Candidate surname	Other names

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

Centre Number

Candidate Number

Tuesday 11 June 2019

Morning (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.**
- 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.

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 ▶

Pearson

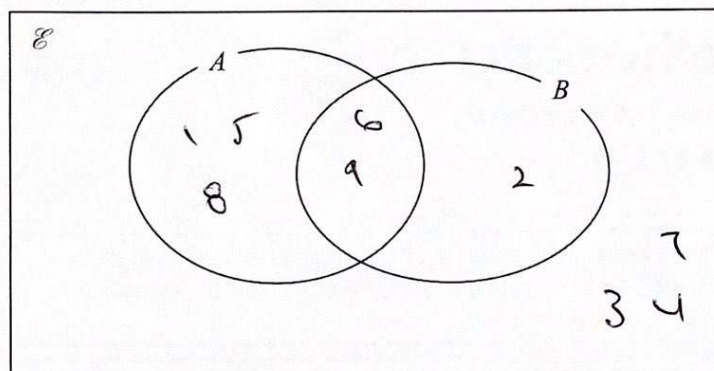**Answer ALL questions.**

Write your answers in the spaces provided.

You must write down all the stages in your working.

1   $\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$
    $A = \{1, 5, 6, 8, 9\}$
    $B = \{2, 6, 9\}$

(a) Complete the Venn diagram to represent this information.

(3)

A number is chosen at random from the universal set $\mathcal{E}$.

(b) Find the probability that the number is in the set $A \cap B$

$$\frac{2}{9}$$

....

(2)

(Total for Question 1 is 5 marks)

2   Katy invests £200 000 in a savings account for 4 years.
    The account pays compound interest at a rate of 1.5% per annum.

    Calculate the total amount of interest Katy will get at the end of 4 years.

$$200,000 \times 1.015^4$$

$$
\begin{array}{r}
212272.71 \\
200000.00 \\
\hline
12272.71
\end{array}
$$

101.5%.

$$\frac{101.5}{100}$$

$$1.015$$

£ .....12272.71.....

(Total for Question 2 is 3 marks)

3   The table shows information about the heights of 80 plants.

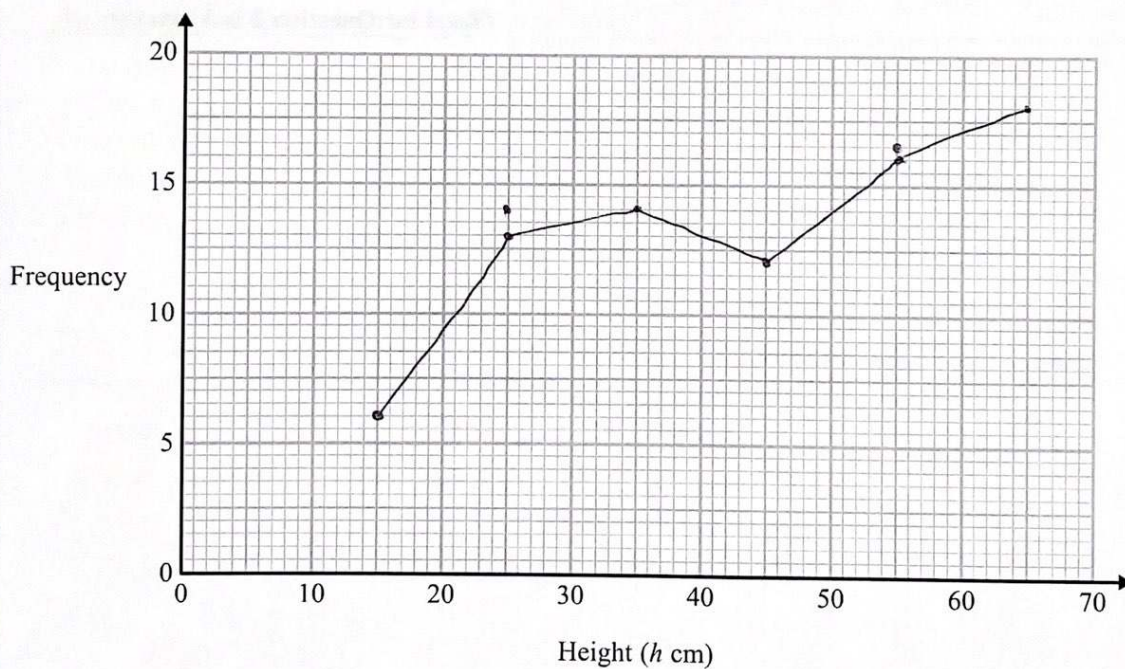| Height (h cm)	Frequency
$10 < h \leqslant 20$	7
$20 < h \leqslant 30$	13
$30 < h \leqslant 40$	14
$40 < h \leqslant 50$	12
$50 < h \leqslant 60$	16
$60 < h \leqslant 70$	18

