

Please write clearly in block capitals.

Centre number

Candidate number

Surname LPO model answers

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.

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	
<b>TOTAL</b>	

### Advice

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



Answer **all** questions in the spaces provided.

Do not write  
outside the  
box

- 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  $\frac{3y}{3} = \frac{3x}{3} - \frac{2}{3}$

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]

~~Range = 19 = 21 - 2~~

~~$12 + 7 + 15 + 3 + 22 + x = 10$~~

6

~~$59 + x = 10$~~

6

~~$x = 1$~~

Answer 2 and 21

$$\frac{\text{Total}}{6} = \text{mean} = 10.$$

$$60 = \text{total}$$

$$x + y = 23$$

$$2 + 21 = 23$$

~~37~~

Turn over ►



- 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

$$\times 192 = 2400$$

$$\times 180 = 1440$$

$$\times 41 = 287$$

$$\underline{\pounds 4127}$$

One day, 480 people visit the park.

67 visit the garden **only**.

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

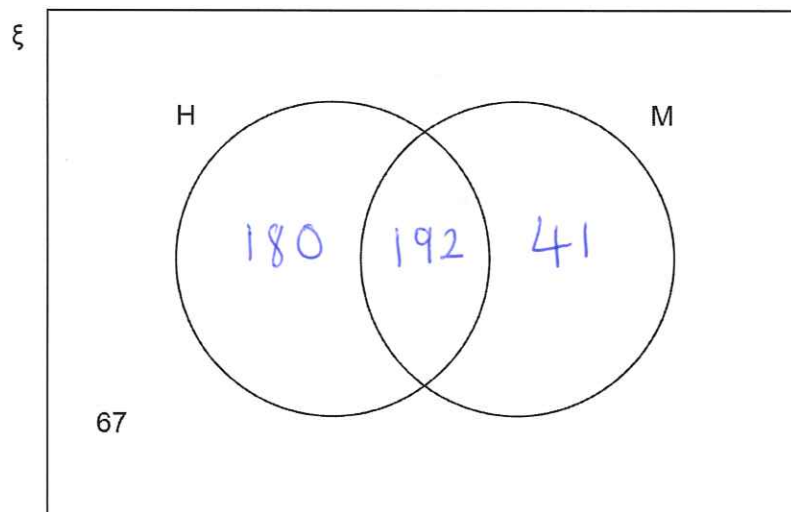
$\frac{3}{8}$  visit the house **only**.

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]



$$H \& M \rightarrow 40\% \text{ of } 480$$

$$= 192.$$

$$H \rightarrow \frac{3}{8} \text{ of } 480$$

$$= 180$$

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]

$$270 \div 3.6 = 75$$

$$75 \times 1.6 = 120$$

Answer £ 120

Turn over ►



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 pound = 0.45 kilograms

1 square inch = 6.25 square centimetres

[3 marks]

$$\text{Pressure} = \frac{\text{force}}{\text{area}}$$

~~$$198 \text{ lb/in}^2 =$$~~

$$198 \text{ lb/in}^2 = \frac{198 \text{ lb}}{1 \text{ in}^2} = \frac{0.45 \times 198}{6.25 \text{ cm}^2}$$

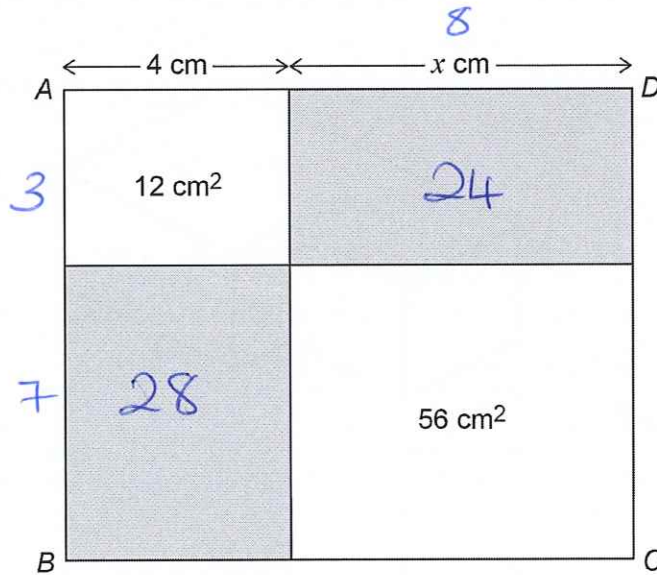
Answer 14.26 kg/cm<sup>2</sup>



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]

