28 + 24 = 52 \text{ cm}^2$
total unshaded area = $56 + 12 = 68 \text{ cm}^2$.
 $52:68 = 13:17$

Answer 13 : 17

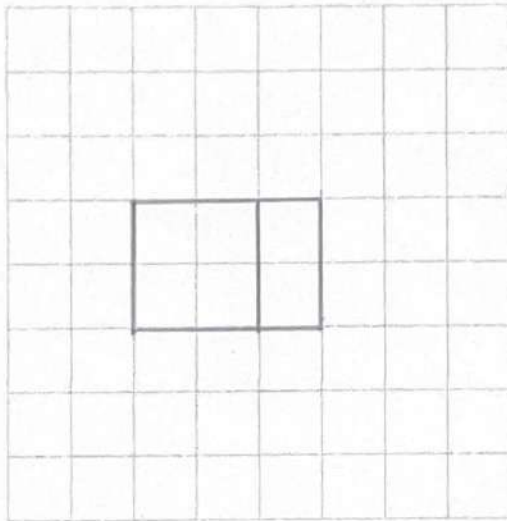


- 10 A solid shape is drawn on isometric paper.



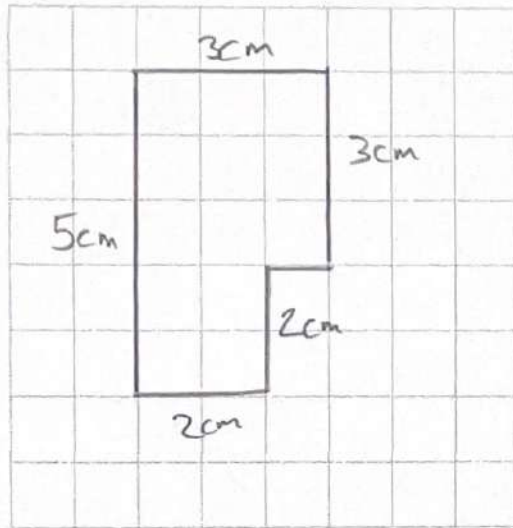
- 10 (a) On the centimetre grid, draw the elevation of the shape from A.

[1 mark]



- 10 (b) On the centimetre grid, draw a plan of the shape.

[1 mark]



- 11 Erik thinks of a prime number between 20 and 30
His number is $x\%$ of 125

Work out **one** possible value of x .

[3 marks]

Prime could be 23 or 29. Choose 29.

$$\frac{29}{125} \times 100 = 0.232 \times 100 = 23.2$$

23.2 is 29% of 125.

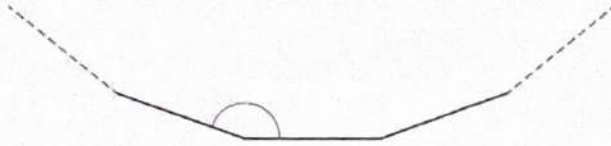
So a possible value for x .

Answer 23.2



- 12 Part of a regular polygon with 15 sides is shown.

Not drawn
accurately



Work out the size of an interior angle.

[2 marks]

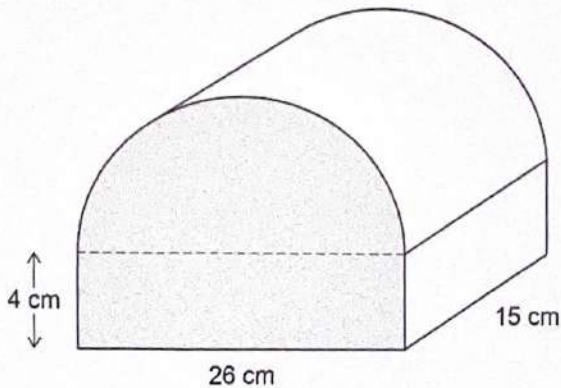
Sum of interior angles = $(15-2) \times 180 = 2340$.

All angles are the same so $2340 \div 15 = 156^\circ$

Answer 156 degrees



- 13 A box is the shape of half a cylinder on top of a cuboid.



Work out the volume of the box.

[4 marks]

Diameter of the cylinder = 26 cm, radius = 13 cm.

Volume of the half cylinder = $\pi \times 13^2 \times 15 \times \frac{1}{2}$

$$= \frac{2535\pi}{2}$$

Volume of cuboid = 1560

Volume of box = $1560 + \frac{2535\pi}{2} = 5541.97$

Answer 5541.97 cm³



14

Phil sells ties.

