Level 1 / Level 2 GCSE (9 – 1)

MATHEMATICS

Paper 2 (Calculator)

Higher Tier

Time : 1 hour 30 minutes **Paper : 1 MA1 / 2H**

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.

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1. a. i. Solve the inequality $8x - 5 \leq 2x + 7$

$6x \leq 12$

(1) (1)

$x \leq 2$ (1)

.....

(3)

ii. n is a positive integer.

Write down all the values of n which satisfy the inequality $8n - 5 \leq 2n + 7$

$n \leq 2$

$\{1,2\}$

(1) one value correct

(1) both values correct

.....

(2)

(Total for Question 1 is 5 marks)

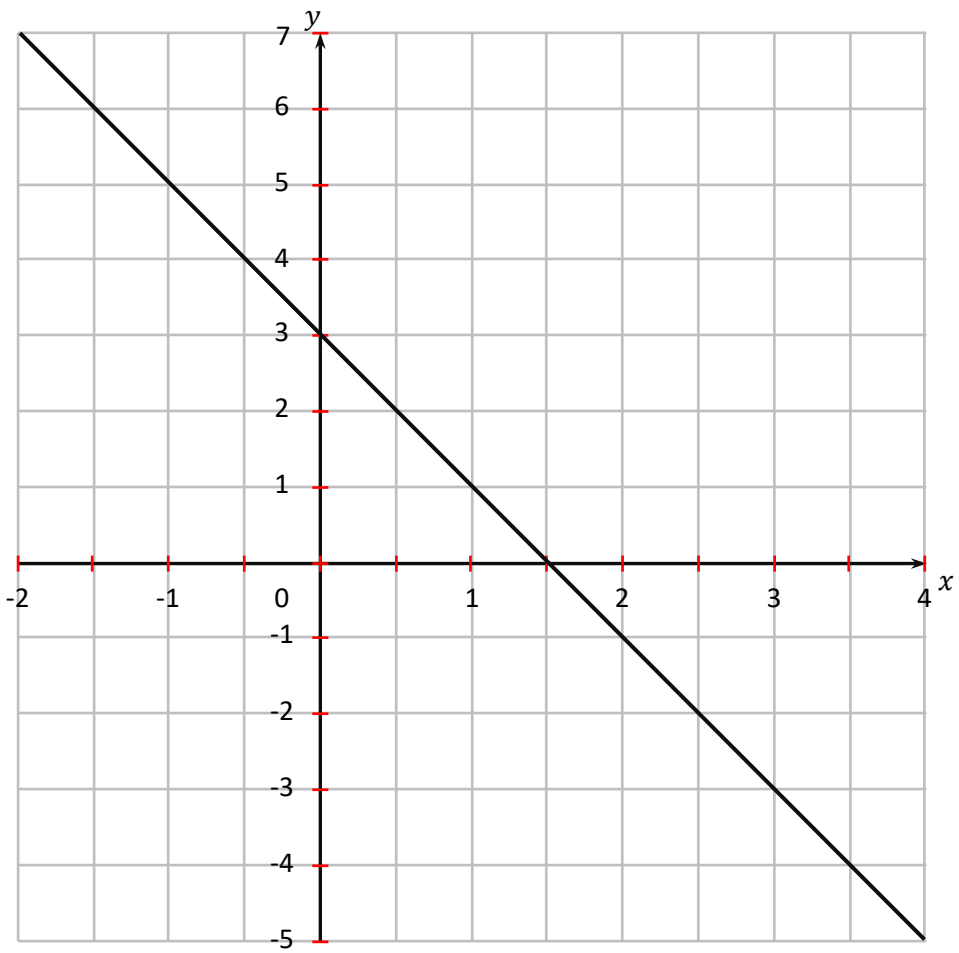
2. a. Complete the table of values for $y = 3 - 2x$

x	-2	-1	0	1	2	3	4
y	7	5	3	1	-1	-3	-5

At least 3 values of y are correct (1) all values are correct (1)

(2)

b. Draw the graph of $y = 3 - 2x$. Use the values of x from -2 to 4.



(3)

(Total for Question 2 is 5 marks)

Any 4 points correctly plotted (1)

All points correctly plotted (1)

Straight line passing through these points (1)

3. The table below shows the number in each year group of a school.

A sample of 56 students is to be taken.