20

34

46

(a) Find the class interval that contains the median.

$$\frac{80}{2} = 40.$$

$40 < h \leqslant 50$

(1)

(b) On the grid, draw a frequency polygon for the information in the table.

Frequency

Height (h cm)

(2)

(Total for Question 3 is 3 marks)

4 Sean has drawn a time series graph to show the numbers, in thousands, of visitors to a fun park.

$a.5$ (10)

Number of visitors (thousands)

Year
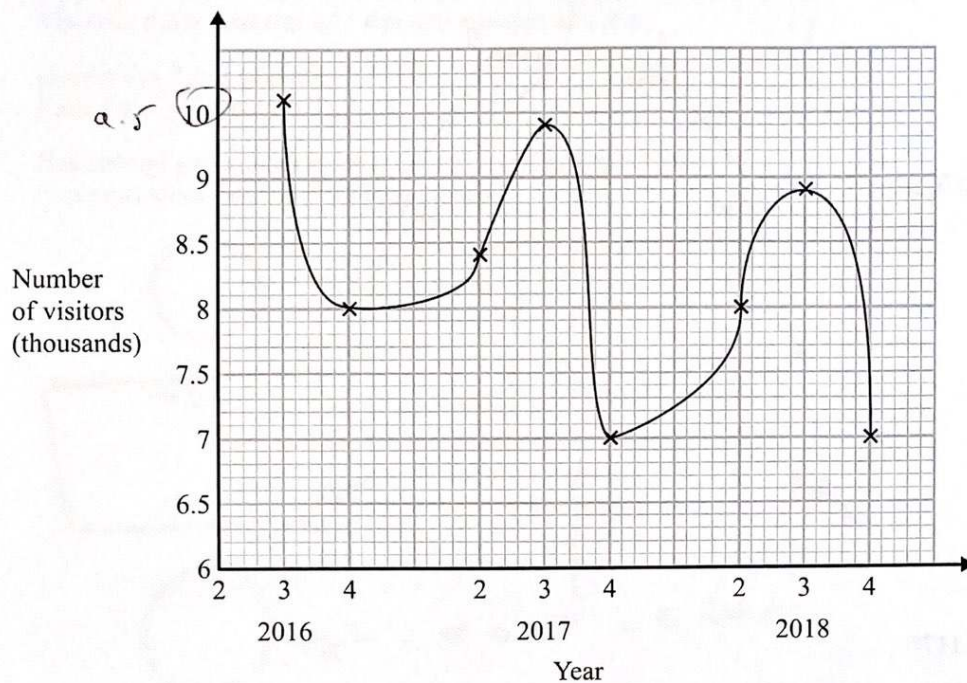
Write down two things that are wrong or could be misleading with this graph.

1 Vertical should be 9.5
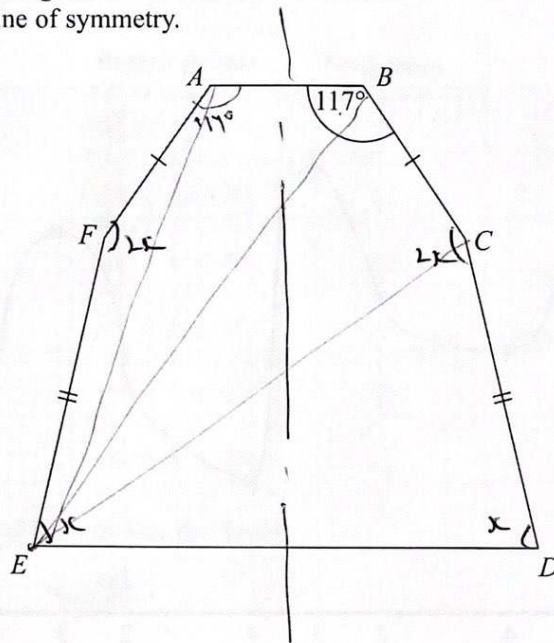
2 Wavy lines

(Total for Question 4 is 2 marks)

5 The diagram shows a hexagon.
The hexagon has one line of symmetry.

Angle C =
4 × 180 = 720°

FA = BC
EF = CD
Angle ABC = 117°

Angle BCD = 2 × angle CDE

Work out the size of angle AFE.
You must show all your working.

