Please check the examination details below before entering your candidate information

Candidate surname	Other names

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

Centre Number | Candidate Number

Monday 11 November 2019

Afternoon (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 ▶

P58876RA

6/1/1/1/1/

P 5 8 8 7 6 R A 0 1 2 4

Pearson

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Expand and simplify $(x + 5)(x - 9)$

F O I L ← Last
Front Outside Inside

$(x+5)(x-9) = x^2 - 9x + 5x - 45$
$= x^2 - 4x - 45$

(2)

$x^2 - 4x - 45$

(2)

(b) Factorise fully $9x^2 + 6x$

$9x^2 + 6x = 3x(3x + 2)$

(2)

$3x(3x+2)$

(2)

(Total for Question 1 is 4 marks)

2 (a) Use your calculator to work out $\dfrac{29^2 - 4.6}{\sqrt{35 - 1.9^3}}$

Write down all the figures on your calculator display.

(2)

157.668255

(2)

(b) Write your answer to part (a) correct to 4 significant figures.

157.668255 ← round up since ≥ 5
= 157.7 (4sf)

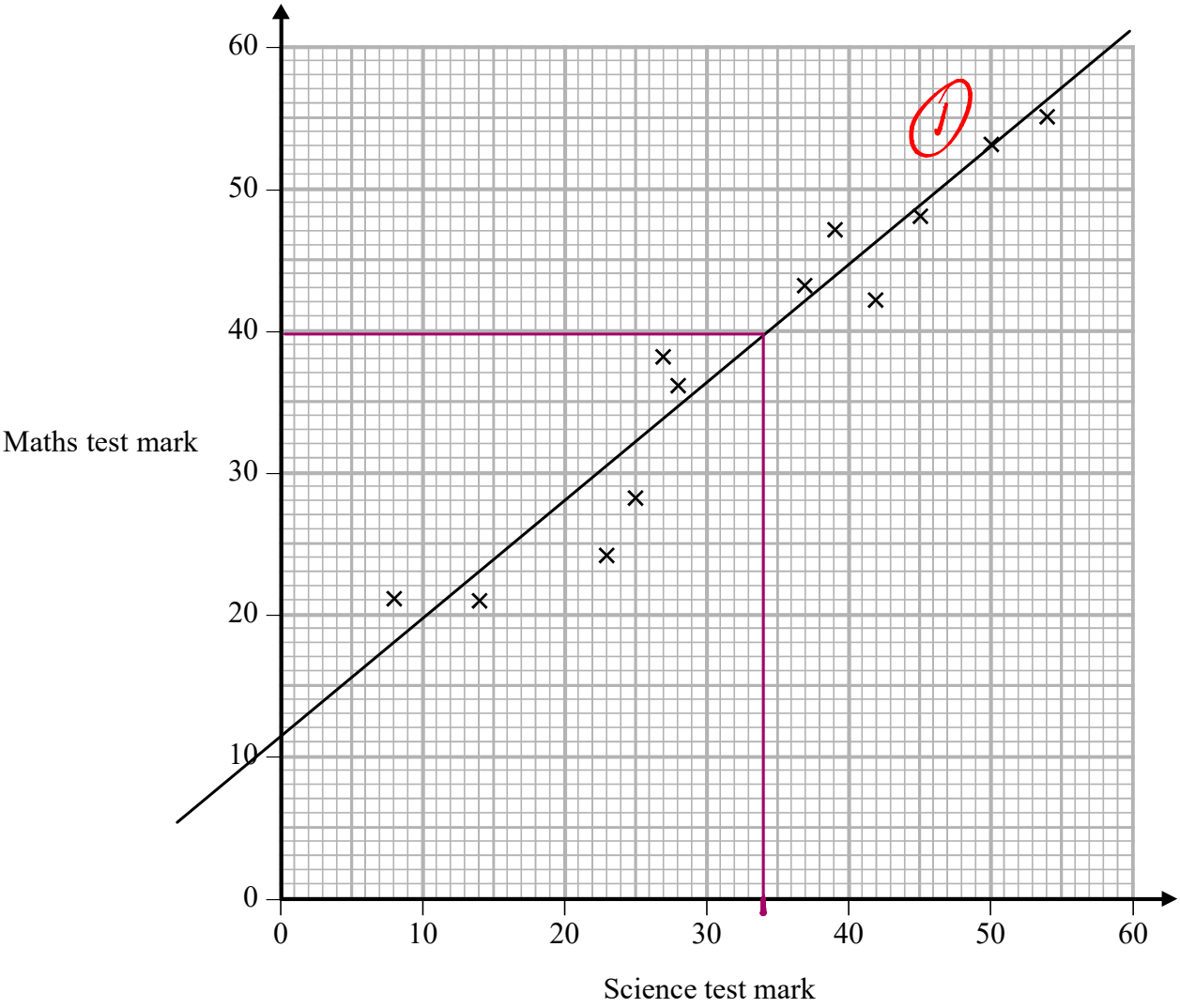
(1)

157.7

(1)

(Total for Question 2 is 3 marks)

3 The scatter graph shows information about the marks a group of students got in a Science test and in a Maths test.



Jamie got a mark of 34 in the Science test.

Using the scatter graph, find an estimate for Jamie's mark in the Maths test.

40 ✓

4 The table gives information about the times taken, in seconds, by 18 students to run a race.

$\frac{5+10}{2} = 7.5$ ← midpoint

Time (t seconds)	Frequency	x (1)	frequency × x (1)
$5 < t \leqslant 10$	1	7.5	1 × 7.5 = 7.5
$10 < t \leqslant 15$	2	12.5	2 × 12.5 = 25
$15 < t \leqslant 20$	7	17.5	7 × 17.5 = 122.5
$20 < t \leqslant 25$	8	22.5	8 × 22.5 = 180

Total = 7.5 + 25 + 122.5 + 180 = 335

Work out an estimate for the mean time.
Give your answer correct to 3 significant figures.

mean = $\frac{\text{total}}{n}$ ← (how many 'things' there are)

Mean = $\frac{335}{18} = 18.6111\ldots = 18.6$ (3sf)

18.6 (1) ..... seconds

(Total for Question 4 is 3 marks)

5 Write 37 cm^3 in mm^3

$1\,cm = 10\,mm$

$1^3\,cm^3 = 10^3\,mm^3$

$1\,cm^3 = 1000\,mm^3$

$1\,cm^3 = 1000\,mm^3$ (x37) → $37\,cm^3 = 37000\,mm^3$ (1)

37000 ..... mm^3

(Total for Question 5 is 1 mark)

6 Nimer was driving to a hotel.
He looked at his Sat Nav at 13 30

Time	13 30
Distance to destination	65 miles

Nimer arrived at the hotel at 14 48

Work out the average speed of the car from 13 30 to 14 48
You must show all your working.

