Write your name here

Surname	Other names

Edexcel GCSE

Centre Number	Candidate Number

Mathematics B

Unit 3: Number, Algebra, Geometry 2 (Calculator)

Higher Tier

Sample Assessment Material **Time: 1 hour 45 minutes**	Paper Reference **5MB3/3H**

You must have: Ruler graduated in centimetres and millimetres, protractor, 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.*
- **Calculators may be used**.
- If your calculator does not have a π button, take the value of π to be 3.142 unless the question instructs otherwise.

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.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care on these questions with your spelling, punctuation and grammar, as well as the clarity of expression.*

Advice

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

Turn over

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2/3/3/2

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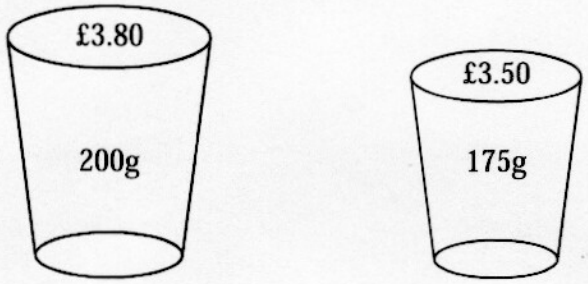
Answer ALL questions.

Write all your answers in the spaces provided.

You must write down all stages in your working.

1



Large Regular

A Large tub of popcorn costs £3.80 and holds 200g.
A Regular tub of popcorn costs £3.50 and holds 175g.

Which is the better value for money?

Large: 200g / £3·80 = 52·6 g/£

Regular: 175g / £3·50 = 50 g/£.

The large tubs are better value.

.....

(Total for Question 1 = 3 marks)

2 Use your calculator to work out

$$\frac{\sqrt{6700} - 2.38^2}{3.6^2 + 5.71}$$

= 4.08083

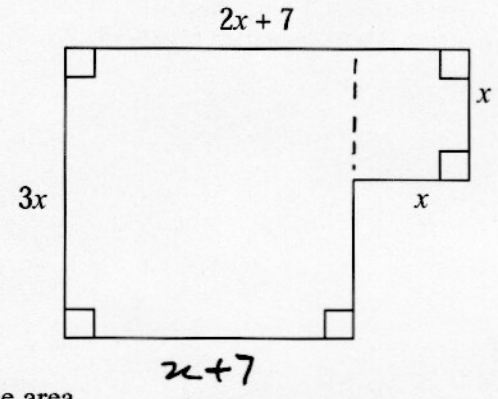
= 4.08 (3s.f.)

You must give your answer as a decimal.
Give your answer to three significant figures.

4.08

(Total for Queston 2 = 3 marks)

3 The perimeter of this shape is 22 cm.



All measurements are in centimetres

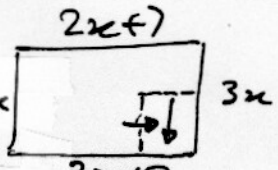
Find the area.

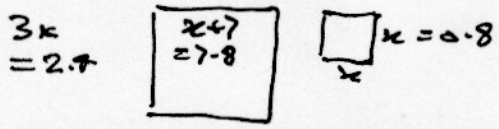
$(2x+7)-x = x+7$.

Perimeter same as

$= 2(2x+7+3x) = 10x+14$

$10x + 14 = 22,\ 10x = 8,\ x = 0.8$





Area

$2.4 \times 7.8 + 0.8^2$

$= 19.36$

19.36 ..... cm²

(Total for Question 3 = 5 marks)

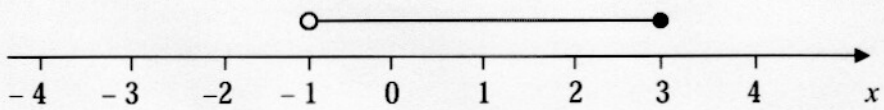
4 $-3 \leqslant n < 2$

n is an integer.

(a) Write down all the possible values of n.