$$\div 4 \left( \begin{array}{l} 4 : x \\ 1 : 2 \end{array} \right) \div 4$$

$$x = 8.$$

Shaded area : unshaded area

$$52 : 68$$

$$26 : 34$$

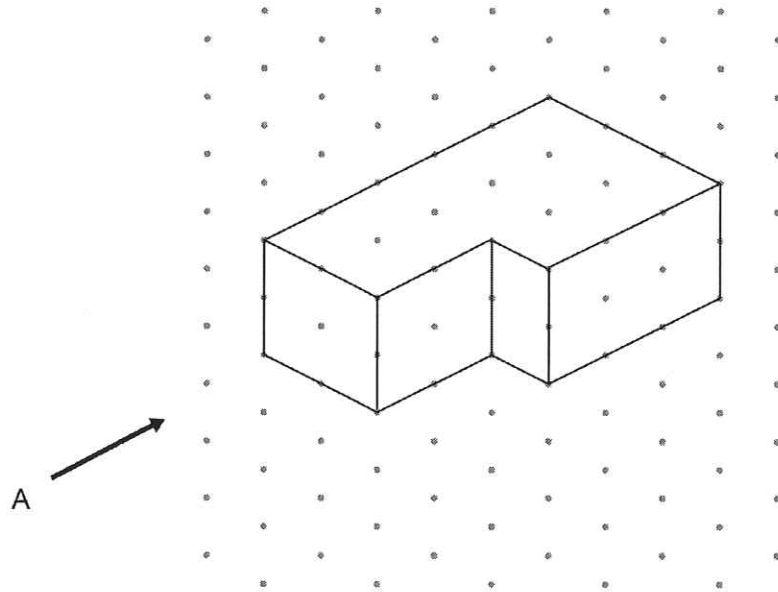
$$13 : 17$$

Answer 13 : 17.

Turn over ►

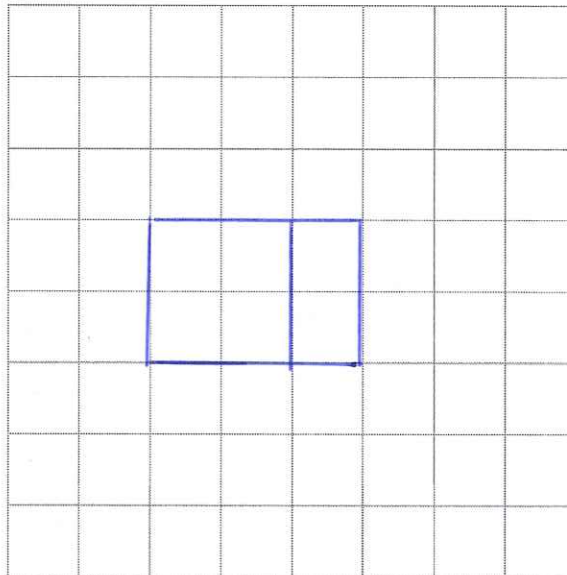


- 10 A solid shape is drawn on isometric paper.



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

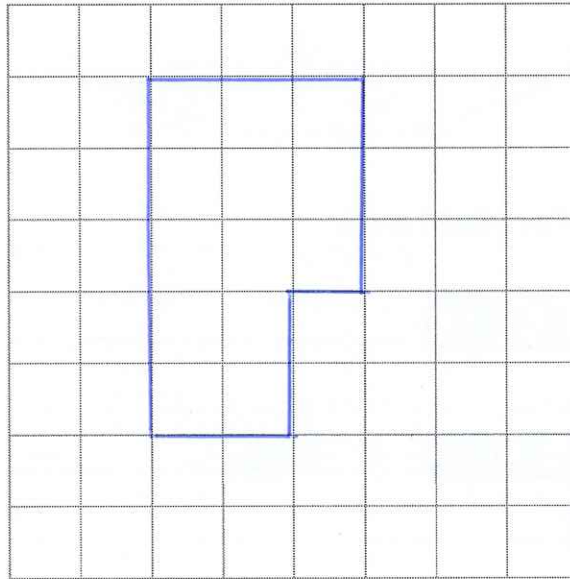
[1 mark]