14 − 13 (1) 48 − 30

Between 13:30 48 there is 1 hour 18 minutes

Convert everything to hours (1)

1 hour 18 minutes → 1 hour + $\frac{18}{60}$ hours → $1 + \frac{18}{60}$ hours → 1.3 hours

Speed = $\frac{\text{distance}}{\text{time}}$ (1)

Speed = $\frac{65}{1.3}$ = 50 mph

50 (1) ..... mph

(Total for Question 6 is 4 marks)

7 (a) Write 32 460 000 in standard form.

32460000.000
3.2460000000
3.246 x 10^7 (1)

3.246 x 10^7

(1)

(b) Write 4.96×10^{-3} as an ordinary number.

4.96 x 10^-3
0004.9600000
0.00496 (1)

0.00496

(1)

Asma was asked to compare the following two numbers.

$A = 6.212 \times 10^8$ and $B = 4.73 \times 10^9$

She says,

"6.212 is bigger than 4.73 so A is bigger than B."

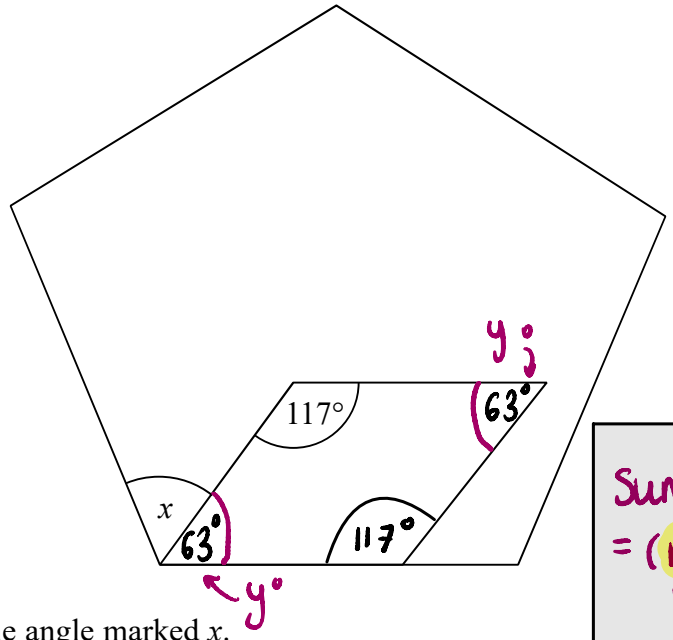
(c) Is Asma correct?
You must give a reason for your answer.

She is incorrect because 10^8 is smaller than 10^9
(She did not take into account standard form) (1)

(1)

(Total for Question 7 is 3 marks)

8 The diagram shows a regular pentagon and a parallelogram.



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

Sum of interior angles
$= (n-2) \times 180$
↑ number of sides
$\therefore (5-2) \times 180$
$= 3 \times 180 = 540°$

① Angles opposite in parallelogram are equal

② Sum of interior angles in parallelogram is 360°

$117 + 117 + y + y = 360$
$234 + 2y = 360$
$-234 \quad -234$
$\frac{2y}{2} = \frac{126}{2}$
$y = 63$ ✓1

③ Sum of interior angles in a pentagon is 540°

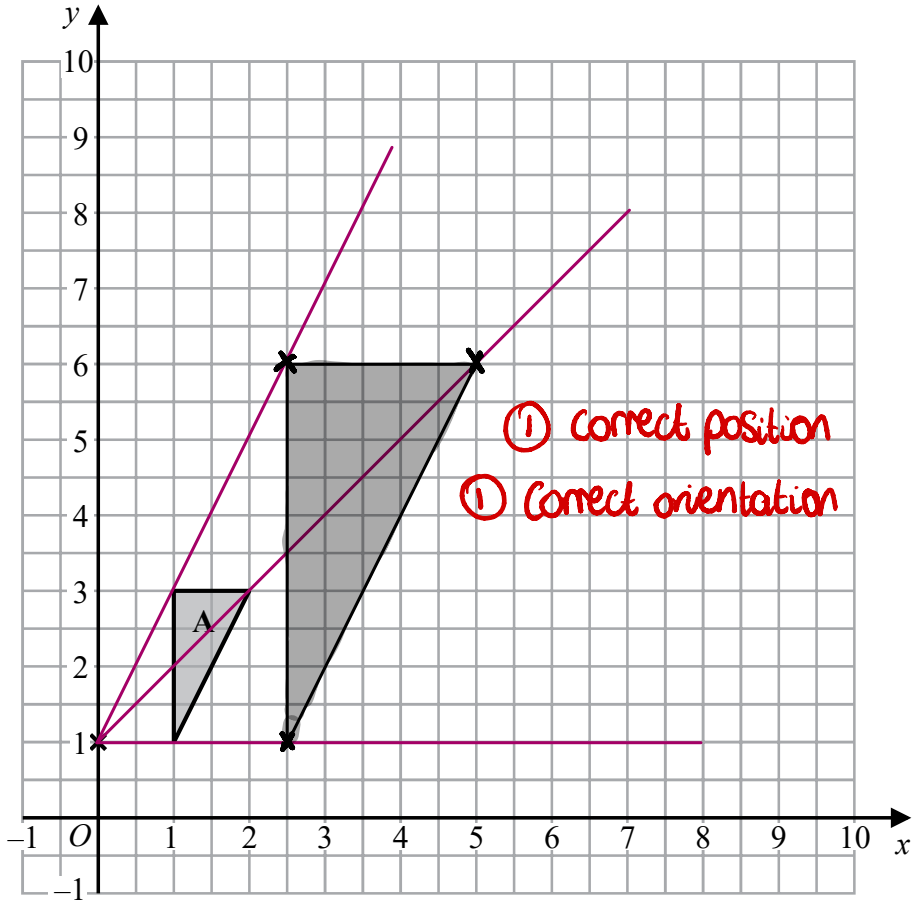
$\therefore$ one angle $= \frac{540}{5} = 108°$ ✓1