(2)

$-3, -2, -1, 0, 1$



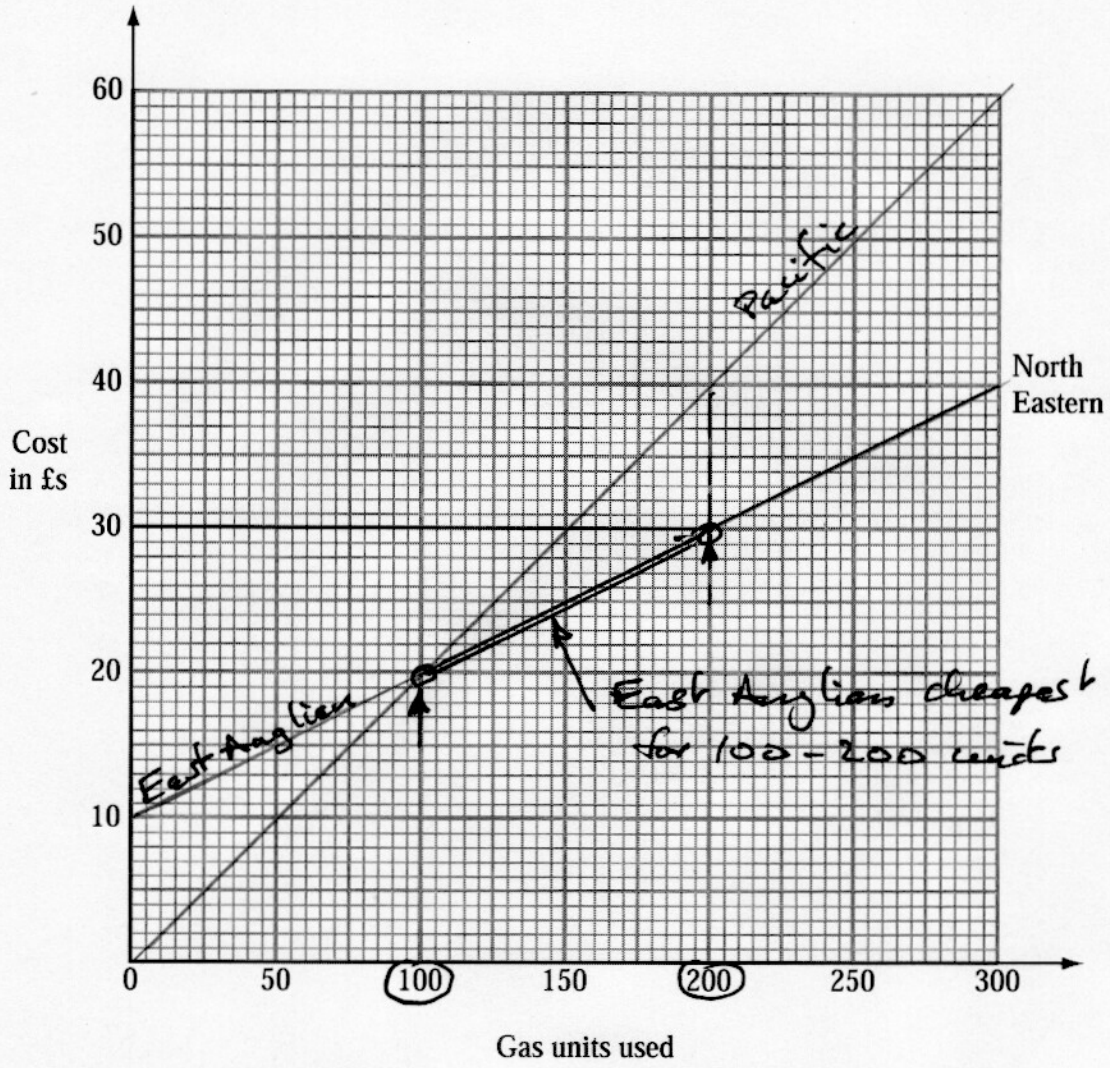
(b) Write down the inequalities represented on the number line.

(2)

$-1 < x \leq 3$

(Total for Question 4 = 4 marks)

*5 The graph shows the cost of buying gas from the North Eastern Gas Company.



Here are the costs for buying gas from three Gas Companies.

North Eastern	Basic cost £30	First 200 units free then each unit costs 5p
Pacific	Every unit costs 20p	
East Anglian	Basic cost £10	Every unit costs 10p

Erica uses between 100 and 200 units each month.

Explain which Company would be the cheapest for her to use.
Show clearly how you got your answer.

