Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9 - 1)

Centre Number | | | | | |

Candidate Number | | | | |

Mathematics

Paper 3 (Calculator)

Solutions

Higher Tier

Mock Set 1 – Autumn 2016
Time: 1 hour 30 minutes

Paper Reference
1MA1/3H

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.*
- **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.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- You must **show all your working out**.

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.
- 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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6/6/7/

S 5 2 6 2 8 A 0 1 2 0

PEARSON

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Buses to Ashby leave a bus station every 24 minutes.
Buses to Barford leave the same bus station every 20 minutes.

A bus to Ashby and a bus to Barford both leave the bus station at 7 30 am.

When will a bus to Ashby and a bus to Barford next leave the bus station at the same time?

2 | 24
2 | 12
2 | 6
3 | 3
1

2 | 20
2 | 10
5 | 5
1

$24 = 2 \times 2 \times 2 \times 3$

$20 = 2 \times 2 \times 5$

$LCM = 2 \times 2 \times 2 \times 3 \times 5 = 120$ min

so 2 hrs later

9.30 am

(Total for Question 1 is 3 marks)

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2 Amzol thinks that $(x + 5)^2 = x^2 + 25$ for all values of x.

Is Amzol right?
You must show how you get your answer.

No $(1+5)^2 = 36$
$1^2 + 25 = 26$

or $(x+5)(x+5) = x^2 + 10x + 25$
$\neq x^2 + 25$

(Total for Question 2 is 2 marks)

3 Kim, Laura and Molly share £385

The ratio of the amount of money Kim gets to the amount of money Molly gets is 2 : 5
Kim gets £105 less than Molly gets.

What percentage of the £385 does Laura get?

Kim 2 shares
Molly 5 shares

so 3 shares = £105

1 share = $\frac{£105}{3}$ = £35

Kim and Molly receive 7 × £35 = £245

Laura receives £385 − £245 = £140

$\frac{140}{385} \times 100 = 36.4\%$

36.4 %

(Total for Question 3 is 4 marks)

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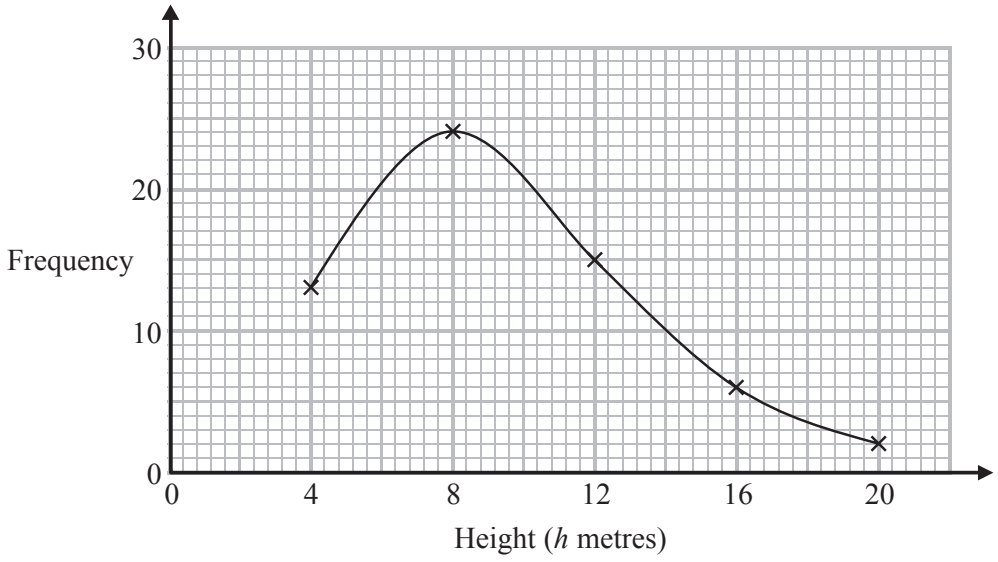
4 The table shows information about the heights of 60 trees.

Height (h metres)	Frequency
$0 < h \leqslant 4$	13
$4 < h \leqslant 8$	24
$8 < h \leqslant 12$	15
$12 < h \leqslant 16$	6
$16 < h \leqslant 20$	2

Jacob drew this frequency polygon for the information in the table.
The frequency polygon is **not** correct.