Year	Number of students
7	145
8	145
9	135
10	150
11	140
12	125

a. How many students from year 10 should be in the sample?

Total number of students: $145 + 145 + 135 + 150 + 140 + 125 = 840$

Proportion of students needed for sample: $\frac{56}{840} = 0.0\dot{6}$

Number of students from year 10 needed: $\frac{150 \times 56}{840} = 10$

(1) (1)

.....

(2)

b. State any assumption you made **and** explain how this may affect your answer.

e.g sample is representative (otherwise answer wrong)

the 56 students are from the 840 (otherwise not accurate)

any sensible answer (1)

.....

(1)

(Total for Question 3 is 3 marks)

4. Milk is poured from a box into a glass.

The box is a cuboid measuring 19 cm, 9 cm and 6 cm.

The glass is a cylinder with a diameter of 8.5 cm.

What is the depth of milk in the glass when $\frac{3}{4}$ of box of milk has been poured in?

Give your answer correct to 3 significant figures

Volume of milk in $\frac{3}{4}$ of the glass: $\frac{3}{4} \times 19 \times 9 \times 6 = 769.5cm^3$ (1)

Set up equation for cylinder of volume $769.5cm^3$ and unknown height:

$\pi \times 4.25^2 \times h = 769.5cm^3$ (1)

Solve for h:

$h = \frac{769.5}{\pi \times 4.25^2}$ (1)

$h = 13.5607$

$h = 13.6cm^3$ to 3 significant figures (1)

……..

(4)

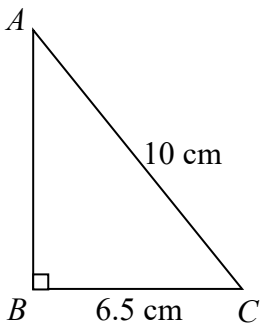
(Total for Question 4 is 4 marks)

5. a. ABC is a right-angled triangle.
$AC = 10$ cm

$BC = 6.5$ cm

Work out the length of AB.

Give your answer correct to 3 significant figures.



$10^2 = 6.5^2 + AB^2$ (1)

$AB = \sqrt{10^2 - 6.5^2}$

$AB = 7.59934$

$AB = 7.60$ to 3 significant figures (1)

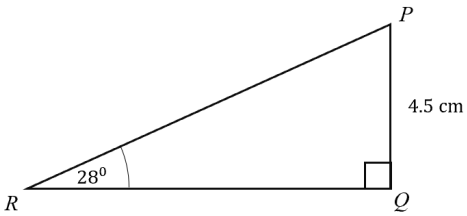
.....

(2)

b. PQR is a right-angled triangle.

Calculate the length of QR.

Give your answer correct to 3 significant figures.



$\tan 28^0 = \frac{4.5}{QR}$ (1)

$QR = \frac{4.5}{\tan 28^0}$ (1)

$QR = 8.4633$

$QR = 8.46$ to 3 significant figures (1)

.....

(3)

(Total for Question 5 is 5 marks)

6. Using algebra, prove that $0.\dot{6} + 0.0\dot{6} = \frac{11}{15}$.

$x = 0.\dot{6}$ (1)

$10x = 6.\dot{6}$ (2)

Subtracting (1) from (2)

$9x = 6$

$x = \frac{6}{9}$ (1)

$y = 0.0\dot{6}$

$100y = 6.\dot{6}$ (3)

$10y = 0.\dot{6}$ (4)

Subtracting (4) from (3)

$90y = 6$

$y = \frac{6}{90}$ (1)

$x + y = \frac{6}{9} + \frac{6}{90}$

$= \frac{11}{15}$ (1)

(Total for Question 6 is 3 marks)

7. At a volleyball game

Number of men : Number of women : Number of children = 12 : 3 : 5

There are 360 more men than women.

Work out the number of children at the game.

M	:	W	:	C
12	:	3	:	5
$x + 360$	:	x	:	?

$\frac{x+360}{x} = \frac{12}{3}$

$3x + 1080 = 12x$

$9x = 1080$

$x = 120$ (1)

Number of children: $\frac{5x}{3} = 200$

(1) (1)

.....