I drew lines on the graph for Pacific and East Anglian:

Pacific: starts at (0,0), then through (300,60), straight line (constant cost per unit),

300 units → 300 × 20p = 6000p = £60

East Anglian: starts at (0,10) "Basic cost", then for 300 units cost = 10 + 300 × 0.1 = £40 so (300,40), again it's a straight line.

For the range 100 → 200 units the East Anglian line is lower (cheaper) than the lines for the other companies.

OR

	100 units	200 units
N. Eastern	£30 (× more expensive)	£30
Pacific	£20	£40 (× more expensive)
E. Anglian	£20	£30

(Total for Question 5 = 5 marks)

6

Ben's Tyre Shop

Mini prices for Tyres

Tyres for Minis	Price
Goodweek	£65
Dunlap	£62
Bridgearth	£75
Pirello	£69
Valves	50p per tyre
Balancing	£1 per tyre

Des buys two Dunlap tyres with valves and balancing and has to pay VAT at 15%.

(a) Work out the total amount Des pays for the tyres.

(3)

1 Dunlap tyre + valve & balancing

$= 62 + 0.50 + 1 = £63.50$

2 of each, + vat:

$2 \times 63.5 \times 1.15 = 146.05$

£ 146.05

Ben sees Dunlap tyres offered for sale in a different garage.
He wants to compare the prices before VAT was added.

(b) What is the price of these tyres before VAT was added?

(2)

Tyre Sale

Dunlap tyres for Minis
(including valves and balancing)

£71.30
including VAT at 15%

£71.3 ÷ 1.15 = £62

£ 62

In 2010 the VAT rate is to be increased from 15% to 17½%.

(c) By what number will Ben have to multiply the old prices by to give the new prices including VAT?

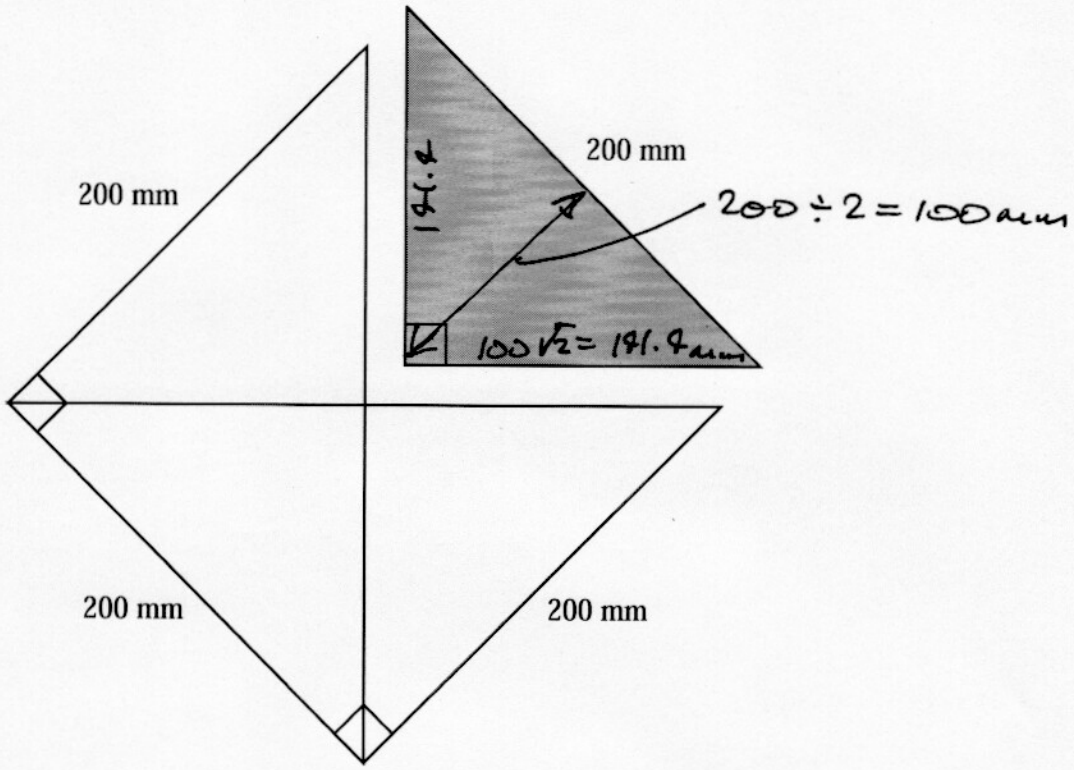
(2)