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]

23, 29

$$x\% \text{ of } 125 = 23$$

$$x \times 125 = 23$$

$$x = \frac{23}{125} = 0.184$$

Answer 18.4 %

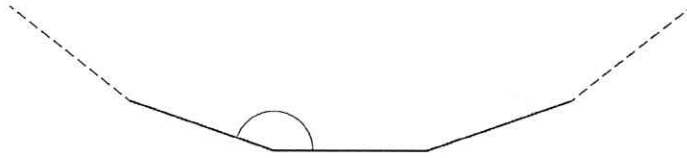
5

Turn over ►



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

Not drawn  
accurately



Work out the size of an interior angle.

[2 marks]

$$\frac{(n-2) \times 180}{n}$$

$$\frac{(15-2) \times 180}{15} = 156^\circ$$

Answer 156 degrees

OR, alternative method:

$$\text{Exterior} + \text{Interior} = 180^\circ$$

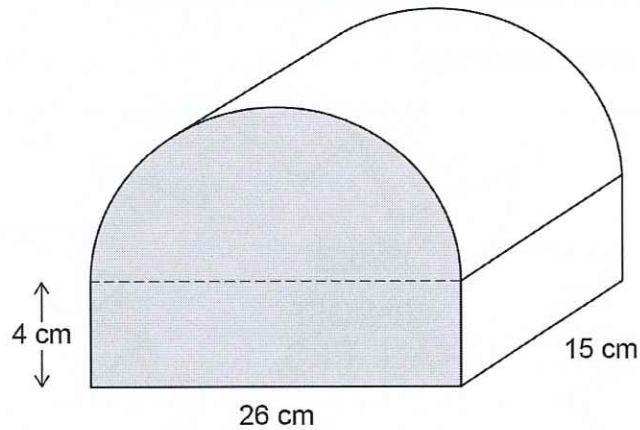
$$\text{Exterior} = \frac{360}{15} = 24^\circ$$

$$\text{Interior} = 156^\circ$$



13

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



Work out the volume of the box.

[4 marks]

$$\text{Vol of semi circle} = \frac{1}{2} \times \pi r^2 \times L.$$

$$= \frac{1}{2} \times \pi \times 13^2 \times 15$$

$$= 3981.968688$$

$$\text{Vol} \\ \text{Area of cuboid} = 4 \times 26 \times 15$$

$$= 1560$$

Answer 5541.97 cm<sup>3</sup>

Turn over ►



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]

$$x \times 1.10 = 13.20$$

$$x = \frac{13.20}{1.10} = \pounds 12.$$

~~$$12 \times 0.9 = \pounds 10.80.$$~~

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



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]