720 = x + 2x + 117 + 117 + 2x + x

720 = 6x + 234

486 = 6x

81 = x

∠AFE = 2x = 162°

(Total for Question 5 is 4 marks)

6   Jeremy has to cover 3 tanks completely with paint.

Each tank is in the shape of a cylinder with a top and a bottom.
The tank has a diameter of 1.6 m and a height of 1.8 m.

Jeremy has 7 tins of paint.
Each tin of paint covers 5 m²

Has Jeremy got enough paint to cover completely the 3 tanks?
You must show how you get your answer.
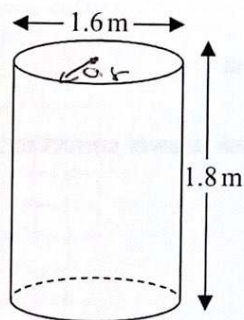
$\pi r^2 = \pi \, 0.8^2 = 0.64\pi$

$\pi \, 1.6 \times 1.8$
$\pi \, D \times 1.8 = \frac{72}{25}\pi$

$\pi r^2 = \pi \, 0.8^2 = 0.64\pi$

Total $= \frac{104}{25}\pi = 13.069 \, m^2$

Total paint $= 3 \times 13.069 \, m^2$
$= 39.207 \, m^2$

Jeremy does not have enough paint $(35 \, m^2)$

(Total for Question 6 is 5 marks)

Turn over ▶

7 Work out $\sqrt{\dfrac{2.5 \times \sin 43°}{8.2^2 - 50.5}}$

Give your answer correct to 3 significant figures.

$= 0.319 1419555$

$= 0.319 \ (3 \text{ sf})$

8   *ABC* is a right-angled triangle.
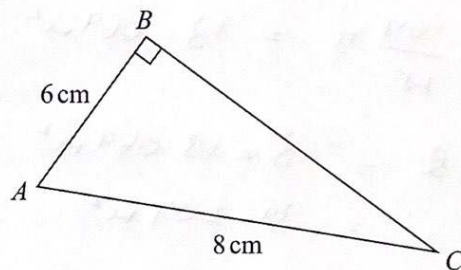
Here is Sarah's method to find the length of *BC*.

$BC^2 = AB^2 + AC^2$
$\quad\ = 6^2 + 8^2$
$\quad\ = 100$
$BC = 10$

(a) What mistake has Sarah made in her method?

Square of hypotenuse = sum squares on other 2 sides
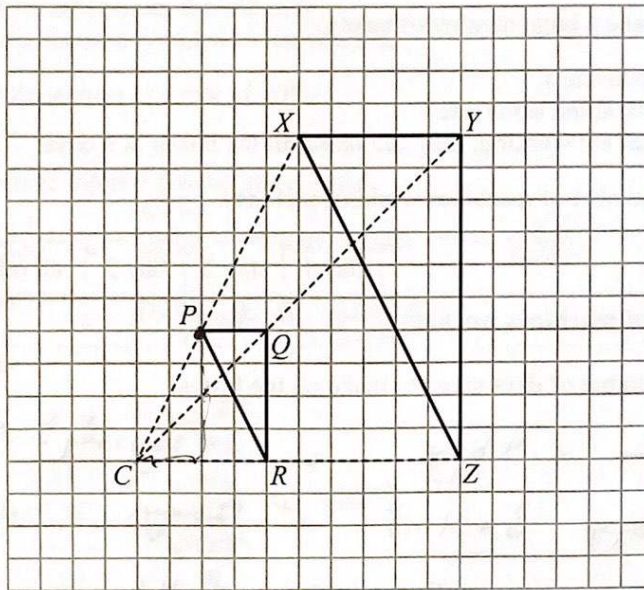
∴ should be $AC^2 = AB^2 + BC^2$

(1)

Roy is going to enlarge triangle PQR with centre C and scale factor $1\frac{1}{2}$

He draws triangle XYZ.

(b) Explain why Roy's diagram is **not** correct.