(Total for Question 7 is 3 marks)

8. The perimeter of a square **A** is 80% of the perimeter of square **B**.

a. Find the ratio of the area of square **A** to the area of square **B**.

$P_A = \frac{80}{100} P_B$ (1)

$\frac{P_A}{P_B} = \frac{4}{5}$

Set $P_A = 4$ and $P_B = 5$

Area $= 4 \times$ perimeter

$A_A = 4 \times 4 = 16$

$A_B = 4 \times 5 = 25$

$A_A : A_B = 16 : 25$ (1)

.....

(2)

Circle **P** has radius of length r cm.

Circle **Q** has radius of length R cm.

The area of circle **P** is 19% less than the area of circle **Q**.

b. Work out the ratio $r : R$

$A_P = \frac{81}{100} A_Q$ (1)

$\frac{\pi r^2}{\pi R^2} = \frac{81}{100}$

Notice that the π on the numerator and denominator cancel

$\frac{r^2}{R^2} = \frac{\sqrt{81}}{\sqrt{100}}$

$\frac{r}{R} = \frac{9}{10}$ (1)

.....

(2)

(Total for Question 8 is 4 marks)

9. a. In 2019 there are approximately 7 578 000 000 people in the world.

Write this number in standard form.

7.578×10^9 (1)

……**(1)**

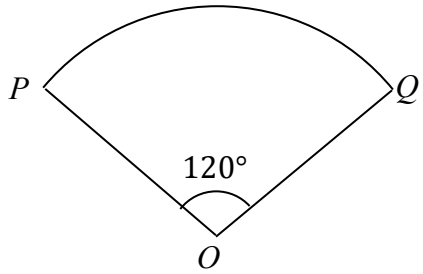
b. Write 3.45×10^{-2} as an ordinary number.

0.0345 (1)

……**(1)**

(Total for Question 9 is 2 marks)

10.



OPQ is a sector of a circle, centre *O*.

The arc length of the sector is 16.1 cm.

Calculate the area of the sector.

Give your answer correct to 3 significant figures.

Set up an equation to find the radius:

$\frac{120}{360} \times 2\pi r = 16.1$ (1)

$r = \frac{16.1 \times 360}{240\pi}$

$r = 7.687183$ (1)

Calculate the area:

$A = \frac{120}{360} \times \pi \times r^2$ (1)

$A = 61.88182$ (1)

$A = 61.9$ to 3 significant figures

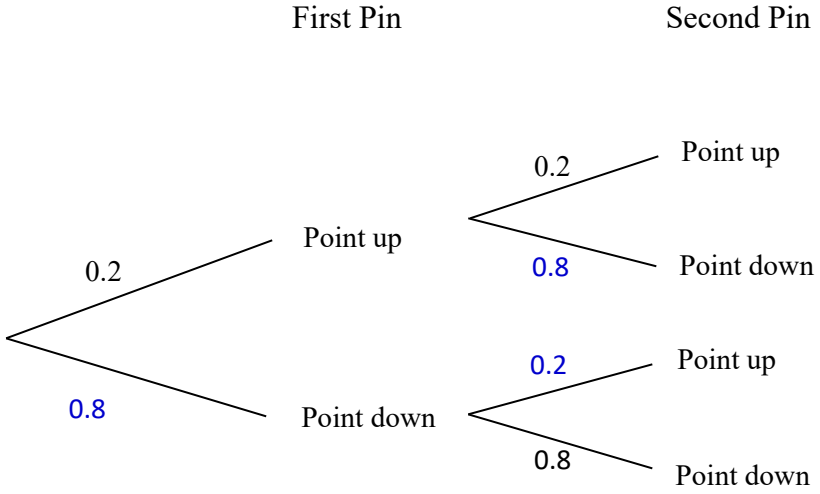
……

(Total for Question 10 is 4 marks)

11. When a drawing pin falls to the ground the probability that it lands point up is 0.2.

Two drawing pins fall one after the other.

a. Complete the tree diagram.



Correct probability in the first branch (1) correct probabilities in the second branch (1)

(2)

b. Find the probability that one pin lands up and one pin lands down.

Want to find $P(\text{up, down})$ or $P(\text{down, up})$

$$P(\text{up, down}) + P(\text{down,up}) = (0.2 \times 0.8) + (0.8 \times 0.2)$$

(1) (1)

$$= 0.32 \text{ (1)}$$

.....