$x + 63 = 108$
$-63 \quad -63$ ✓1
$x = 45$

✓1 45 °

(Total for Question 8 is 4 marks)

9



Enlarge triangle **A** by scale factor 2.5 with centre (0, 1)

(Total for Question 9 is 2 marks)

10 (a) Solve $\frac{9+x}{7} = 11 - x$

$\frac{7(9+x)}{7} = 7(11-x)$

$9 + x = 77 - 7x$

$+7x \quad +7x$ (1)

$9 + 8x = 77$

$-9 \quad -9$

$\frac{8x}{8} = \frac{68}{8}$ (1)

$x = 8.5$

$x = 8.5$ (1)

(3)

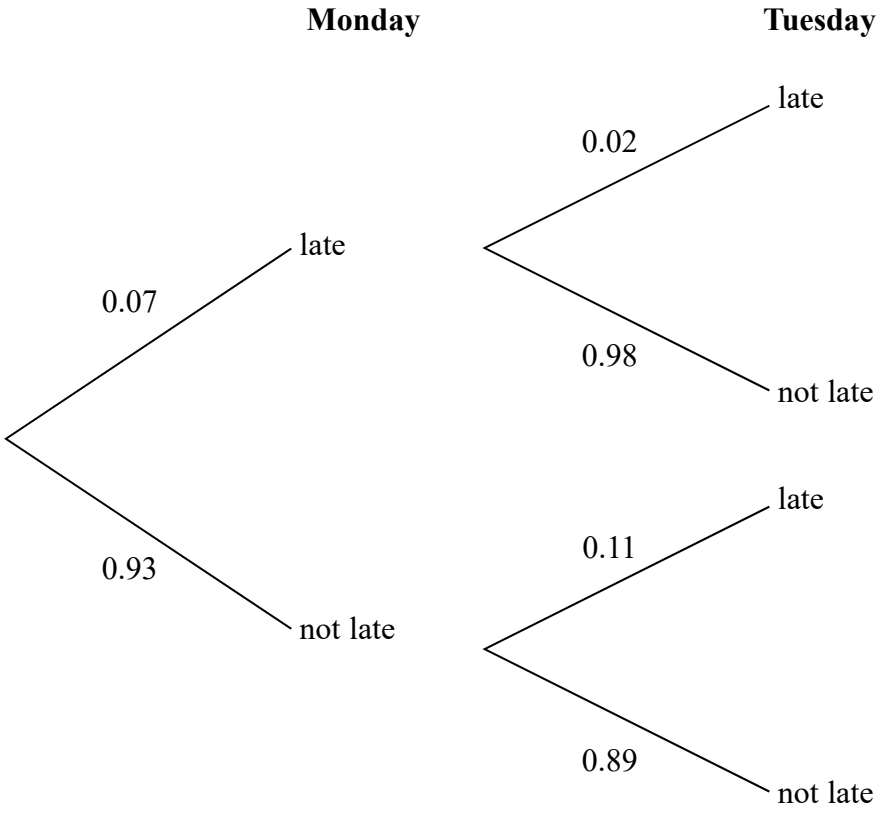
(b) Simplify $\frac{4(y+3)^3}{(y+3)^2}$

$\frac{4(y+3)^3}{(y+3)^2} = \frac{4(y+3)(y+3)(y+3)}{1(y+3)(y+3)} = \frac{4(y+3)}{1} = 4(y+3)$ (1)

(1)

(Total for Question 10 is 4 marks)

11 The probability tree diagram shows the probabilities that Bismah will be late for work on two days next week.



Calculate the probability that Bismah will be late on exactly one of the two days.

And is X
Or is +

(0.07 × 0.98) + (0.93 × 0.11) (1)

= 0.1709 (1)

0.1709

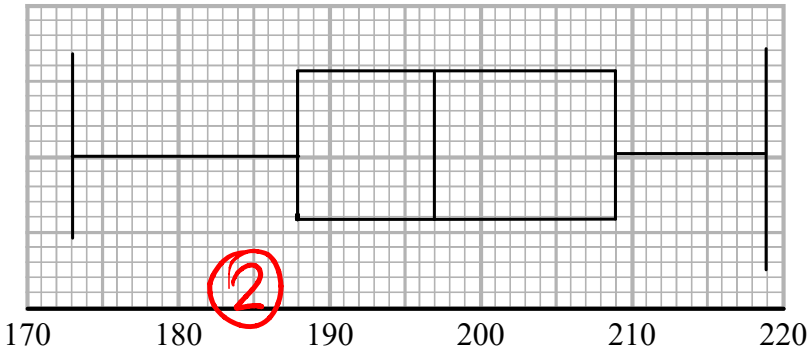
(Total for Question 11 is 3 marks)

12 The stem and leaf diagram shows information about the heights, in cm, of 23 sunflowers.

17	3	4	9				
18	6	8	8				
19	0	0	1	4	6	7	8
20	1	4	7	7	9	9	
21	4	8	8	9			

Key: 17|3 represents 173 cm

On the grid, draw a box plot for this information.



lowest = 173cm
Highest = 219 cm
Median = 197cm
UQ = 188
LQ = 209
(1)
(2)
at position
$\frac{23+1}{2} = 12$ in data
∴ LQ at position
$\frac{12}{2} = 6$ in data
UQ at position
12 + 6 = 18 in data

(Total for Question 12 is 3 marks)

13 Liquid A and liquid B are mixed together in the ratio 2 : 13 by volume to make liquid C.

Liquid A has density 1.21 g/cm^3
Liquid B has density 1.02 g/cm^3

A cylindrical container is filled completely with liquid C.
The cylinder has radius 3 cm and height 25 cm.