He increases the original price of each tie by 10% to £13.20

A month later he announces a sale.



Phil says,

"The ties will be back to their original price, because each change was by 10%"

Is he correct?

Tick a box.

Yes

No

Show working to support your answer.

[3 marks]

Price decrease $13.20 \times 0.9 = \pounds 11.88$

original price $13.20 \div 1.1 = \pounds 12$



15

A biased spinner can land on A, B or C.

The table shows the probabilities, in terms of k , of A, B and C.

	A	B	C
Probability	$0.5k$	$7k - 0.15$	$2.5k$

Work out the probability of B.

[3 marks]

$$0.5k + 7k - 0.15 + 2.5k = 1$$

$$10k = 1 + 0.15, \quad k = 0.115.$$

$$7 \times 0.115 - 0.15 = 0.655.$$

Answer 0.655

Turn over for the next question



16

P is the point (2, 14)

Q is the point (6, 8)

R is the point (2, 5)

Use gradients to show that angle PQR is not a right angle.

[3 marks]

$$\text{Gradient of } PQ = \frac{14-8}{2-6} = -\frac{3}{2}$$

$$\text{Gradient of } QR = \frac{8-5}{6-2} = \frac{3}{4}$$

$$-\frac{3}{2} \times \frac{3}{4} = -1.125 \neq -1$$



17 $m^2 > 9$

Circle the possible value of m .

[1 mark]

$-2\frac{7}{8}$

2.8

3

$\frac{7}{2}$

18 Simplify $w^1 \times w^0$

Circle your answer.

[1 mark]

1

0

w

 w^2

19 The equation of a circle is $x^2 + y^2 = 11$

Work out the length of the **diameter**.

Circle your answer.

[1 mark]

$\sqrt{11}$

$2\sqrt{11}$

$\sqrt{22}$

22

Turn over for the next question



20

$$\frac{a}{b} = 3c$$

$$\frac{b}{c} = 2$$

Work out the value of a when $c = 8$

[3 marks]

$$b = 2c, \quad b = 2 \times 8 = 16.$$

$$\frac{a}{16} = 3 \times 8 = 24$$

$$a = 16 \times 24 = 384.$$

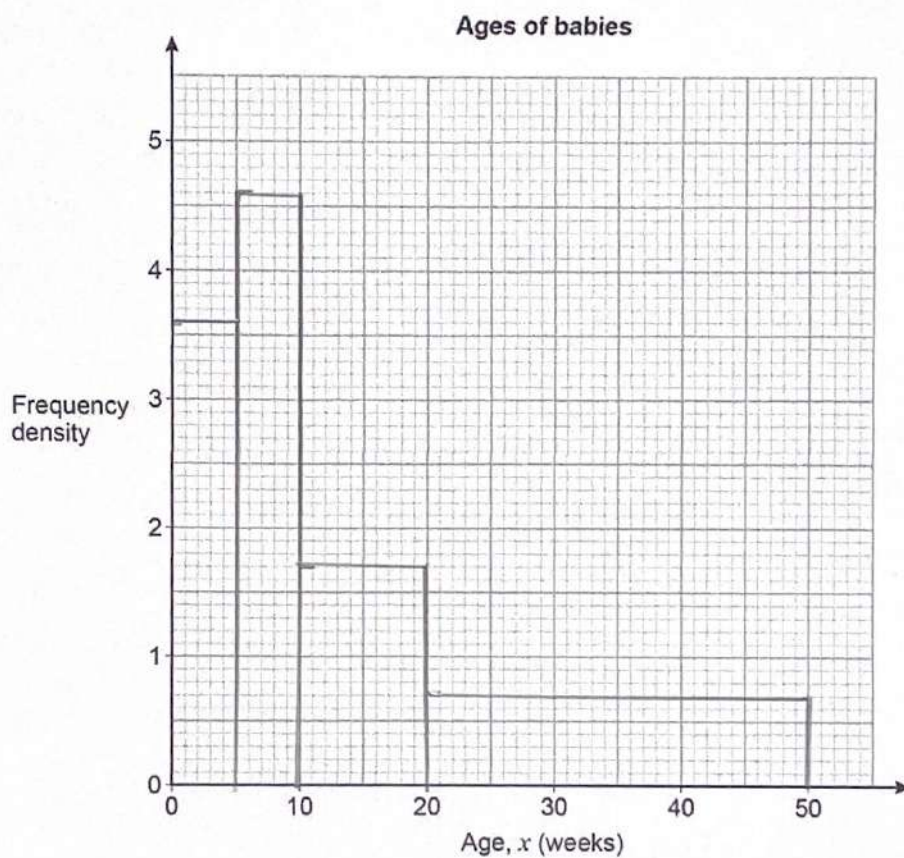
Answer 384

- 21 Here is some information about the ages of babies at a clinic.