(3)

(Total for Question 11 is 5 marks)

12. Show that $\frac{3x+15}{x^2+x-20} - 2$ simplifies to $\frac{ax-b}{cx-d}$ where a, b, c and d are integers.

$$= \frac{3(x+5)}{(x+5)(x-4)} - 2 \quad (1)$$

$$= \frac{3}{x-4} - 2$$

$$= \frac{3-2(x-4)}{x-4} \quad (1)$$

$$= \frac{11-2x}{x-4} \quad (1)$$

.....

(Total for Question 12 is 3 marks)

13. The grouped frequency table gives information about the heights, in cm of a number of Year 12 students.

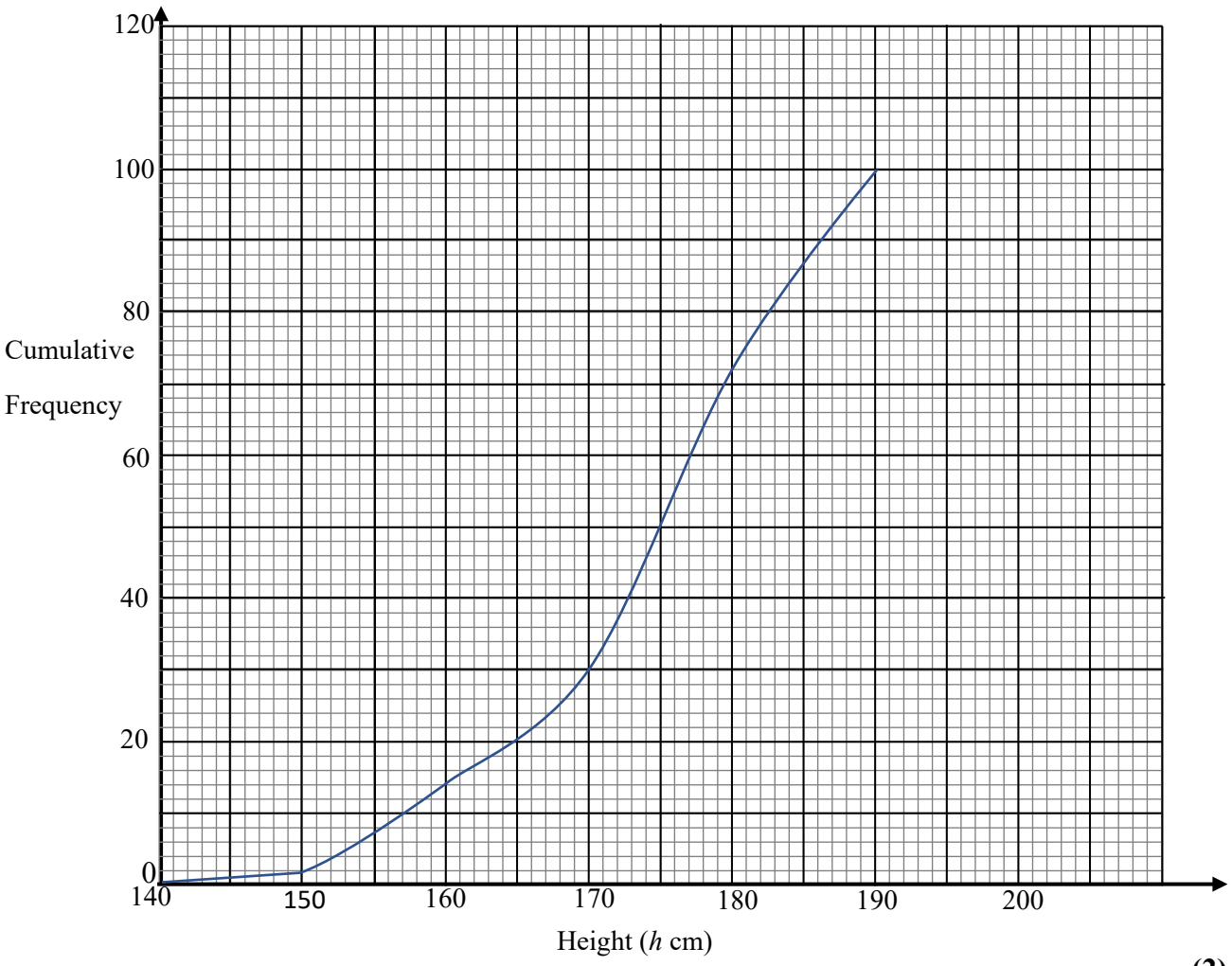
Height (h cm)	Frequency
$140 \leq h < 150$	2
$150 \leq h < 160$	12
$160 \leq h < 170$	16
$170 \leq h < 180$	42
$180 \leq h < 190$	28