Work out the mass of the liquid in the container.
Give your answer correct to 3 significant figures.
You must show all your working.

Volume cylinder $= \pi r^2 h$ (height, radius) (1)

Volume cylinder $= \pi(3)^2 25 = 225\pi \text{ cm}^3$

split into ratio 2 : 13

$2 + 13 = 15$

$\frac{225\pi}{15} = 15\pi$

$2 \times 15\pi : 13 \times 15\pi$

$30\pi : 195\pi$

∴ Within cylinder we have

$30\pi \text{ cm}^3$ of liquid A (1)

$195\pi \text{ cm}^3$ of liquid B

density $= \frac{\text{mass}}{\text{volume}}$ so mass = density x volume

In the cylinder → liquid A, liquid B

Mass $= 1.21 \times 30\pi$
$= 36.3\pi$ g

Mass $= 1.02 \times 195\pi$
$= 198.9\pi$ g

Therefore mass of container (1)

$36.3\pi + 198.9\pi = 235.2\pi \text{ g} = 738.90259... = 739 \text{ g (3sf)}$ 739 (1) g

(Total for Question 13 is 4 marks)

14 A group of people went to a restaurant.
Each person chose one starter and one main course.

starter	main course
soup	lasagne
prawns	curry

the number of people who chose soup : the number of people who chose prawns = 2 : 3

Of those who chose soup,
the number of people who chose lasagne : the number of people who chose curry = 5 : 3

Of those who chose prawns,
the number of people who chose lasagne : the number of people who chose curry = 1 : 5

What fraction of the people chose curry?
You must show how you get your answer.

Soup : prawns

2 : 3 2+3=5

$\frac{2}{5}$ $\frac{3}{5}$ (1)

Fraction who chose soup

Fraction who chose prawns

lasagne : curry

5 : 3 5+3=8

$\frac{5}{8}$ $\frac{3}{8}$ (1)

Fraction who chose soup then lasagne

Fraction who chose soup then curry

lasagne : curry

1 : 5 1+5=6

$\frac{1}{6}$ $\frac{5}{6}$ (1)

Fraction who chose prawns then lasagne

Fraction who chose prawns then curry

People who had curry

(Soup and curry) or (prawns and curry)

'And' use ×
'Or' use +

$\left(\frac{2}{5} \times \frac{3}{8}\right) + \left(\frac{3}{5} \times \frac{5}{6}\right) = \frac{13}{20}$ (1)

(1)

$\frac{13}{20}$

(Total for Question 14 is 4 marks)

15 Prove algebraically that the sum of the squares of any two consecutive even numbers is always a multiple of 4

$2n$ ← even number ← when n is any whole number

$2n+2$ ← 'next' even number

$(2n)^2 + (2n+2)^2 = (2^2n^2) + (2n+2)(2n+2)$

$= (2^2n^2) + (4n^2+4n+4n+4)$

$= (2^2n^2) + (4n^2+8n+4)$ (2)

$= 4n^2 + 4n^2 + 8n + 4$

$= 8n^2 + 8n + 4$

$= 4(2n^2 + 2n + 1)$ (1)

(Total for Question 15 is 3 marks)

16 y is inversely proportional to the square of x.

$y = 8$ when $x = 2.5$ ← x^2

Find the negative value of x when $y = \frac{8}{9}$

$y \propto \frac{1}{x^2}$

$y = \frac{k}{x^2}$ (1) ← we want to work out value of k so sub in info from question

$8 = \frac{k}{2.5^2}$

$k = 8 \times 2.5^2$

$k = 50$ (1)