From C to P vector $\binom{2}{4}$

If enlarged by sf $1\frac{1}{2}$ location of x could be $\binom{2}{4} \times 1.5$

$= \binom{3}{6}$

not $\binom{5}{10}$ s.f 2.5 down

(1)

(Total for Question 8 is 2 marks)

9 A company has to make a large number of boxes.

The company has 6 machines.
All the machines work at the same rate.
When all the machines are working, they can make all the boxes in 9 days.

The table gives the number of machines working each day.

	day 1	day 2	day 3	all other days
Number of machines working	3	4	5	6

Work out the total number of days taken to make all the boxes.

6 machines × 9 days = 54 days req.

First 3 days 3 + 4 + 5 = 12 days

Remaining = 54 - 12 = 42

All other days $\frac{42}{6}$ = 7 more days

Have achieved 3 days + 7 days = <u>10 days</u>.

....

(Total for Question 9 is 3 marks)

10 Marie invests £8000 in an account for one year.
At the end of the year, interest is added to her account.

Marie pays tax on this interest at a rate of 20%
She pays £28.80 tax.

Work out the percentage interest rate for the account.

$$28.80 = 20\% \text{ tax paid on profit}$$

$$\frac{28.80}{0.2} = \text{Amount of profit}$$

$$144 = \text{Profit}$$

$$\text{Interest} = \frac{144}{8000} \times 100$$

$$= 0.018$$

$$= 1.8\%$$

.............................1.8%............................ %

(Total for Question 10 is 3 marks)

11 In May 2019, the distance between Earth and Mars was 3.9×10^7 km.

In May 2019, a signal was sent from Earth to Mars.
Assuming that the signal sent from Earth to Mars travelled at a speed of 3×10^5 km per second,

(a) how long did the signal take to get to Mars?

$$\frac{3.9 \times 10^7}{3 \times 10^5} = 130 \text{ seconds}$$

.... seconds

(2)

The speed of the signal sent from Earth to Mars in May 2019 was actually less than 3×10^5 km per second.

(b) How will this affect your answer to part (a)?

It would take longer

(1)

(Total for Question 11 is 3 marks)

12 Patrick has to work out the exact value of $64^{\frac{1}{4}}$

Patrick says,

"$\frac{1}{4}$ of 64 is 16 so $64^{\frac{1}{4}} = 16$"

Explain what is wrong with what Patrick says.

$64^{\frac{1}{4}}$ means $\sqrt[4]{64} = 2.828\ldots$

(Total for Question 12 is 1 mark)

13 The density of ethanol is $1.09\,g/cm^3$
The density of propylene is $0.97\,g/cm^3$

60 litres of ethanol are mixed with 128 litres of propylene to make 188 litres of antifreeze.

Work out the density of the antifreeze.
Give your answer correct to 2 decimal places.

Ethanol $= 60,000\,cm^3$

$$Density = \frac{Mass}{Volume}$$

$$1.09 = \frac{Mass}{60,000}$$

$$65400 = g\; Mass$$

Propylene $128000\,cm^3$

$$Density = \frac{Mass}{Volume}.$$

$$0.97 = \frac{Mass.}{128,000}$$

$$124160 = g\; Mass$$

Antifreeze

$$Density = \frac{Mass}{Volume} = \frac{65400 + 124160}{188,000} = 1.00829$$

.... $\underline{\underline{1.01}}$ .... g/cm³

(Total for Question 13 is 4 marks)

14 The diagram shows a rectangle, *ABDE*, and two congruent triangles, *AFE* and *BCD*.

A — x — B

30° 24 cm $3x$ F E — D — C 30° 24 cm
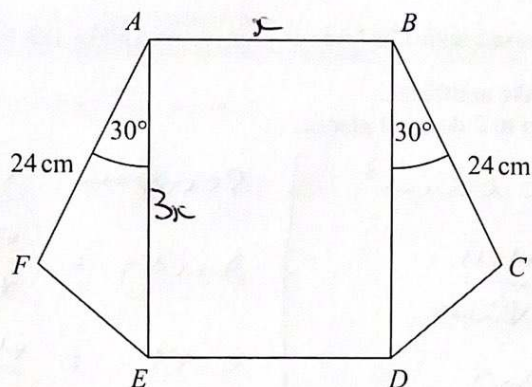
area of rectangle *ABDE* = area of triangle *AFE* + area of triangle *BCD*

$$AB : AE = 1 : 3$$

Work out the length of *AE*.