a. Complete the cumulative frequency table.

Height (h cm)	Cumulative Frequency
$140 \leq h < 150$	2
$140 \leq h < 160$	14
$140 \leq h < 170$	30
$140 \leq h < 180$	72
$140 \leq h < 190$	100

Correct cumulative frequency values (1) **(1)**

b. On the grid, draw the cumulative graph for this information.



(2)

Points are correctly plotted (1) all points are correctly joined (1)

c. Use your graph to estimate the median height.

$\frac{100}{2} = 50^{th}$ (1) 176 cm (1)

.....

(2)

d. What percentage of the students in Year 12 are over 165 cm?

$\frac{80}{100} \times 100\% = 80\%$

(1) (1)

.....

(2)

(Total for Question 13 is 7marks)

14. Make P the subject of the formula.

$$Q = \left(\frac{4P-5}{P}\right)^2$$

$\sqrt{Q} = \frac{4P-5}{P}$ (1)

$P\sqrt{Q} = 4P - 5$ (1)

$5 = 4P - P\sqrt{Q}$

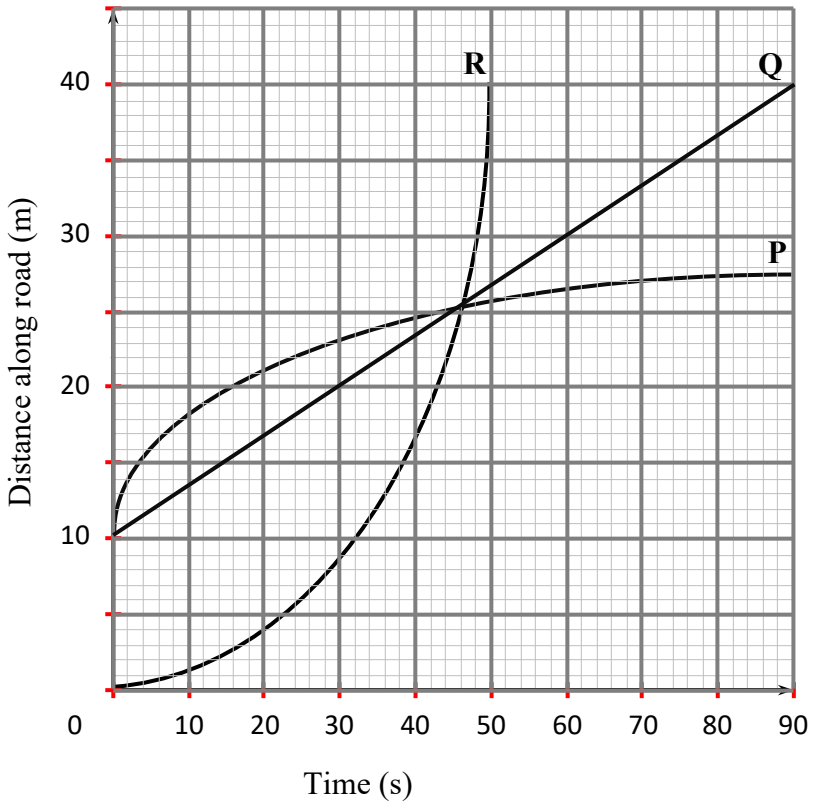
$5 = P\left(4 - \sqrt{Q}\right)$ (1)

$P = \frac{5}{4-\sqrt{Q}}$ (1)

.....

(Total for Question 14 is 4 marks)

15. Three scooter riders, *P*, *Q* and *R* go on a journey along the same road. Part of their journey is shown in the travel graph.



a. Which rider won the race in the first 90 seconds?

R (1)

……..