$y = \frac{50}{x^2}$ ← Sub $y = \frac{8}{9}$

$\frac{8}{9} = \frac{50}{x^2}$

$x^2 \times \frac{8}{9} = 50$

$x^2 \times \frac{8}{9} \times \frac{9}{8} = 50 \times \frac{9}{8}$

$x^2 = 56.25$

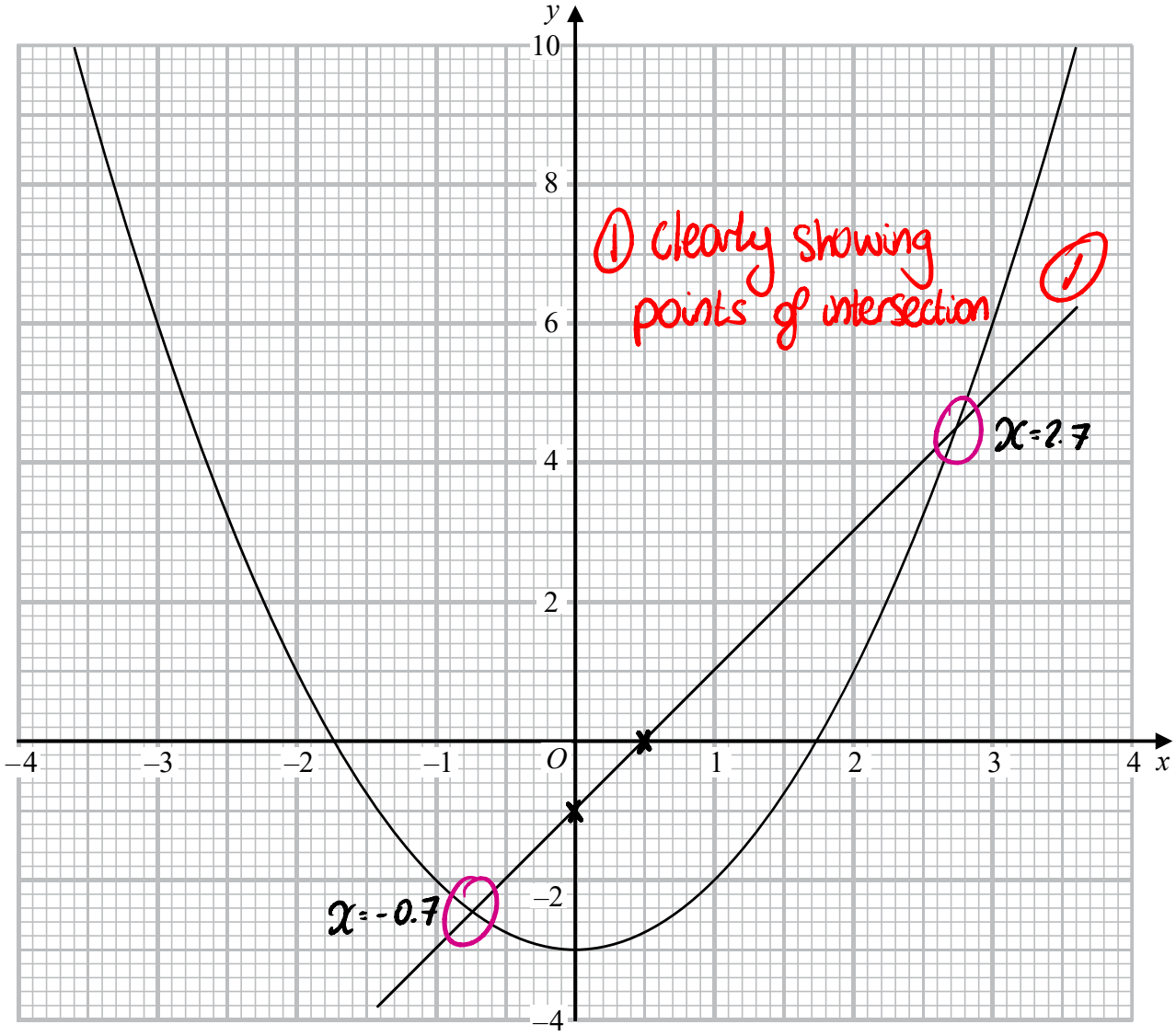
$x = \pm\sqrt{56.25}$

$x = \pm 7.5$ ← Since we want negative value

-7.5 (1)

(Total for Question 16 is 3 marks)

17 Here is the graph of $y = x^2 - 3$



Use the graph to find estimates for the solutions to the equation $x^2 - 2x - 2 = 0$
You must show how you get your solutions.

$x^2 + 0x - 3$
$-x^2 - 2x - 2$
$0 + 2x - 1$ ①

$y = 2x - 1$

Gives the line we need to plot

To plot let us find two points

let $y = 0$
$0 = 2x - 1$
$2x = 1$
$x = \frac{1}{2}$
$(\frac{1}{2}, 0)$

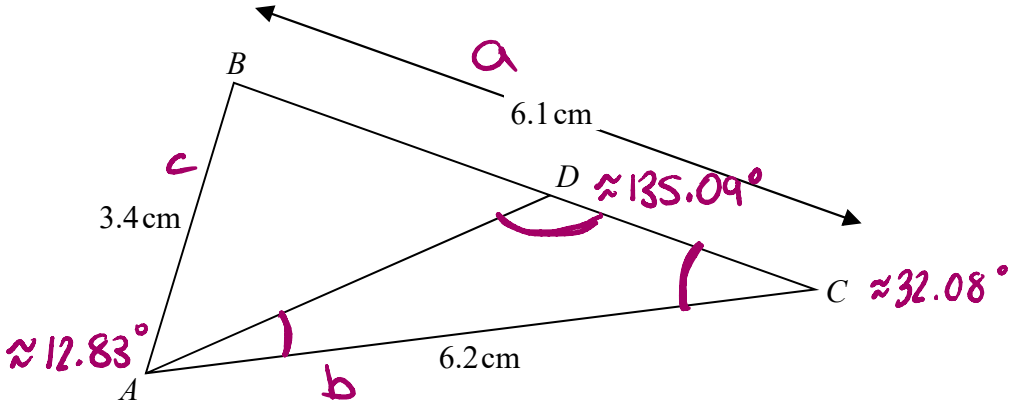
let $x = 0$
$y = 2(0) - 1$
$y = -1$
$(0, -1)$

look for x coordinates where line and curve intercept

$x = 2.7$ $x = -0.7$ ①

(Total for Question 17 is 4 marks)

18 The diagram shows triangle ABC.



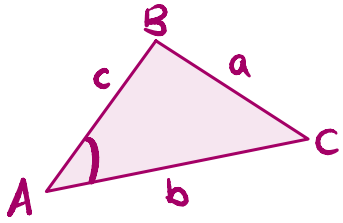
$AB = 3.4\,\text{cm}$ $AC = 6.2\,\text{cm}$ $BC = 6.1\,\text{cm}$

D is the point on BC such that

$$\text{size of angle } DAC = \frac{2}{5} \times \text{size of angle } BCA$$

Calculate the length DC.
Give your answer correct to 3 significant figures.
You must show all your working.

$a^2 = b^2 + c^2 - 2bc\cos(A)$ ← cosine rule



$c^2 = b^2 + a^2 - 2ba\cos(C)$

(1) $3.4^2 = 6.2^2 + 6.1^2 - 2(6.2)(6.1)[\cos(C)]$

$11.56 = 75.65 - 75.64\cos(C)$

$+75.64\cos(C)$ $+75.64\cos(C)$

$11.56 + 75.64\cos(C) = 75.65$

-11.56 -11.56

$\frac{75.64\cos(C)}{75.64} = \frac{64.09}{75.64}$

$\cos(C) = \frac{64.09}{75.64}$

$C = \cos^{-1}\left(\frac{64.09}{75.64}\right)$

$= 32.080469\,13°$ (1)