Area $= \frac{1}{2} ab \sin C$

$\triangle \quad = \frac{1}{2} \cdot 24 \cdot 3x \cdot \sin 30°$

$= 18x$

Area $\quad = 36x$

$\square$

$3x^2 = 36x$

$3x = 36$

$x = 12$

AE = 36 .... cm

(Total for Question 14 is 4 marks)

15 The graph of the curve C with equation $y = f(x)$ is transformed to give the graph of the curve S with equation $y = f(-x) - 3$

The point on C with coordinates (7, 2) is mapped to the point Q on S.

Find the coordinates of Q.

$$\begin{array}{cc} x & y \\ -7 & 2-3 = -1 \end{array}$$

(..-7.. , ..-1..)

(Total for Question 15 is 2 marks)

16 Here are the first six terms of a quadratic sequence.

$$-1 \qquad 5 \qquad 15 \qquad 29 \qquad 47 \qquad 69$$

Find an expression, in terms of n, for the nth term of this sequence.

$$a+b+c = -1$$
$$3a+b = 6$$
$$2a = +4$$

$-1 \underbrace{\quad} 5 \underbrace{\quad} 15 \underbrace{\quad} 29 \underbrace{\quad} 47 \underbrace{\quad} 69$

$\underbrace{6} \quad \underbrace{10} \quad \underbrace{14} \quad \underbrace{18} \quad \underbrace{22}$

$+4 \qquad +4 \qquad +4 \qquad +4$

$an^2 + bn + c$

$2n^2 + 0n - 3$

$$3a + 1 = 6$$
$$3(2) + b = 6$$
$$b = 0$$

$$a + b + c = -1$$
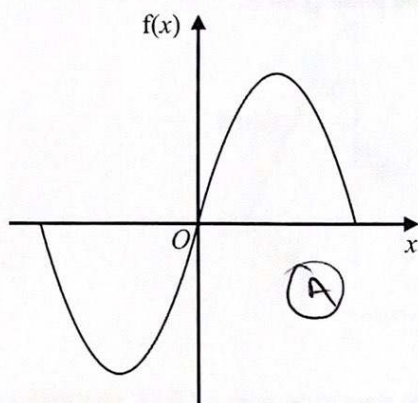$$2 + 0 + c = -1 \qquad -2$$
$$-2 \qquad c = -3$$

$$\underline{\underline{2n^2 - 3}}$$

(Total for Question 16 is 3 marks)

17 Here are four graphs.

Graph A

f(x)

O x

(A)

Graph B

f(x)

O x

(B)

$y \propto \frac{1}{x}$

$x = 1 \quad x = 2 \quad x = -1$

$y = 1 \quad y = \frac{1}{2} \quad y = -\frac{1}{1}$

Graph C

f(x)

O x

Graph D

f(x)

O x
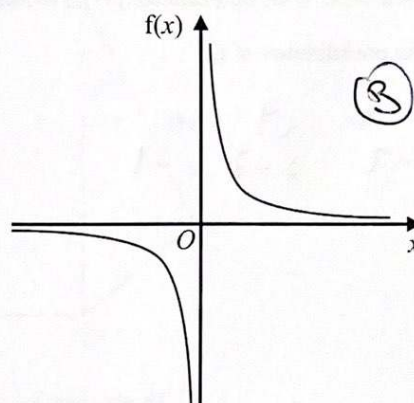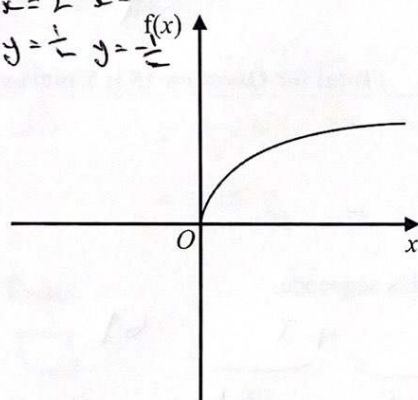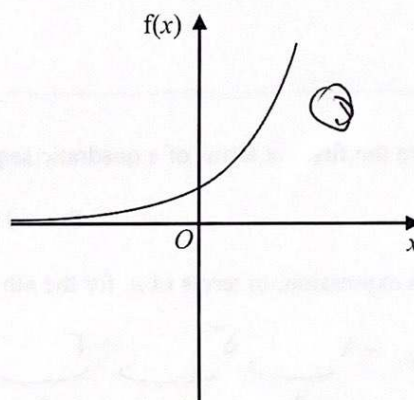
The graphs represent four different types of function f.