(1)

b. Which rider travels at a constant speed?

Q (1)

……

(1)

c. Which rider's speed is gradually decreasing?

P (1)

……

(1)

(Total for Question 15 is 3 marks)

16. A has coordinates (–2,3) and X has coordinates (1,5).

X is the mid-point of the line AB.

Find the coordinates of point B.

$\frac{-2+x}{2} = 1$ $\frac{3+y}{2} = 5$

$x = 4$ $y = 7$

(1) (1)

.....

(Total for Question 16 is 2 marks)

17. Mary bought a box of sweets. The box contains sweet assortment with almonds, hazelnut and milk chocolates in the ratio 3 : 4 : 5. Given that there were more than 30 pieces of sweets in the box, work out the minimum number of hazelnuts in the box.

Almond : Hazelnut : Milk Chocolate

3 : 4 : 5

6 : 8 : 10

9 : 12 : 15

$9 + 12 + 15 = 36 > 30$

Number of hazelnut=12 (1)

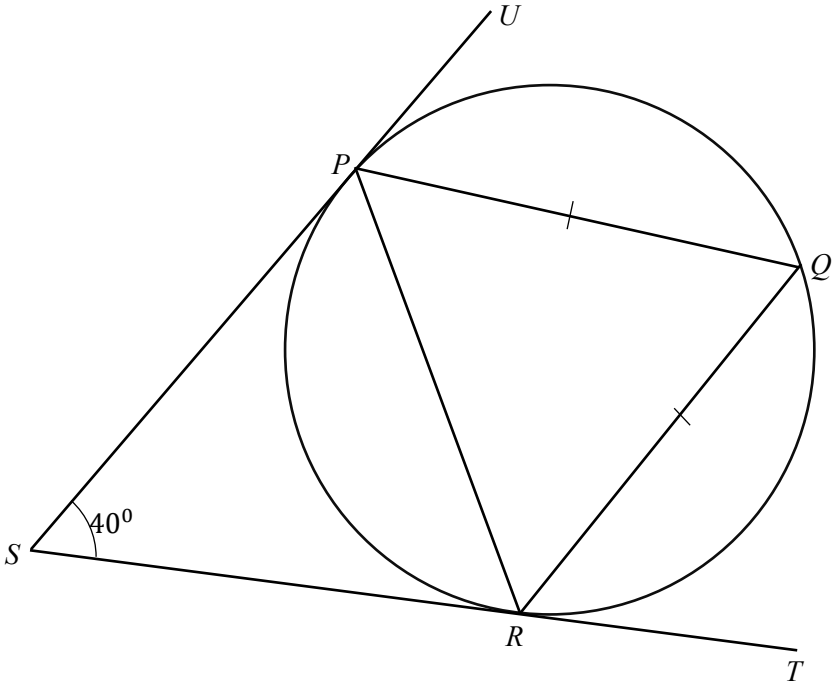
correct multiples of 3 (1)

Sum of these multiples of 3 are over 30 (1)

.....

(Total for Question 17 is 3 marks)

18.



The point P, Q and R lie on a circle.

SP and SR are tangents to the circle.

SPU and SRT are straight lines.

$PQ = QR$

Angle $PSR = 40^0$

Work out the size of angle QRT.

You must give a reason for each stage of your working.

$SPR = SRP = 70^0$ (base angles of an isosceles triangle are equal) (1)

$PQR = 70^0$ (alternate segment theorem) (1)

$QPR = QRP = 55^0$ (base angles of an isosceles triangles) (1)

$QRT = 55^0$ (alternate segment theorem) (1)

……..

(Total for Question 18 is 4 marks)

19. The diagram shows a triangular prism with a horizontal rectangular base $ABCD$.

$AB = 3.6$ m

$BC = 6$ m

Q is the midpoint of AB.

The vertex P is vertically above Q.

$PQ = 3$m

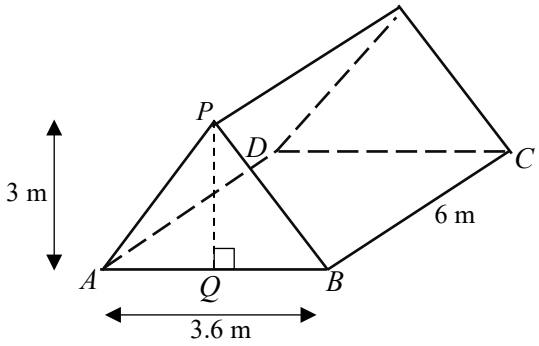


Diagram NOT accurately drawn

M is the point on BC such that BM is half of MC.