Write down **two** things that are wrong with the frequency polygon.

1 Point should be plotted at midpoints of intervals

2 Points should be joined with straight line segments

(Total for Question 4 is 2 marks)

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5 The price of all rail tickets increased by 5%.
The price of a rail ticket from London to Ipswich increased by £2.30

Work out the price of the ticket before the increase.

£2.30 = 5%

£4.60 = 10%

£46 = 100%

£ 46

(Total for Question 5 is 2 marks)

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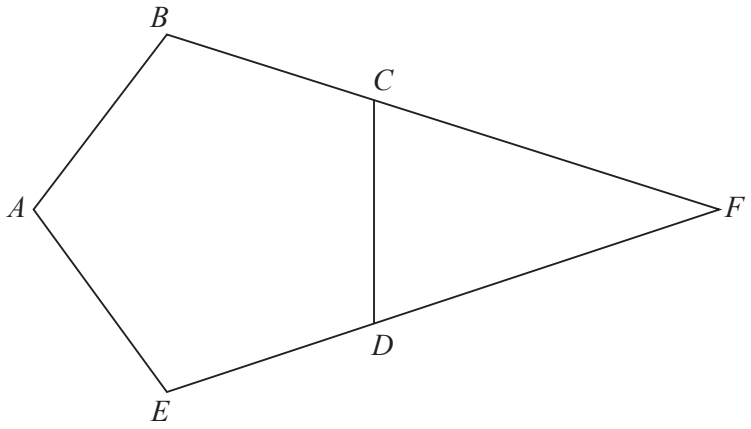
6



ABCDE is a regular pentagon.
BCF and *EDF* are straight lines.

Work out the size of angle *CFD*.
You must show how you get your answer.

$\angle DCF = \angle CDF = 72°$ = exterior angle of regular pentagon

$\frac{360}{5}$

$\angle CFD = 180 - (72 + 72)$ (Angle sum of △)

$= 180 - 144$

$= 36°$

36 °

(Total for Question 6 is 3 marks)

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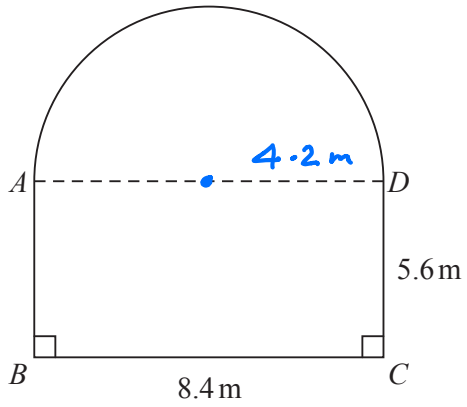
7 A garden is in the shape of a rectangle, $ABCD$, and a semicircle.
AD is the diameter of the semicircle.



Carol is going to cover the garden with fertiliser.

A box of fertiliser costs £4.99
Carol has been told that one box of fertiliser will cover 12 m^2 of garden.

(a) Work out the cost of buying enough fertiliser to cover the garden completely.

Area $= \frac{\pi \times 4.2^2}{2} + 8.4 \times 5.6 = 74.75\ m^2$

$\frac{74.75}{12} = 6.23$ boxes

So buy 7 boxes $\quad 7 \times £4.99 = £34.93$

£ 34.93

(5)

Carol finds out that one box of fertiliser will cover more than 12 m^2 of garden.

(b) Explain how this might affect the number of boxes she needs to buy.

May need to buy less boxes

(1)