Size angle $DAC = \frac{2}{5} \times 32.080\ldots$

$= 12.832\,187\,65°$

Size angle $ADC = 180 - 32.080\ldots - 12.832\ldots$

$= 135.087\,643\,2°$

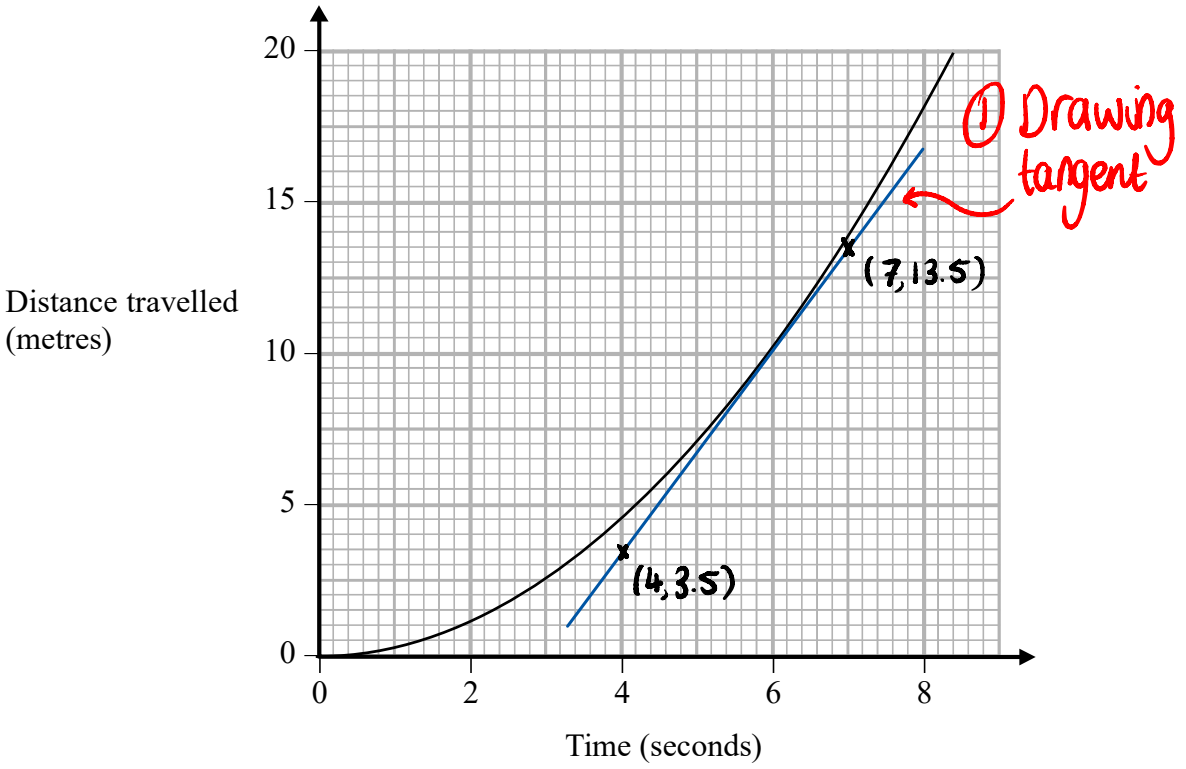
$\frac{DC}{\sin(DAC)} = \frac{AC}{\sin(ADC)}$ ← sine rule (1)

$\frac{DC}{\sin(12.832\ldots°)} = \frac{6.2}{\sin(135.087\ldots)}$

(1) $DC = \frac{6.2}{\sin(135.087\ldots)} \times \sin(12.832\ldots°)$ (1)

$DC = 1.95035\ldots = 1.95\,\text{cm}$ (3sf) 1.95 cm (3sf) ..... cm

19 The graph shows information about part of a cyclist's journey.



Work out an estimate of the speed, in m/s, of the cyclist at time 6 seconds.

For a distance time graph the speed is the gradient

Need to work out gradient at $t = 6$ by drawing a tangent

Gradient of line (m) $= \frac{y_2 - y_1}{x_2 - x_1}$ $\therefore m = \frac{13.5 - 3.5}{7 - 4} = \frac{10}{3} = 3.33$ (2dp)