~~$0.5k + 7k + 2.5k = 1$~~

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

$$10k = 1.15$$

$$k = \frac{1.15}{10}$$

$$k = 0.115$$

$$P(B) = 7k - 0.15$$

$$= 7(0.115) - 0.15$$

$$= 0.655$$

Answer 0.655

Turn over for the next question

Turn over ►



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]**

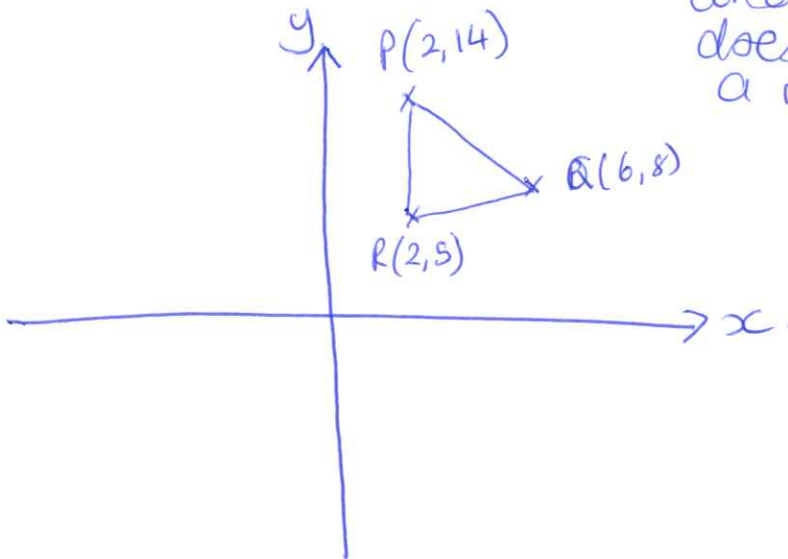
$$M \text{ of } PR = 0$$

$$M \text{ of } RQ = \frac{3}{4}$$

$$M \text{ of } PQ = \frac{-6}{4} = -\frac{3}{2}$$

$\frac{3}{4}$  is not the negative reciprocal of  $-\frac{3}{2}$ .

therefore the lines are not perpendicular  
and the triangle  
does not contain  
a right angle.



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.

$w^{1+0} = w^1 = w$

[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

$$x^2 + y^2 = r^2$$

$$r^2 = 11$$

$$r = \sqrt{11}$$

$$d = 2r = 2\sqrt{11}$$

Turn over for the next question

Turn over ►



20

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

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

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

[3 marks]

$$\frac{b}{c} = 2 \qquad \frac{a}{b} = 3c$$


---


$$\frac{b}{8} = 2 \qquad \frac{a}{16} = 3 \times 8$$


---


$$b = 16 \qquad \frac{a}{16} = 24$$


---

Answer            $a = 384$           



21

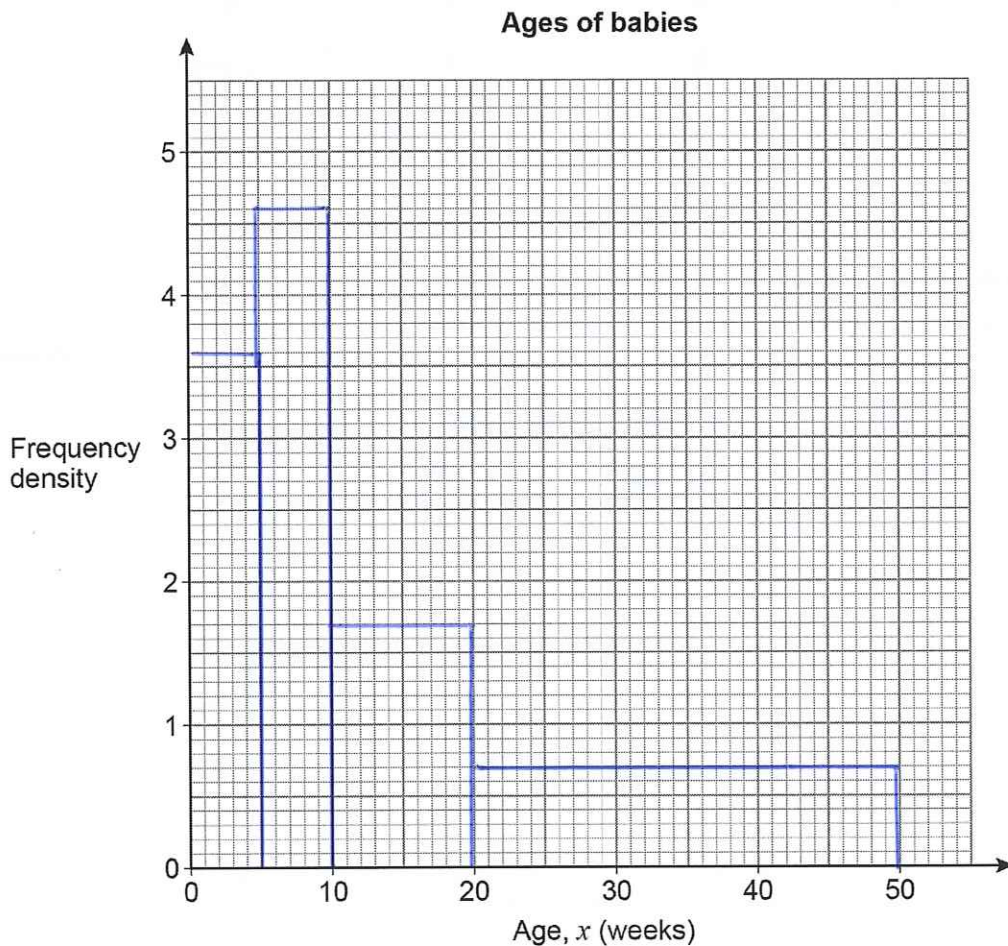
Here is some information about the ages of babies at a clinic.