Match each description of the function in the table to the letter of its graph.

Description of function	Graph
f(x) is inversely proportional to x	B
f(x) is a trigonometrical function	A
f(x) is an exponential function	D
f(x) is directly proportional to $\sqrt{x}$	C

(Total for Question 17 is 2 marks)

18 (a) Show that $(2x + 1)(x + 3)(3x + 7)$ can be written in the form $ax^3 + bx^2 + cx + d$ where a, b, c and d are integers.

$$(2x+1)\left[(x+3)(3x+7)\right]$$

$$(2x+1)\left[3x^2 + 7x + 9x + 21\right]$$

$$(2x+1)(3x^2 + 16x + 21)$$

$$6x^3 + 3x^2 + 42x + 3x^2 + 16x + 21$$

$$6x^3 + 35x^2 + 58x + 21$$

$$a = 6 \quad b = 35 \quad c = 58 \quad d = 21$$

(3)

(b) Solve $(1-x)^2 < \dfrac{9}{25}$

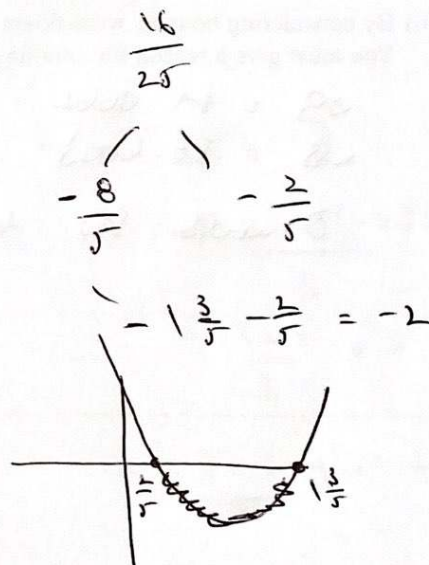$$(1-x)(1-x) < \frac{9}{25}$$

$$+1 - 2x + x^2 < \frac{9}{25}$$

$$x^2 - 2x + \frac{25}{25} < \frac{9}{25}$$

$$x^2 - 2x + \frac{16}{25} < 0$$

$$\left(x - \frac{8}{5}\right)\left(x - \frac{2}{5}\right) < 0$$

$$x = \frac{8}{5} \qquad x = \frac{2}{5}$$

$$\frac{16}{25}$$

$$-\frac{8}{5} \qquad -\frac{2}{5}$$

$$-1\frac{3}{5} - \frac{2}{5} = -2$$

$$\frac{2}{5} < x < \frac{8}{5}$$

(3)

(Total for Question 18 is 6 marks)

19 $D = \dfrac{u^2}{2a}$

$u = 26.2$ correct to 3 significant figures

$a = 4.3$ correct to 2 significant figures

(a) Calculate the upper bound for the value of D.
 Give your answer correct to 6 significant figures.
 You must show all your working.

$upper = \dfrac{\text{biggest}}{\text{smallest}}$

$= \dfrac{(26.25)^2}{2(4.25)} \quad = \quad 81.066\cancel{/}7647\ldots$

81.0662.
  _____
  (3)

The lower bound for the value of D is 78.6003 correct to 6 significant figures.

(b) By considering bounds, write down the value of D to a suitable degree of accuracy.
 You must give a reason for your answer.

UB = 81.0662
LB = 78.6003

D would so to 1 sig fig.

(2)

(Total for Question 19 is 5 marks)

UB 26.25
26.2
LB 26.15

4.3   UB 4.35
      LB 4.25

18

20 Solve algebraically the simultaneous equations

$$x^2 - 4y^2 = 9$$
$$3x + 4y = 7$$

$$3x = 7 - 4y$$
$$x = \frac{7 - 4y}{3}$$

$$\left(\frac{7-4y}{3}\right)^2 - 4y^2 = 9$$

$$\left(\frac{7-4y}{3}\right)\left(\frac{7-4y}{3}\right) - 4y^2 = 9$$

$$\frac{49 - 28y - 28y + 16y^2}{9} - \frac{36y^2}{9} = 9 \quad (\times 9)$$

$$-20y^2 - 56y + 49 = 81$$

$$0 = 20y^2 + 56y + 32$$
$$0 = 10y^2 + 28y + 16$$
$$0 = 5y^2 + 14y + 8$$
$$= 5y^2 + 10y + 4y + 8$$
$$= 5y(y+2) + 4(y+2)$$
$$0 = (5y+4)(y+2)$$