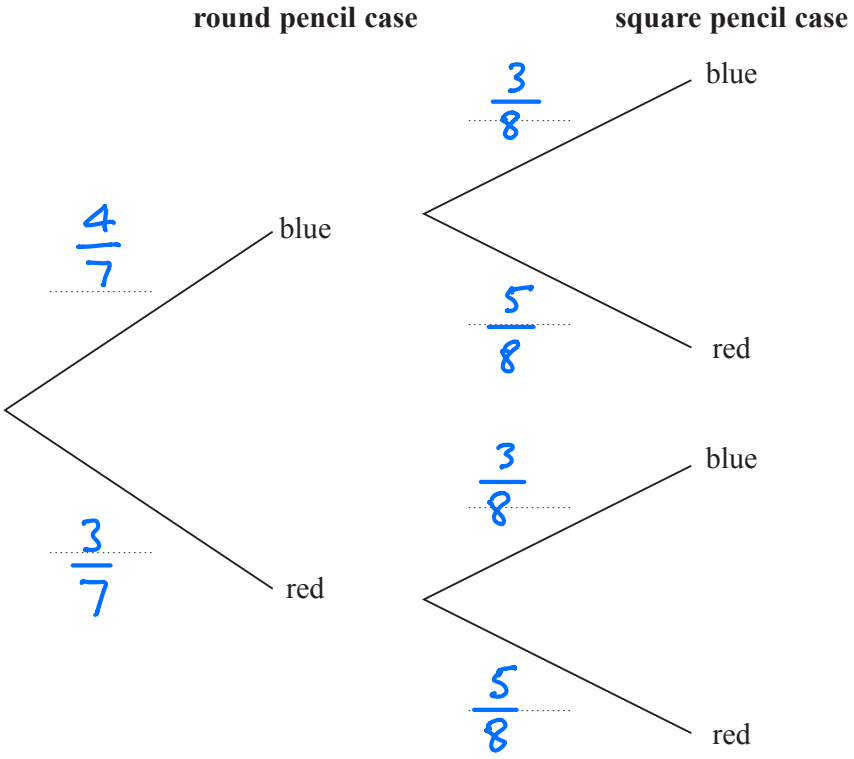
(Total for Question 7 is 6 marks)

8 Sameena has a round pencil case and a square pencil case.

There are 4 blue pens and 3 red pens in the round pencil case.
There are 3 blue pens and 5 red pens in the square pencil case.

Sameena takes at random one pen out of each pencil case.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that the pens Sameena takes are both red.

$P(\text{Both Red}) = \frac{3}{7} \times \frac{5}{8} = \frac{15}{56}$

$\frac{15}{56}$

(2)

(Total for Question 8 is 4 marks)

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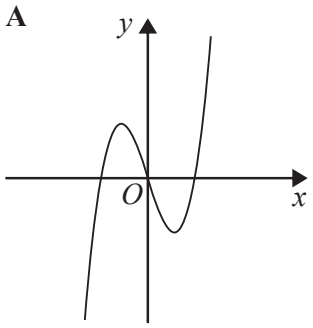
9 Here are six graphs.

A



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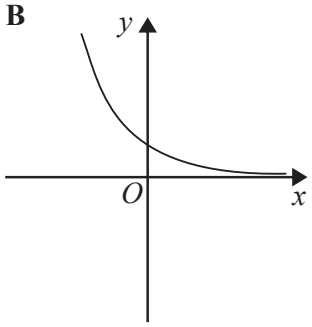

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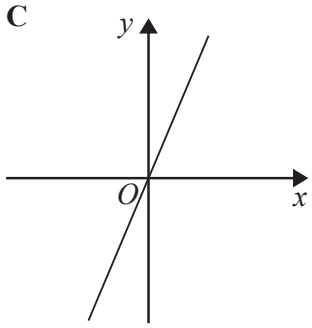

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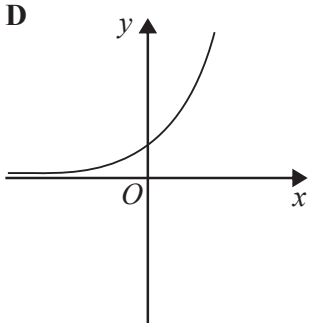

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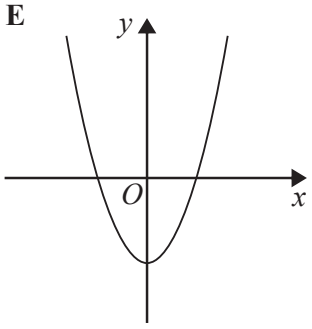

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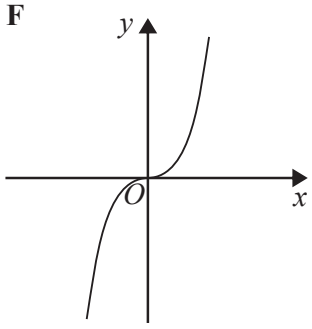