Calculate the size of the angle between PM and the base ABCD in the triangle PQM.

Give your answer correct to 1 decimal place.

$QM^2 = 1.8^2 + 3^2$ (1)

$QM = 3.49857\ldots$ (1)

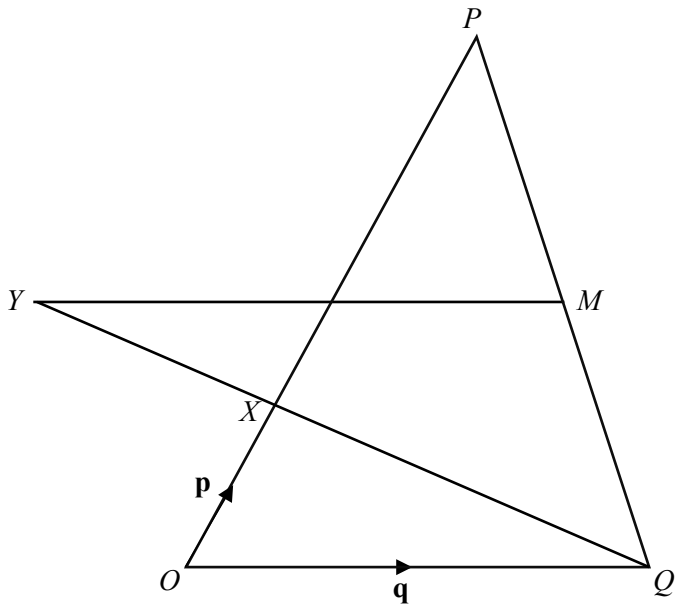
$\tan M = \frac{3}{3.4987\ldots}$ (1)

$M = 40.6^0$ (1)

……..

(Total for Question 19 is 4 marks)

20.



In the diagram OPQ is a triangle.

M is the midpoint of PQ.

$\overrightarrow{OX} = \mathbf{p}$

$\overrightarrow{OP} = \mathbf{3p}$

$\overrightarrow{OQ} = \mathbf{q}$

a. Find, in terms of **p** and **q,** in its simplest form

i. $\overrightarrow{QX}$

$\overrightarrow{QX} = \overrightarrow{QO} + \overrightarrow{OX}$

$\overrightarrow{QX} = -\boldsymbol{q} + \mathbf{p}$

$= \mathbf{p} - \mathbf{q}$ **(1)**

.....

(1)

ii. $\overrightarrow{PQ}$

$\overrightarrow{PQ} = \overrightarrow{PO} + \overrightarrow{OQ}$

$\overrightarrow{PQ} = -3\boldsymbol{p} + \boldsymbol{q}$

.....

(2)

X lies on QY such that $\overrightarrow{QY} = m\overrightarrow{QX}$

b. i. Find MY in terms of **p**, **q** and m.

$\overrightarrow{QY} = m(-\mathbf{q} + \mathbf{p})$ **(1)**

$\overrightarrow{MY} = \overrightarrow{MQ} + \overrightarrow{QY}$

$\overrightarrow{MY} = \frac{1}{2}\overrightarrow{PQ} + m\overrightarrow{QX}$

$= \frac{1}{2}(-3\mathbf{p}+\mathbf{q}) + m(-\mathbf{q}+\mathbf{p})$ (1)

$= \left(m - \frac{3}{2}\right)\mathbf{p} + \left(\frac{1}{2} - m\right)\mathbf{q}$

.....

(2)

ii. Hence find the value of m if MY is parallel to QO.

$\overrightarrow{MY} = k\overrightarrow{QO}$

$\left(m - \frac{3}{2}\right)\mathbf{p} + \left(\frac{1}{2} - m\right)\mathbf{q} = k\mathbf{q}$

$m - \frac{3}{2} = 0$ (1)

$m = \frac{3}{2}$ (1)

.....

(2)

(Total for Question 20 is 7 marks)