freq density  
=  $\frac{F}{Coq} = cw$   
↓

Age, $x$ (weeks)	Frequency	$cw$	↓
$0 \leq x < 5$	18	5	$18 \div 5 = 3.6$
$5 \leq x < 10$	23	5	$23 \div 5 = 4.6$
$10 \leq x < 20$	17	10	$17 \div 10 = 1.7$
$20 \leq x < 50$	21	30	$21 \div 30 = 0.7$

Draw a histogram to represent the information.

[4 marks]



Turn over ►



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

total

4

7

10.

What fraction of the total number of sticks in Pattern  $n$  are horizontal?Give your answer in terms of  $n$ .

[3 marks]

$$2n \rightarrow 2, 4, 6$$

$$3n+1 \rightarrow 4, 7, 10$$

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)

$$16^2 = 256$$

$$16^{32} \neq 2$$

$$16^2 = 256$$

$$16^{256} \neq 2$$

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

Work out the  $x$ -coordinate.

[1 mark]

$$\frac{1}{16} = 16^x$$

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]

$$27^{\frac{1}{3}} = \sqrt[3]{27} = 3$$

$$9^{\frac{1}{2}} = \sqrt{9} = 3$$

$a =$  27       $b =$   $\frac{1}{3}$



25

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

[3 marks]

Do not write  
outside the  
box

$$\begin{aligned}
 & (x-3)(x+2)(x+5) \\
 = & (x-3)(x^2+5x+2x+10) \\
 = & (x-3)(x^2+7x+10) \\
 = & (x-3)(x^2+7x+10) = x^3+7x^2+10x \\
 & (x-3)(x^2+7x+10) = \frac{-3x^2+21x+30}{x^3+10x^2+31x+30} \\
 & x^3+4x^2-11x-30
 \end{aligned}$$

Answer  ~~$x^3+10x^2+31x+30$~~   
 $x^3+4x^2-11x-30.$

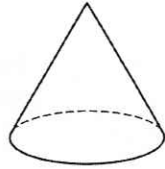


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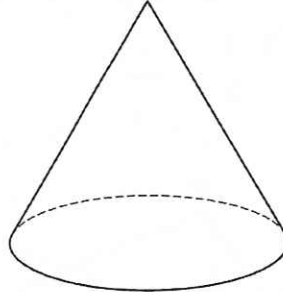
26

Here are two similar cones.

Cone A



Cone B



The surface area of cone A is  $2 \text{ m}^2$

The surface area of cone B is  $4.5 \text{ m}^2$

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

Give your answer in the form  $1 : n$

[3 marks]

	A		B	
Area	2	$\xrightarrow{\times \frac{9}{4}}$	4.5	
Radius	$x$	$\xrightarrow{\times \frac{3}{2}}$		