Write down the letter of the graph that could have the equation

(i) $y = 2^x$

D

(ii) $y = x^3 - 3x$

A

(Total for Question 9 is 2 marks)

10 Simplify $3m^2r \times 4m^3r^6$

$12m^5r^7$

(Total for Question 10 is 2 marks)

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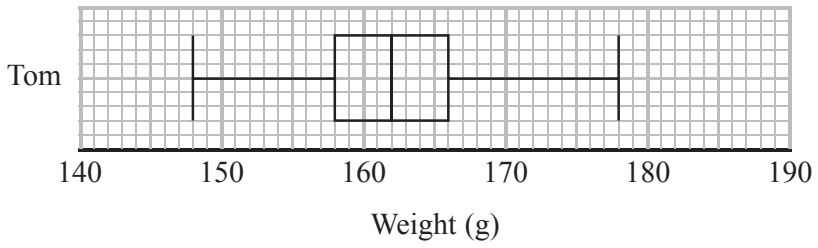
11 Tom grows tomatoes.

The box plot below shows the distribution of the weights of 15 of Tom's tomatoes.



(a) Work out the interquartile range.

166 − 158 = 8

8 g

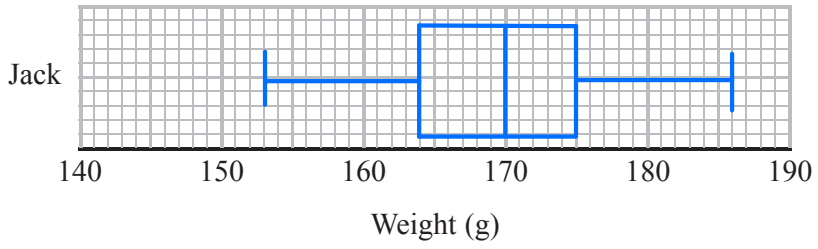
(1)

Jack also grows tomatoes.

Here are the weights, in grams, of 15 of Jack's tomatoes.

153 155 158 164 166 167 170 170 173 174 175 175 177 179 186

(b) On the grid below, draw a box plot for this information.



(3)

(c) Compare the distribution of the weights of Tom's tomatoes with the distribution of the weights of Jack's tomatoes.

On average, Jack's tomatoes weighed more than Tom's. Median 170 > 164.

Jack's tomatoes varied in weight more than Tom's. IQR 11 > 8.

(2)

(Total for Question 11 is 6 marks)

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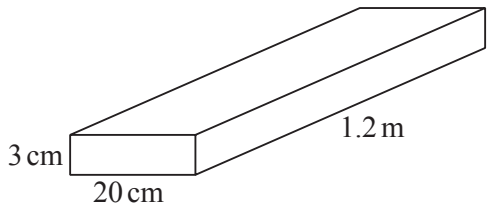
12 The diagram shows a piece of wood in the shape of a cuboid.



The piece of wood is 3 cm by 20 cm by 1.2 m.
The mass of the piece of wood is 8 kg.

The piece of wood will float in sea water if the density of the wood is less than the density of the sea water.

In a large pool, 1 litre of sea water has a mass of 1030 g.

Will the piece of wood float in this pool?
You must show how you get your answer.

Density sea water $= \frac{\text{Mass}}{\text{Vol}} = \frac{1030}{1000} = 1.03\ \text{g cm}^{-3}$

Vol of wood $= 3 \times 20 \times 120 = 7200\ \text{cm}^3$

Density of wood $\frac{8000}{7200} = 1.11\ \text{g cm}^{-3}$

Wood will sink since $1.11 > 1.03$

(Total for Question 12 is 4 marks)

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13 (a) Show that the equation $x^3 + 5x - 4 = 0$ has a solution between $x = 0$ and $x = 1$

$0^3 + 5(0) - 4 = -4$

$1^3 + 5(1) - 4 = 2$

Sign change between 0 and 1. $x^3 + 5x - 4$ is a continuous function so there is a solution between 0 and 1

(2)

(b) Show that the equation $x^3 + 5x - 4 = 0$ can be arranged to give $x = \dfrac{4}{x^2 + 5}$