The prices "including VAT" will have to be multiplied by $\frac{1.175}{1.15} = 1.0217$

£

(Total for Question 6 = 7 marks)

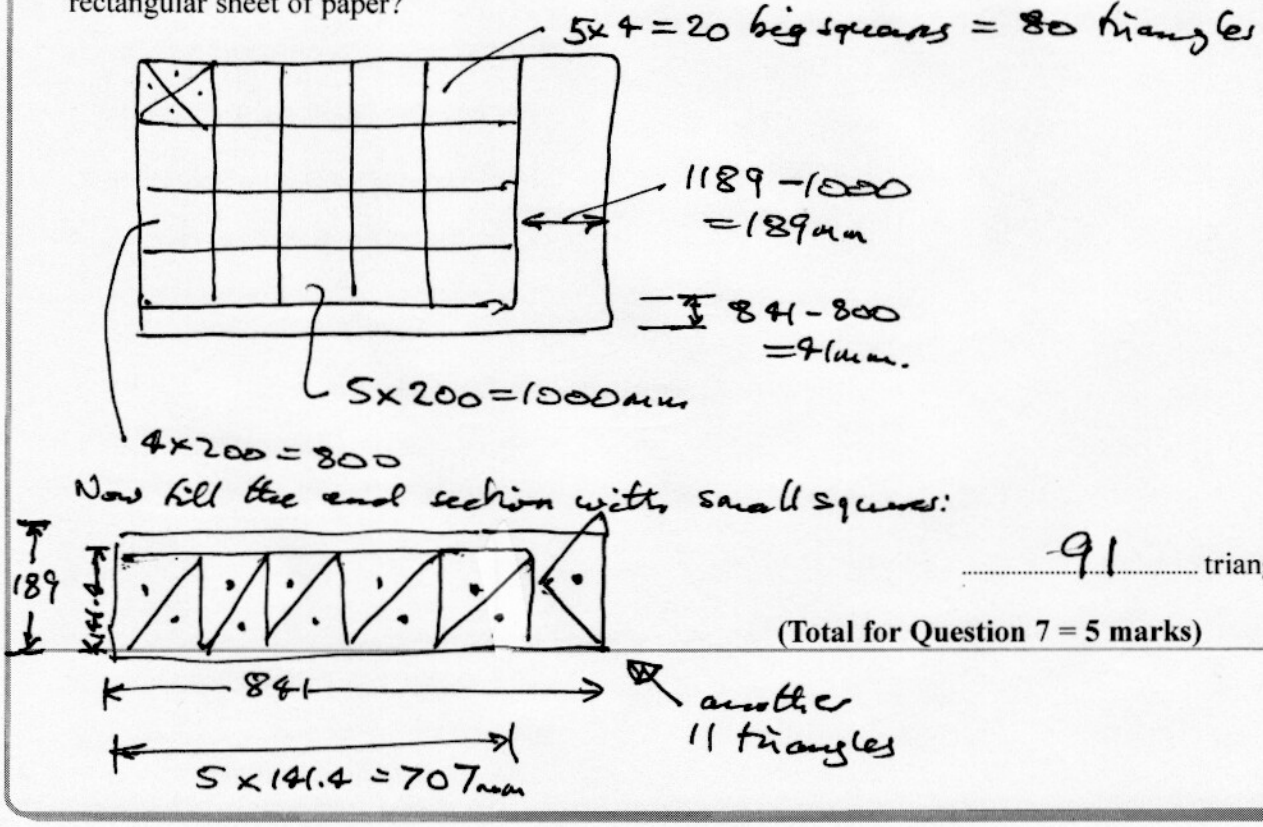
7 The shaded isosceles right angled triangle is cut out of a large square of side 200 mm.



The squares are cut out of an A0 sized rectangular piece of paper which has dimensions 1189 mm by 841 mm.

More triangles are cut from the paper that is left after the squares have been cut out.

What is the greatest total number of these triangles that can be cut out of the large, rectangular sheet of paper?