Answer 1 :  $\frac{3}{2}$

6

Turn over ►



27

In the diagram

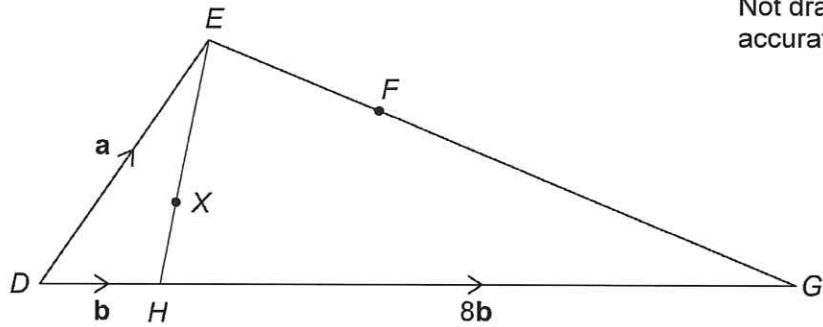
$$\overrightarrow{DE} = \mathbf{a}$$

$$\overrightarrow{DH} = \mathbf{b}$$

$$\overrightarrow{HG} = 8\mathbf{b}$$

$$EX : XH = 3 : 1$$

$$EF : FG = 1 : 3$$

Not drawn  
accurately

27 (a) Show that  $\overrightarrow{DX} = \frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$

$$\overrightarrow{EH} = \overrightarrow{ED} + \overrightarrow{DH}$$

$$\overrightarrow{DX} = \overrightarrow{DE} + \overrightarrow{EX}$$

$$\overrightarrow{EH} = -\mathbf{a} + \mathbf{b}$$

[2 marks]

$$= \mathbf{a} + \frac{3}{4}\overrightarrow{EH}$$

$$= \mathbf{a} + \frac{3}{4}(-\mathbf{a} + \mathbf{b})$$

$$= \mathbf{a} - \frac{3}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$$

$$= \frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$$



27 (b) Is  $DXF$  a straight line?

Show working to support your answer.

[4 marks]

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

$$\begin{aligned}\vec{XF} &= \vec{XE} + \vec{EF} \\ &= \frac{3}{4}a - \frac{3}{4}b + \frac{1}{4}\vec{EG}\end{aligned}$$

$$= \frac{3}{4}a - \frac{3}{4}b + \frac{1}{4}(-a + 9b)$$

$$= \frac{3}{4}a - \frac{3}{4}b - \frac{1}{4}a + \frac{9}{4}b$$

$$= \frac{2}{4}a + \frac{6}{4}b$$

$$\vec{XF} = 2\left(\frac{1}{4}a + \frac{3}{4}b\right)$$

$$\vec{XF} = 2\vec{DX}$$

$\vec{DX}$  and  $\vec{XF}$  are scalar multiples  
are are therefore parallel and are  
a straight line

Turn over for the next question

Turn over ►



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]

$$\frac{UBa}{LBb} = \frac{4.725}{157.5} = 0.03$$

Answer 0.03



29

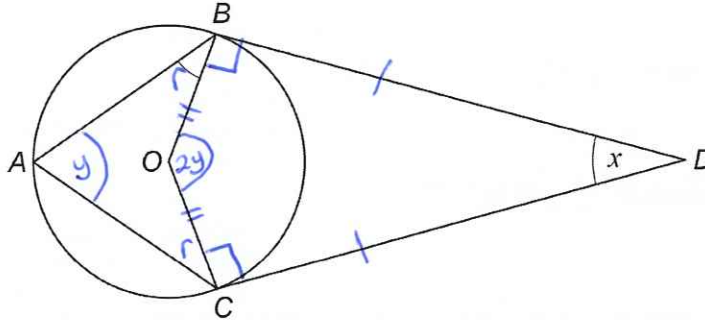
$A, B$  and  $C$  are three points on the circumference of a circle, centre  $O$ .

$BD$  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]

$$x + 180 + 2y = 360 \rightarrow y = 90 - \frac{x}{2}$$

$$y + 2r + 180 + x = 360$$

$$90 - \frac{x}{2} + 2r + 180 + x = 360$$

~~$$\frac{x}{2} + 2r = 90$$~~

$$-\frac{x}{2} + 2r + x = 90$$

$$2r = 90 + \frac{x}{2} - x$$

$$2r = 90 - \frac{x}{2}$$

$$r = 45 - \frac{x}{4}$$



30

A sphere has radius  $r$  cmAn 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]

---



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$$r_2 = 5.843$$

$$r_3 = 6.395$$

30 (b)

Continue the iteration to work out the radius to 1 decimal place.

[1 mark]

---



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Answer 6.2 cm

END OF QUESTIONS



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3 2



2 1 6 6 8 3 0 0 / 3 H

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