$x^3 + 5x = 4$

$x(x^2 + 5) = 4$

$x = \dfrac{4}{x^2 + 5}$

(2)

(c) Starting with $x_0 = 0$, use the iteration formula $x_{n+1} = \dfrac{4}{x_n^2 + 5}$ twice,

to find an estimate for the solution of $x^3 + 5x - 4 = 0$

$x_1 = \dfrac{4}{0^2 + 5} = \dfrac{4}{5}$

$x_2 = \dfrac{4}{\left(\frac{4}{5}\right)^2 + 5} = \dfrac{4}{\left(\frac{16}{25} + 5\right)} = 0.709$

0.709

(3)

(Total for Question 13 is 7 marks)

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14 The number of fish in a lake decreases by x% each year.

Given that the number of fish halves in 8 years, work out the value of x.
Give your answer correct to 1 decimal place.

$$\left(\frac{100-x}{100}\right)^8 = \frac{1}{2}$$

$$\frac{100-x}{100} = \left(\frac{1}{2}\right)^{\frac{1}{8}} = 0.917$$

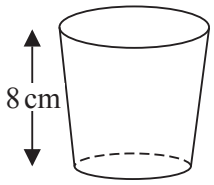
$$100 - x = 91.7$$

$$100 - 91.7 = x$$

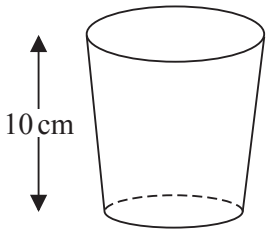
$x = 8.3$

(Total for Question 14 is 3 marks)

15 Here are two pots.



Pot **A**



Pot **B**

Pot **A** and pot **B** are mathematically similar.

The area of the base of pot **B** is 160 cm^2.

Work out the area of the base of pot **A**.

Length $8 : 10 = 4 : 5$

Area $= 4^2 : 5^2 = 16 : 25$

Base of A $= 160 \times \frac{16}{25}$

102.4 cm^2

(Total for Question 15 is 2 marks)

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16

$$v = \sqrt{\frac{a}{b}}$$

$a = 6.43$ correct to 2 decimal places.
$b = 5.514$ correct to 3 decimal places.

By considering bounds, work out the value of v to a suitable degree of accuracy.
Give a reason for your answer.

$6.425 < a < 6.435$

$5.5135 < b < 5.5145$

$\sqrt{\frac{6.425}{5.5145}} < V < \sqrt{\frac{6.435}{5.5135}}$

$1.0794 < V < 1.08034$

$V = 1.08$

Bounds agree to 2 d.p.

$V = 1.08$

(Total for Question 16 is 5 marks)

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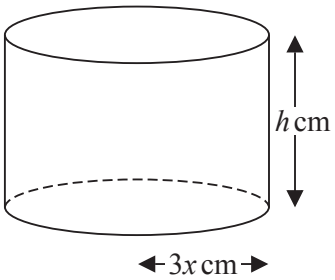
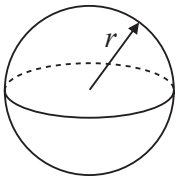
17 The diagram shows a solid metal cylinder.



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



The cylinder has base radius $3x$ cm and height h cm.

The metal cylinder is melted.
All the metal is then used to make 270 spheres.

Each sphere has a radius of $\frac{1}{2}x$ cm.

Find an expression, in its simplest form, for h in terms of x.

$$\pi r_c^2 h = 270 \times \frac{4}{3}\pi r_s^3$$

$$9\pi x^2 h = 360\pi\left(\frac{x}{2}\right)^3$$

$$9x^2 h = \frac{360x^3}{8}$$

$$9x^2 h = 45x^3$$

$$h = \frac{45x^3}{9x^2}$$

$$h = 5x$$

$h = 5x$

(Total for Question 17 is 3 marks)

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18 Make m the subject of

$$f = \frac{4 - 3m}{5 + m}$$

$f(5+m) = 4 - 3m$

$5f + fm = 4 - 3m$

$fm + 3m = 4 - 5f$

$m(f+3) = 4 - 5f$

$m = \frac{4 - 5f}{f + 3}$

(Total for Question 18 is 4 marks)