$$\begin{array}{cc} 40 \\ 10 \diagup \diagdown \ 4 \end{array}$$

$$y = -\frac{4}{5} \qquad\qquad y = -2 \qquad\qquad y = -2$$

$$x = \frac{7 - 4\left(-\frac{4}{5}\right)}{3} \qquad\qquad x = \frac{7 - 4(-2)}{3}$$

$$x = \frac{17}{5} \qquad\qquad\qquad = \frac{7 + 8}{3} = 5$$

$$x = \frac{17}{5} \quad y = -\frac{4}{5} \qquad\qquad x = 5 \ , \ y = -2$$

....

(Total for Question 20 is 5 marks)

21 The histogram gives information about the distribution of the weights of some onions grown by a farmer.

Frequency density

(histogram with handwritten annotations: bars with values 120, 150, 270, 90, 90; x-axis labeled Weight (grams) with 135 marked below 120)

$\frac{120 + 150}{2}$

$= 135.$
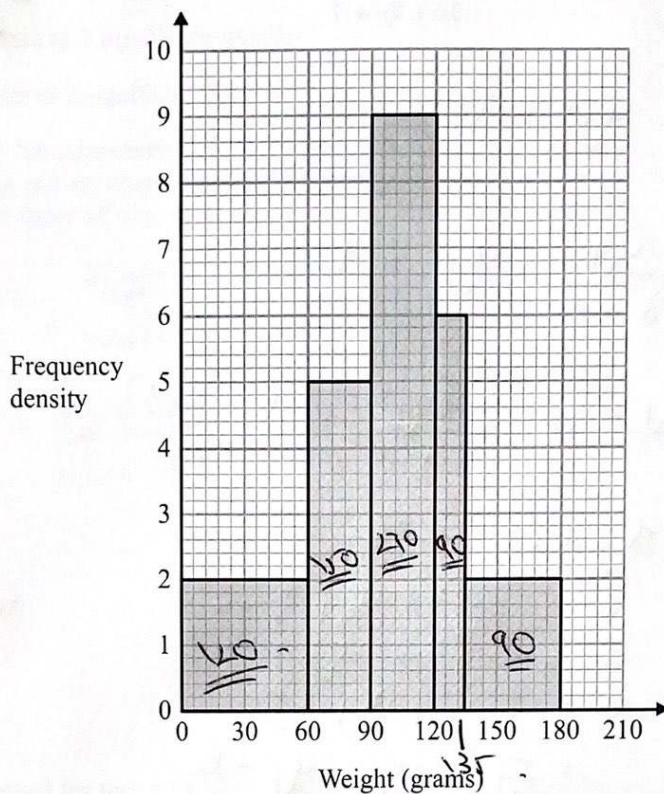
Onions less than 60 grams in weight are used for pickling.
Onions greater than 120 grams in weight are sold at the market.
The rest of the onions are sent to a food processing factory.

$FD = \frac{freq}{cw}$

$2 = \frac{freq}{60}$

$120 = F$

$FD = \frac{f}{3|30}$

$5 = \frac{f}{30}$

$150 = F$

$FD = \frac{f}{3|30}$

$9 = \frac{f}{30}$

$270 = F$

$FD = \frac{f}{3|45}$

$6 = \frac{f}{45}$

$90 = F$

$FD = \frac{f}{3|45}$

$2 = \frac{f}{45}$

$90 = F$

$\text{Total freq} = \begin{array}{r} 120 \\ 150 \\ 270 \\ 90 \\ 90 \\ \hline 720 \end{array}$

A pie chart is drawn using the information opposite to show what the farmer does with the onions he grows.
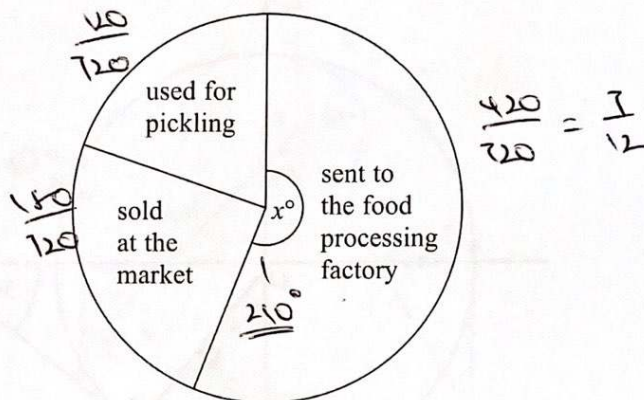
The angle of the sector for the onions sent to the food processing factory is $x°$.