91 triangles

(Total for Question 7 = 5 marks)

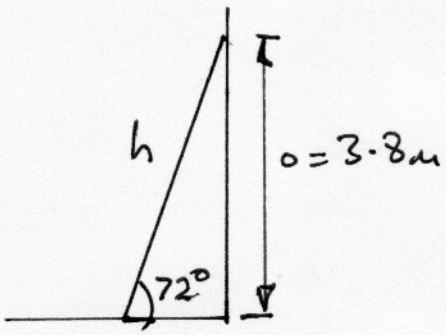
8 Tom wants to clean the upstairs windows of his house.

He decides to buy a ladder.

The ladder has to reach exactly 3.8 metres up the wall of the house.

To be safe, the ladder has to be at an angle of 72° to the ground.

What length of ladder should Tom buy?



$\frac{o}{h} = \sin 72$

$o = h \times \sin 72$

$h = \frac{o}{\sin 72}$

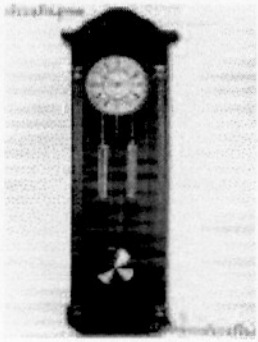
$= 3.996\text{m}$,

he needs a 4m ladder

4m

(Total for Question 8 = 4 marks)

9 The time it takes for the pendulum of a clock to swing from one end of its arc to the other and back again is given by the formula



$$T = 2\pi\sqrt{\frac{l}{g}}$$

(a) Find the value of l, when

$T = 2$, $\pi = 3.14$ and $g = 9.81$

(2)

$\frac{T}{2\pi} = \sqrt{\frac{l}{g}}$, $\frac{l}{g} = \left(\frac{T}{2\pi}\right)^2$,

$l = g\left(\frac{T}{2\pi}\right)^2 = 9.81 \times \left(\frac{2}{2\times 3.14}\right)^2 = \frac{9.81}{3.14^2}$

$= 0.995$

0.995

(b) Make l the subject of the formula. As above!

(3)

$\frac{T}{2\pi} = \sqrt{\frac{l}{g}}$, $\frac{l}{g} = \left(\frac{T}{2\pi}\right)^2$,

$l = g\left(\frac{T}{2\pi}\right)^2 = \frac{gT^2}{4\pi^2}$

$l = g\left(\frac{T}{2\pi}\right)^2$

(Total for Question 9 = 5 marks)

10 Solve

$$\frac{x}{x+4} = \frac{x+7}{x+3}$$

(4)

$x(x+3)$: $\dfrac{x(x+3)}{x+4} = x+7$

$x(x+4)$: $x(x+3) = (x+7)(x+4)$

$x^2 + 3x = x^2 + 7x + 8x + 28$

$3x = 11x + 28$

$8x + 28 = 0$

$8x = -28$

$x = -28/8 = -\frac{7}{2}$

$x =$ −3.5

(Total for Question 10 = 4 marks)

11

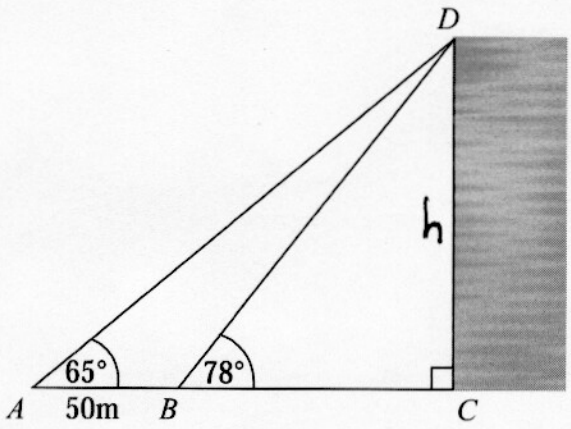


Diagram NOT accurately drawn

Steve is working out the height of a tall vertical building *CD*.
The building is standing on horizontal ground.

Steve measures the angle of elevation of the top, *D*, of the building from two different points *A* and *B*.

The angle of elevation of *D* from *A* is 65°
The angle of elevation of *D* from *B* is 78°
AB = 50 m.
ABC is a straight line.

Calculate the height of the building.
Give your answer correct to 3 significant figures.

Just like the example in my year 9 trigonometry notes

$\frac{h}{AC} = \tan 65°, \quad AC = \frac{h}{\tan 65}$

$\frac{h}{BC} = \tan 78°, \quad BC = \frac{h}{\tan 78}$

$AC - BC = 50m$

$\therefore h\left(\frac{1}{\tan 65} - \frac{1}{\tan 78}\right) = 50$

$0.25375\,h = 50,$

$h = \frac{50}{ANS} = 197.04m$

$= 197m$ (3s.figs)

197 m

(Total for Question 11 = 6 marks)

12 Solve the simultaneous equations

$3x + 2y = 11$ — (1)

$2x - 5y = 20$ — (2)

(1) × 5 $\quad 15x + 10y = 55$

(2) × 2 $\quad 4x - 10y = 40$ +

$19x = 95, \quad x = \frac{95}{19} = 5$

$2y = 11 - 3x = 11 - 15 = -4$

$\therefore y = -2$

{Check: $2x - 5y = 10 + 10 = 20$ ✓}

$x =$ 5

$y =$ −2

(Total for Queston 12 = 4 marks)

---

13 Solve $3x^2 + 2x - 4 = 0$

Give your answer correct to three significant figures.

$b^2 - 4ac = 4 - (4 \times 3 \times -4) = 4 + 48 = 52,$

not a perfect square so will not factorise

(and we expect this from "three sig. figures").

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-2 \pm \sqrt{52}}{6}$

$\frac{-2 + \sqrt{52}}{6} = 0.86852,$

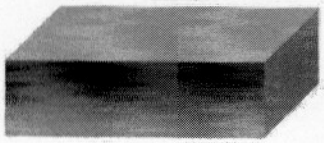
$\frac{-2 - \sqrt{52}}{6} = -1.53518$

$x = 0.869, \; x = -1.54$

(Total for Question 13 = 3 marks)

14 Gerry has an ingot of steel that he is going to turn into ball bearings.

The ingot is in the shape of a cuboid and it cost him £50.



The dimensions of the cuboid are 30 cm, by 15 cm by 8 cm to the nearest mm.
The ball bearings are spheres of diameter 5 mm to the nearest tenth of a millimetre.

Gerry melts the ingot and recasts the metal without losing any of the steel.
He sells all the ball bearings he makes at 10 ball bearings for 1 pence.

Work out the least profit Gerry could make if he sells all of the ball bearings.

Minimum possible ingot dimensions are

$299.5\text{mm} \times 149.5\text{mm} \times 79.5\text{mm}$

$\therefore$ Minimum possible volume $= 3559632.375\ \text{mm}^3$

Largest possible ball radius $= \frac{5.05\text{mm}}{2}$

$\therefore r = 2.525\text{mm}.$

$\therefore$ Largest possible ball volume $= \frac{4}{3}\pi r^3$

$= 67.433\ \text{mm}^3$

$\therefore$ Minimum possible number of balls

$= 3559632.375 / 67.433 = 52787.66$

$\therefore$ 52787 balls

$\therefore$ 5278p, £52.78

$\therefore$ Profit $= 52.78 - 50 = 2.78$

£ 2.78

(Total for Question 14 = 6 marks)

***15**

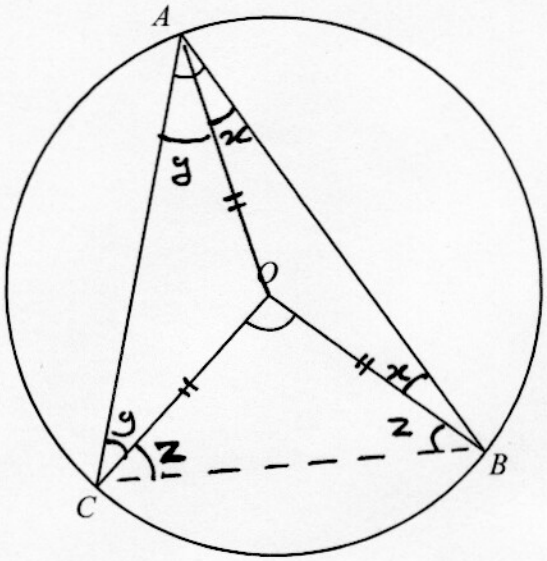


Diagram NOT accurately drawn

A, *B* and *C* are points on the circle with centre *O*.