Age, x (weeks)	Frequency		
$0 \leq x < 5$	18		
$5 \leq x < 10$	23		
$10 \leq x < 20$	17		
$20 \leq x < 50$	21		

Draw a histogram to represent the information.

[4 marks]



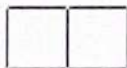
22

A sequence of patterns is made using horizontal sticks and vertical sticks.

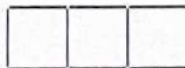
Pattern 1



Pattern 2



Pattern 3



The table shows the number of horizontal sticks and vertical sticks in each pattern.

Pattern	Number of horizontal sticks	Number of vertical sticks
1	2	2
2	4	3
3	6	4

What fraction of the total number of sticks in Pattern n are horizontal?

Give your answer in terms of n .

[3 marks]

$$\text{Pattern 1} = \frac{1}{2}, \text{ Pattern 2} = \frac{4}{7}$$

$$\text{Pattern 3} = \frac{6}{10} \quad \text{Total sticks} = 3n + 1.$$

$$\text{Horizontal sticks} = 2n.$$

$$\text{Pattern } n = \frac{2n}{3n+1}$$

Answer $\frac{2n}{3n+1}$



23 The equation of a curve is $y = 16^x$

23 (a) Circle the point that lies on the curve.

[1 mark]

(2, 32)

(32, 2)

(2, 256)

(256, 2)

23 (b) A different point on the curve has y -coordinate $\frac{1}{16}$

Work out the x -coordinate.

[1 mark]

$$(16)^{-1} = \frac{1}{16}$$

Answer -1

24 $a^b = 3$ where a is an integer and b is a proper fraction.

Work out **one** possible pair of values of a and b .

[1 mark]

$$3^2 = 9, \text{ so } 9^{\frac{1}{2}} = 3$$

$a =$ 9 $b =$ $\frac{1}{2}$



25

Expand and simplify fully $(x-3)(x+2)(x+5)$

[3 marks]

$$(x-3)(x+2) = x^2 - x - 6.$$

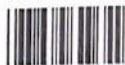
$$(x-3)(x+2)(x+5) = (x^2 - x - 6)(x+5)$$

$$= x(x^2 - x - 6) + 5(x^2 - x - 6)$$

$$= x^3 - x^2 - 6x + 5x^2 - 5x - 30$$

$$= x^3 + 4x^2 - 11x - 30$$

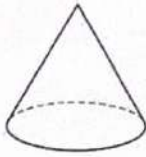
Answer $x^3 + 4x^2 - 11x - 30$



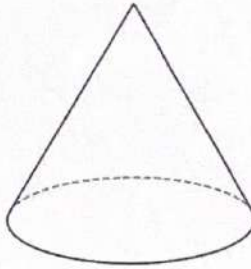
26

Here are two similar cones.

Cone A



Cone B

The surface area of cone A is 2 m^2 The surface area of cone B is 4.5 m^2

Work out the ratio radius of cone A : radius of cone B

Give your answer in the form $1 : n$

[3 marks]

$$4.5 \div 2 = 2.25.$$

$$\sqrt{2.25} = 1.5$$

$$1 : 1.5$$

Answer 1 : 1.5

27

In the diagram

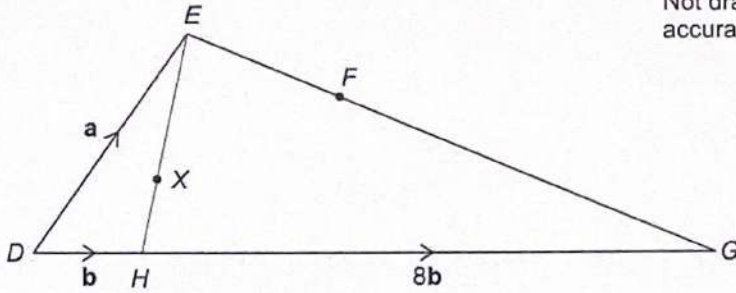
$$\overline{DE} = a$$

$$\overline{DH} = b$$

$$\overline{HG} = 8b$$

$$EX : XH = 3 : 1$$

$$EF : FG = 1 : 3$$

Not drawn
accurately

27 (a)