① working out gradient

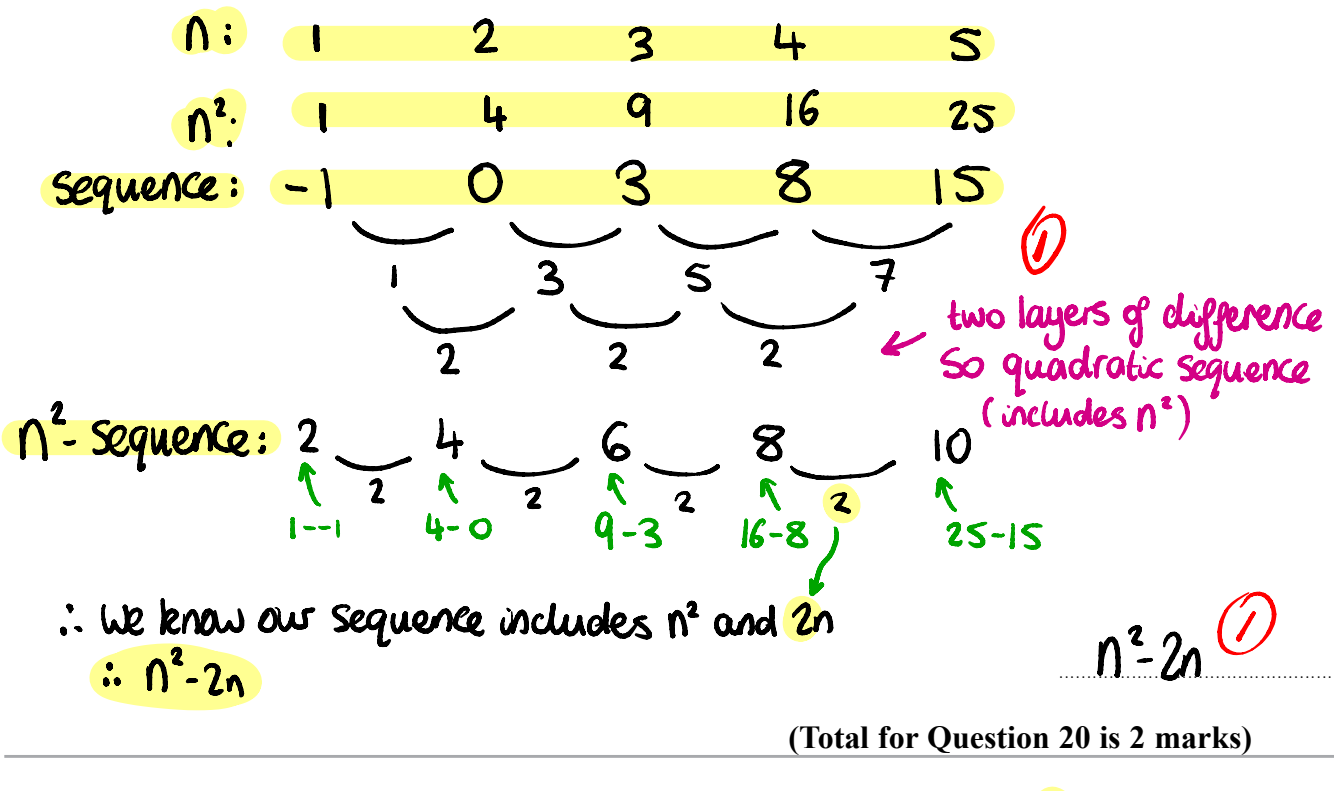
3.33 ① m/s

(Total for Question 19 is 3 marks)

20 Here are the first five terms of a sequence.

−1 0 3 8 15

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

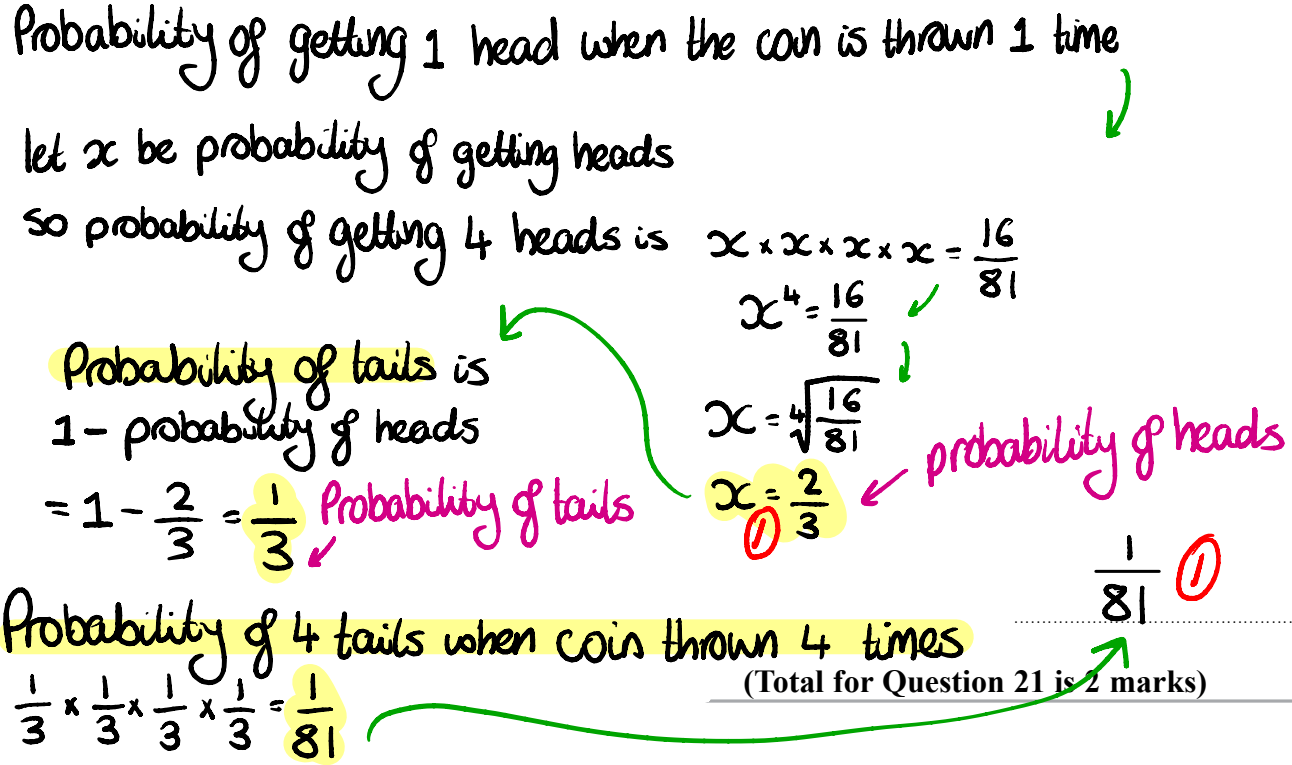


$n^2 - 2n$ (1)

(Total for Question 20 is 2 marks)

21 When a biased coin is thrown 4 times, the probability of getting 4 heads is $\frac{16}{81}$

Work out the probability of getting 4 tails when the coin is thrown 4 times.



$\frac{1}{81}$ (1)

(Total for Question 21 is 2 marks)

22 Show that $\dfrac{7x-14}{x^2+4x-12} \div \dfrac{x-6}{x^3-36x}$ simplifies to ax where a is an integer.

$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}$

$$\frac{7x-14}{x^2+4x-12} \times \frac{x^3-36x}{x-6} \quad (1)$$

$x^3-36x = x(x^2-36)$
$= x[(x+6)(x-6)]$
$= x(x+6)(x-6)$

$$= \frac{7(x-2)}{(x-2)(x+6)} \quad (1) \times \frac{x(x+6)(x-6)}{x-6} \quad (1)$$

$$= \frac{7(x-2)x(x+6)(x-6)}{1(x-2)(x+6)(x-6)}$$

$$= \frac{7x}{1} = 7x \quad (1)$$

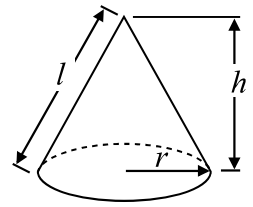
(Total for Question 22 is 4 marks)

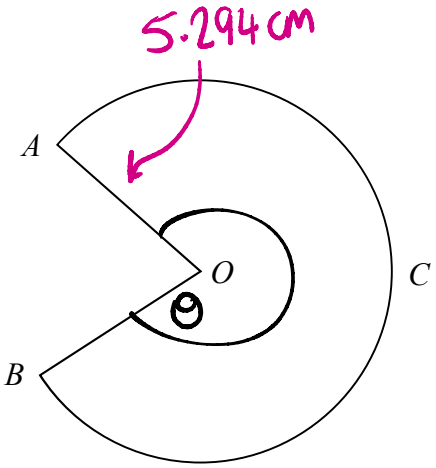
23 The diagram shows a sector $OACB$ of a circle with centre O.
The point C is the midpoint of the arc AB.