Prove that the angle subtended by arc *BC* at the centre of the circle is twice the angle subtended by arc *BC* at point *A*.

O is the centre of the circle $\therefore$ OA = OB = OC = radius.

Hence OAB, OAC and OBC are isosceles triangles.

The base angles are equal within each triangle, call these x, y and z.

The angles in triangle ABC must add to 180°

$\therefore 2x + 2y + 2z = 180°$

$\angle BOC = 180 - 2z$ (angles in triangle adding to 180)

$2x + 2y = 180 - 2z$

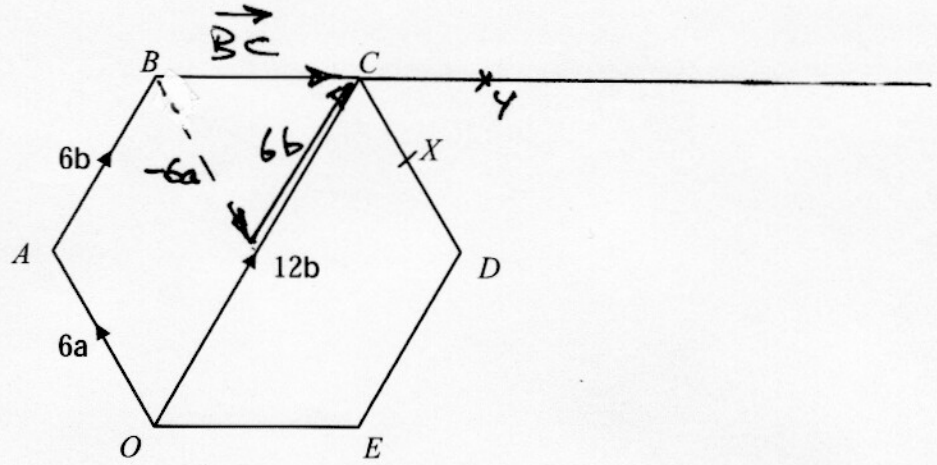
$\therefore \angle BOC = 2(x+y)$

But $\angle BAC = x + y$

$\therefore \angle BOC = 2 \times \angle BAC$

(Total for Question 15 = 4 marks)

16

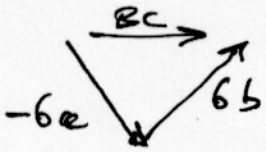


The diagram shows a regular hexagon $OABCDE$.

$\overrightarrow{OA} = \overrightarrow{DC} = 6\mathbf{a}$, $\overrightarrow{OC} = 12\mathbf{b}$

(a) Find $\overrightarrow{BC}$, in terms of **a** and **b**.

(1)



$-6\mathbf{a}+6\mathbf{b}$

X is the midpoint of CD.

Y is the point on BC extended, such that $BC : CY = 3 : 2$

*(b) Prove that O, X and Y lie on the same straight line.

(4)

$\overrightarrow{CY} = \frac{2}{3}\overrightarrow{BC} = -4\mathbf{a}+4\mathbf{b}$

$\overrightarrow{OY} = \overrightarrow{OC} + \overrightarrow{CY} = 12\mathbf{b} + (-4\mathbf{a}+4\mathbf{b})$