Show that $\overline{DX} = \frac{1}{4}a + \frac{3}{4}b$

[2 marks]

$$\overline{DX} = \overline{DH} + \overline{HX} \quad \overline{HE} = a - b$$

$$\overline{HX} = \frac{1}{4}(a - b) = \frac{1}{4}a - \frac{1}{4}b$$

$$\overline{DX} = b - \frac{1}{4}b + \frac{1}{4}a = \frac{1}{4}a + \frac{3}{4}b$$



27 (b) Is DXF a straight line?

Show working to support your answer.

[4 marks]

$$\overrightarrow{EF} = \frac{1}{4} \overrightarrow{EG}$$

$$\overrightarrow{EG} = -a + 9b$$

$$\overrightarrow{EF} = -\frac{1}{4}a + \frac{9}{4}b.$$

$$\begin{aligned} \overrightarrow{DF} &= \overrightarrow{DE} + \overrightarrow{EF} = a - \frac{1}{4}a + \frac{9}{4}b \\ &= +\frac{3}{4}a + \frac{9}{4}b. \end{aligned}$$

$$\overrightarrow{DF} = 3\left(\frac{1}{4}a + \frac{3}{4}b\right) \text{ (so passes through X).}$$

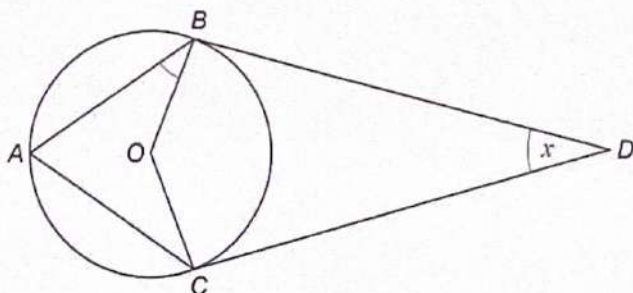
Yes, DXF is a straight line.

Turn over for the next question

Turn over ►



- 29 A, B and C are three points on the circumference of a circle, centre O.
 BD and CD are tangents to the circle.
 ABDC is a kite.
 Angle BDC is x



Not drawn
accurately

Prove that angle ABO is $45^\circ - \frac{x}{4}$

[4 marks]

$\angle OBD$ & $\angle OCD$ are right angles. (radius meets tangent)
 So $\angle BOC = 360^\circ - (90^\circ + 90^\circ + x)$ (obtuse)
 obtuse $\angle BOC = 180^\circ - x$ Angles around a point
 reflex $\angle BOC = 180^\circ + x$. add to 360° .
 $\angle BAC = 90^\circ - \frac{x}{2}$ as angles in a circumference
 are half angles at the centre.

$\angle ABO + \angle ACO = 360^\circ - (90^\circ - \frac{x}{2} + 180^\circ + x) = 90^\circ - \frac{x}{2}$
 as angles in a quadrilateral add to 360° .

$\angle ABO = \frac{1}{2}(90^\circ - \frac{x}{2}) = 45^\circ - \frac{x}{4}$.



28

 $a = 4.72$ to 3 significant figures. $b = 158$ to 3 significant figures.Work out the upper bound of $\frac{a}{b}$ You **must** show your working.

[3 marks]

Upper bound of $a = 4.725$
 Lower bound of $b = 157.5$

$$\frac{4.725}{157.5} = \frac{3}{100}$$

Answer 0.03



- 30 A sphere has radius r cm
An approximate value of r can be found using the iterative formula

$$r_{n+1} = \sqrt{\frac{239}{r_n}}$$

The starting value is $r_1 = 7$

- 30 (a) Work out the values of r_2 and r_3

[2 marks]

$$r_2 = \sqrt{\frac{239}{7}} = 5.84$$

$$r_3 = \sqrt{\frac{239}{5.84}} = \cancel{6.29} = 6.40$$

$$r_2 = 5.84$$

$$r_3 = 6.40$$

- 30 (b) Continue the iteration to work out the radius to 1 decimal place.

[1 mark]

$$r_4 = 6.11, r_5 = 6.25, r_6 = 6.18$$

$$r_7 = 6.22, r_8 = 6.199...$$

Answer 6.2 cm

END OF QUESTIONS