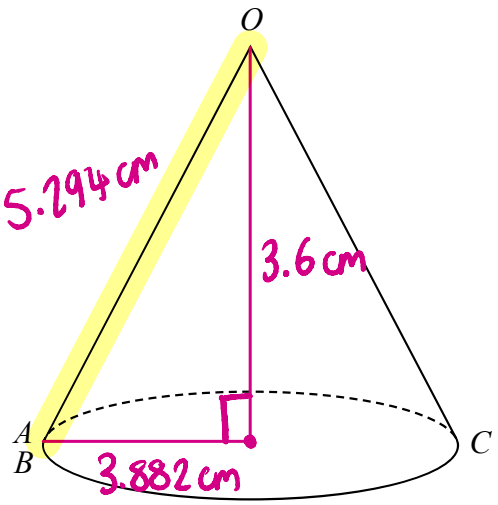
The diagram also shows a hollow cone with vertex O.
The cone is formed by joining OA and OB.

Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi rl$







The cone has volume $56.8\,\text{cm}^3$ and height $3.6\,\text{cm}$.

Calculate the size of angle AOB of sector $OACB$.
Give your answer correct to 3 significant figures.
You must show all your working.

$V = \frac{1}{3}\pi r^2 h$

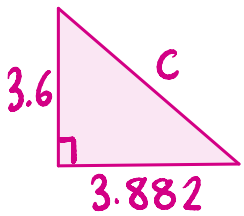
$56.8 = \frac{1}{3}\pi r^2 (3.6)$ (1)

$\frac{56.8}{1.2\pi} = \frac{1.2\pi r^2}{1.2\pi}$

$r^2 = \frac{56.8}{1.2\pi}$ square root

$r = 3.882$ (3dp) (1)

$a^2 + b^2 = c^2$



$3.882^2 + 3.6^2 = c^2$

$c^2 = 28.030$ (3dp)

$c = 5.294$ (3dp) square root (1)

Curved SA cone $= \pi rl$

Curved SA cone

$= \pi \times 3.882 \times 5.294$

$= 20.551\pi$ (3dp)

Sector Area $= \frac{\theta}{360} \times \pi r^2$

$20.551\pi = \frac{\theta}{360} \times \pi (5.294)^2$ (1)

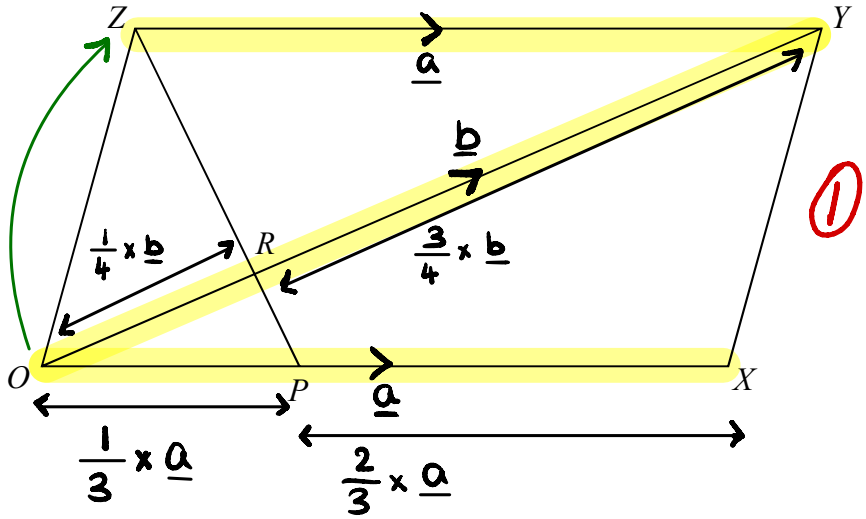
$20.551 \times 360 = \theta \times (5.294)^2$

$\theta = \frac{20.551 \times 360}{(5.294)^2} = 263.978\ (3dp) = 264^\circ\ (3sf)$ (1)

264 °

(Total for Question 23 is 5 marks)

24 $OXYZ$ is a parallelogram.



$\overrightarrow{ZY} = a$ Since shape is a parallelogram

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

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

P is the point on OX such that $OP : PX = 1 : 2$ $1 + 2 = 3$

R is the point on OY such that $OR : RY = 1 : 3$ $1 + 3 = 4$

Work out, in its simplest form, the ratio $ZP : ZR$

You must show all your working.

$\overrightarrow{ZP} = a - b + \left(\frac{1}{3} \times a\right)$

$\overrightarrow{ZR} = a - \left(\frac{3}{4} \times b\right)$ (2)

$a - b + \frac{a}{3} : a - \frac{3b}{4}$

$\frac{3a}{3} - b + \frac{a}{3} : a - \frac{3b}{4}$

$\frac{4a}{3} - b : a - \frac{3b}{4}$

$\frac{4a}{3} - b : \frac{3}{4}\left(\frac{4a}{3} - b\right)$

(1) $\overrightarrow{ZP} : \frac{3}{4}(\overrightarrow{ZP})$

$\overrightarrow{ZR} = \frac{3}{4}\overrightarrow{ZP}$

let $\overrightarrow{ZP} = 4$

$\overrightarrow{ZR} = \frac{3 \times 4}{4} \rightarrow \overrightarrow{ZR} = 3$

Since we want $\overrightarrow{ZP} : \overrightarrow{ZR}$ → 4 : 3 (1)

(Total for Question 24 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

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