$= -4\mathbf{a}+16\mathbf{b}$

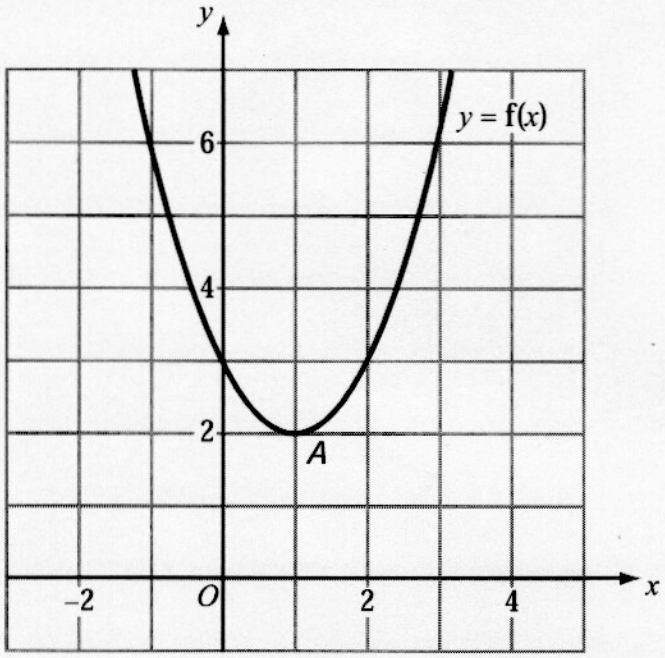
$\overrightarrow{CX} = \frac{1}{2}(-6\mathbf{a}) = -3\mathbf{a}$

$\overrightarrow{OX} = \overrightarrow{OC} + \overrightarrow{CX} = 12\mathbf{b} - 3\mathbf{a} = -3\mathbf{a}+12\mathbf{b}$

$\therefore \overrightarrow{OY} = \frac{4}{3}\overrightarrow{OX}$. The lines through O, X and through O, Y are parallel. Since they have a common point O they are the same line $\therefore$ O, X and Y lie on a straight line.

(Total for Question 16 = 5 marks)

17



The diagram shows the graph of $y = f(x)$.

The only vertex of the graph is A at $(1, 2)$.

Write down the coordinates of the vertex of the curve with equation.

(a) (i) $y = f(x) + 3$

Moves ↑ 3

(1)

(1, 5)

(ii) $y = f(x - 2)$

Moves 2 →

(1)

(3, 2)

The curve with equation $y = f(x)$ is transformed to give the curve with equation $y = -f(x)$

(b) Describe the transformation.

(1)

Reflection in the x-axis

(Total for Question 17 = 3 marks)

18

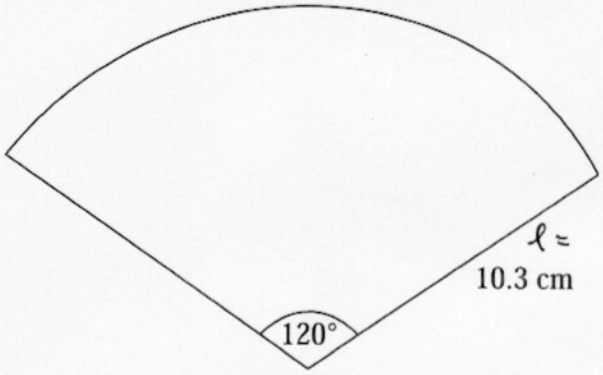


Diagram NOT accurately drawn

The diagram shows a net.
The net is a sector of a circle.
The radius of the circle is 10.3 cm and the angle at the centre of the circle is 120°.

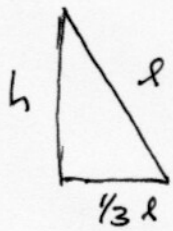
The net is used to make a cone.

Calculate the vertical height of the cone.
Give your answer correct to 3 significant figures.

From formula page, curved surface area $= \pi r l$. $l = 10.3$ cm.

Area of sector $= \left(\frac{120^\circ}{360^\circ}\right) \times \pi l^2 = \frac{1}{3}\pi l^2$

$\therefore \pi r l = \frac{1}{3}\pi l^2$, $r = \frac{1}{3} l$



$h^2 + (\frac{1}{3}l)^2 = l^2$

$h^2 + \frac{1}{9}l^2 = l^2$

$h^2 = \frac{8}{9}l^2$, $h = \sqrt{8}\,(\frac{l}{3})$

$= \sqrt{8} \times 10.3/3 = 9.71093$ cm

$= 9.71$ cm to 3 s.f.s

OR

Arc length $= \frac{120}{360} \times 2\pi \times 10.3 = \frac{103}{15}\pi$

= circumference of base circle $= 2\pi r$ $\therefore r = \left(\frac{103}{15}\pi\right)/2\pi$

$= \frac{103}{30}$

$h = \sqrt{10.3^2 - (103/30)^2} = 9.71$ cm

9.71 cm

(Total for Question 18 = 4 marks)

TOTAL FOR PAPER = 80 MARKS