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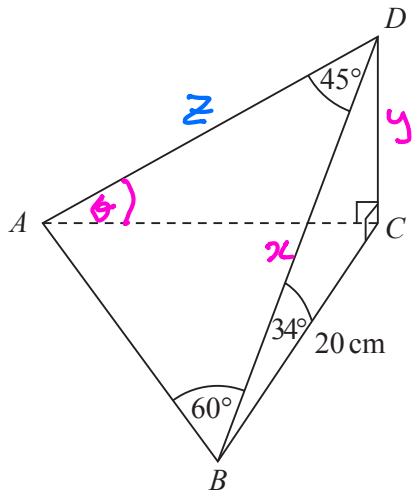
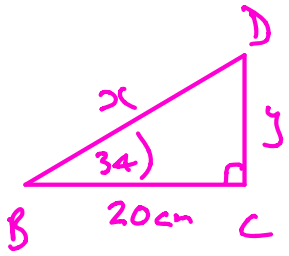
19 The diagram shows a pyramid with base ABC.



CD is perpendicular to both CA and CB.
Angle $CBD = 34°$ Angle $ADB = 45°$ Angle $DBA = 60°$
$BC = 20$ cm.

Calculate the size of the angle between the line AD and the plane ABC.
Give your answer correct to 1 decimal place.

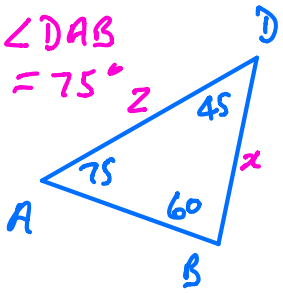


$\tan 34° = \frac{y}{20}$

$y = 20 \tan 34° = 13.49$ cm

$\cos 34 = \frac{20}{x}$

$x = \frac{20}{\cos 34°} = 24.12$ cm



$\frac{x}{\sin 75°} = \frac{z}{\sin 60}$ $\Rightarrow z = \frac{24.12}{\sin 75} \times \sin 60$

$z = 21.63$ cm

$\sin\theta = \frac{y}{z} = \frac{13.49}{21.63}$

$\theta = \sin^{-1}\left(\frac{13.49}{21.63}\right) = 38.6°$

38.6 °

(Total for Question 19 is 5 marks)

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20 For all values of x

$$f(x) = 2x - 3 \quad \text{and} \quad g(x) = x^2 + 2$$

(a) Find $g(-4)$

$g(-4) = (-4)^2 + 2$

$= 16 + 2$

$= 18$

18

(1)

(b) Show that $gf(x) = 4x^2 - 12x + 11$

$gf(x) = g(2x - 3)$

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

$= 4x^2 - 12x + 9 + 2$

$= 4x^2 - 12x + 11$

(2)

(c) Solve $fg(x) = gf(x)$

$fg(x) = f(x^2 + 2) = 2(x^2 + 2) - 3$

$= 2x^2 + 4 - 3$

$= 2x^2 + 1$

Solve $2x^2 + 1 = 4x^2 - 12x + 11$

$0 = 2x^2 - 12x + 10$

$0 = x^2 - 6x + 5$

$0 = (x - 1)(x - 5)$

$x = 1$ or $x = 5$

$x = 1, x = 5$

(4)

(Total for Question 20 is 7 marks)

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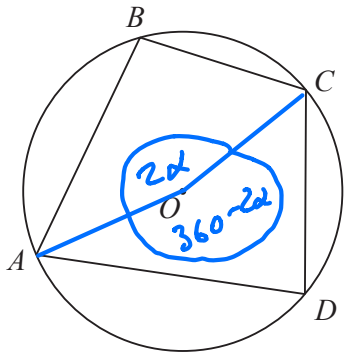
21 A, B, C and D are points on the circumference of a circle, centre O.



Prove that the sum of angle ABC and angle ADC is 180°

Let obtuse $\angle AOC = 2\alpha$

then reflex $\angle AOC = 360 - 2\alpha$

$\angle ADC = \alpha$ ($\angle$ at centre twice $\angle$ at circumference)

$\angle ABC = 180 - \alpha$ ($\angle$ at centre twice $\angle$ at circumference)

$\therefore \angle ADC + \angle ABC = \alpha + 180 - \alpha = 180°$

(Total for Question 21 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS

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