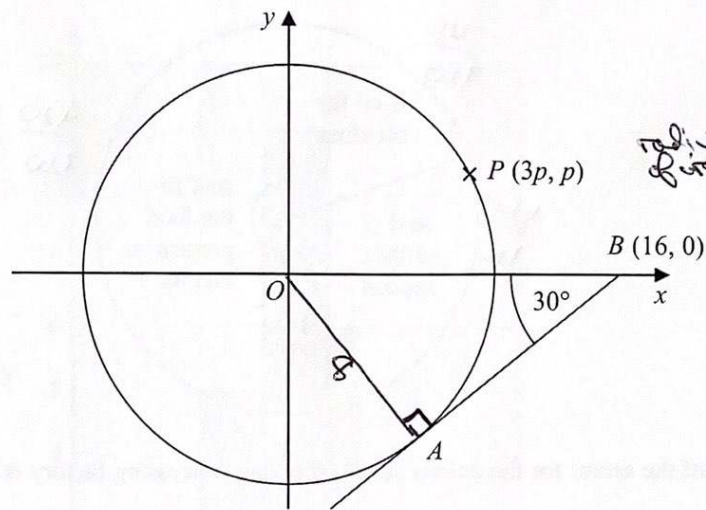Work out the value of x.

$x = \dfrac{1}{12} \times 360$

$= 210°$

$x = \underline{\quad 210° \quad}$

(Total for Question 21 is 4 marks)

22 The diagram shows a circle, centre O.

AB is the tangent to the circle at the point A.
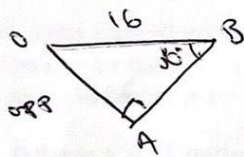Angle $OBA = 30°$

Point B has coordinates $(16, 0)$
Point P has coordinates $(3p, p)$

Find the value of p.
Give your answer correct to 1 decimal place.
You must show all your working.

$$\text{SOH CAH TOA}$$
$$\sin 30° = \frac{opp}{16}$$
$$8 = opp$$

$$x^2 + y^2 = r^2$$
$$(3p)^2 + (p)^2 = 64$$
$$9p^2 + p^2 = 64$$
$$10p^2 = 64$$
$$p^2 = 6.4$$
$$p = \sqrt{6.4}$$
$$p = 2.5298$$
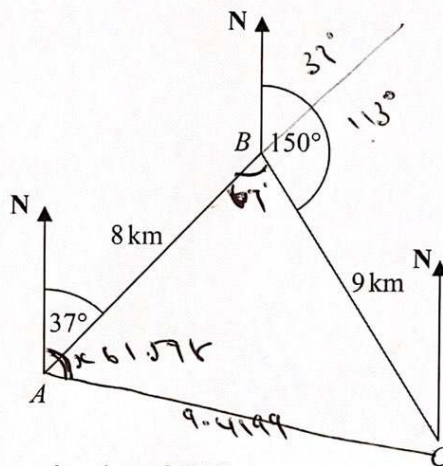
$p = $ _2.5 (1dp)_

(Total for Question 22 is 4 marks)

23 The diagram shows the positions of three towns, Acton (*A*), Barston (*B*) and Chorlton (*C*).

N

37°

113°

B 150°

67°

N

8 km

N

9 km

37°

x 61.57...

A

9.4199

C

Barston is 8 km from Acton on a bearing of 037°
Chorlton is 9 km from Barston on a bearing of 150°

Find the bearing of Chorlton from Acton.
Give your answer correct to 1 decimal place.
You must show all your working.

$$a^2 = b^2 + c^2 - 2bc \cos A$$
$$= 8^2 + 9^2 - 2 \cdot 8 \cdot 9 \cdot \cos 67°$$
$$a^2 = 58.734\ldots$$
$$a = 9.4199$$

$$\frac{\sin x}{9} = \frac{\sin 67}{9.4199}$$

$$\sin^{-1} x = \left(\frac{9 \cdot \sin 67}{9.4199} \right) = 61.578$$

∴ Bearing
$$37 + 61.578$$
$$= 98.578°$$

$$= 98.6°$$

.... °

(Total for Question 23 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS