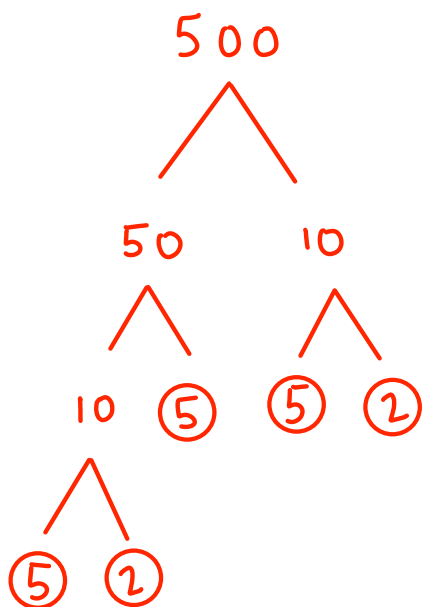


- 1 Write 500 as a product of powers of its prime factors.



$$2^2 \times 5^3$$

(Total for Question 1 is 3 marks)

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2 (a) Work out $1\frac{3}{5} + 2\frac{1}{4}$

Give your answer as a mixed number.

$$\frac{8}{5} + \frac{9}{4}$$

$$= \frac{32}{20} + \frac{45}{20} = \frac{77}{20} = 3\frac{17}{20}$$

$$3\frac{17}{20}$$

(2)

(b) Show that $2\frac{2}{3} \div 6 = \frac{4}{9}$

$$\frac{8}{3} \div \frac{6}{1}$$

$$= \frac{8}{3} \times \frac{1}{6} = \frac{8}{18} = \frac{4}{9}$$

(2)

(Total for Question 2 is 4 marks)

3 Simplify $(2^{-5} \times 2^8)^2$

Give your answer as a power of 2

$$(2^3)^2 = 2^6$$

.....
 2^6

(Total for Question 3 is 2 marks)

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5 A car factory is going to make four different car models **A**, **B**, **C** and **D**.

80 people are asked which of the four models they would be most likely to buy.

The table shows information about the results.

Car model	Number of people
A	23
B	15
C	30
D	12

The factory is going to make 40 000 cars next year.

Work out how many model **B** cars the factory should make next year.

$$80 \overline{) 40000} \begin{array}{r} 00500 \\ \hline \end{array}$$

$$\begin{array}{r} 80 \times 500 \\ \hline 40000 \end{array}$$

7500

(Total for Question 5 is 2 marks)

6 Rizwan writes down three numbers a , b and c

$$a:b = 1:3$$

$$b:c = 6:5$$

(a) (i) Find $a:b:c$

$$\begin{array}{l} a : b \\ 1 : 3 \\ 2 : 6 \end{array} \quad \begin{array}{l} b : c \\ 6 : 5 \end{array}$$

$$\underline{2 : 6 : 5}$$

(2)

(ii) Express a as a fraction of the total of the three numbers a , b and c

$$\frac{2}{13}$$

(2)

Emma writes down three numbers m , n and p

$$n = 2m$$

$$p = 5n$$

(b) Find $m:p$

$$\begin{aligned} p &= 5n \\ p &= 5(2m) = 10m \end{aligned}$$

$$\underline{1 : 10}$$

(2)

(Total for Question 6 is 6 marks)

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7



$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

A storage tank exerts a force of 10 000 newtons on the ground.

The base of the tank in contact with the ground is a 4 m by 2 m rectangle.

Work out the pressure on the ground due to the tank.

$$\text{Area} = 4 \times 2 = 8$$

$$\begin{array}{r} 01250 \\ 8 \overline{) 10000} \end{array}$$

$$\dots\dots\dots 1250 \dots\dots\dots \text{ newtons/m}^2$$

(Total for Question 7 is 2 marks)

- 8 Two numbers m and n are such that
 m is a multiple of 5
 n is an even number
the highest common factor (HCF) of m and n is 7

Write down a possible value for m and a possible value for n .

m : 5, 10, 15, 20, 25, 30, 35

Both in the 7 times tables

$$m = 35$$

$$n = 14$$

(Total for Question 8 is 2 marks)

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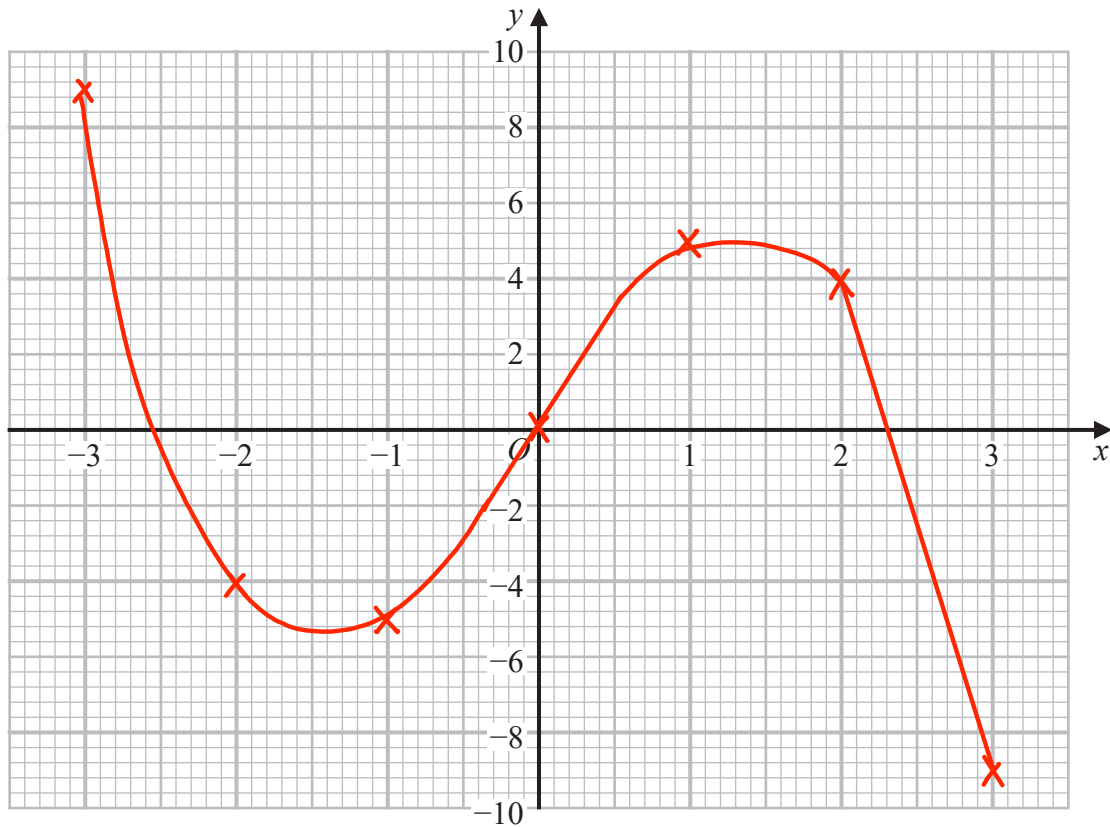
9 (a) Complete the table of values for $y = 6x - x^3$

$$\begin{array}{llll}
 6(-2) - (-2)^3 & 6(-1) - (-1)^3 & 6(0) - (0)^3 & 6(1) - (1)^3 \\
 = -12 - -8 & = -6 - -1 & = 0 & = 6 - 1 \\
 = -12 + 8 & = -6 + 1 & & = 5 \\
 = -4 & = -5 & &
 \end{array}$$

x	-3	-2	-1	0	1	2	3
y	9	-4	-5	0	5	4	-9

(2)

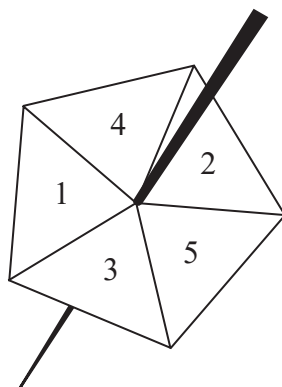
(b) On the grid, draw the graph of $y = 6x - x^3$ for values of x from -3 to 3



(2)

(Total for Question 9 is 4 marks)

10 Lina spins a biased 5-sided spinner 40 times.



Here are her results.

Score	1	2	3	4	5
Frequency	6	8	9	7	10

$$\frac{10}{40} = \frac{1}{4}$$

Lina is now going to spin the spinner another two times.

(a) Work out an estimate for the probability that she gets a score of 5 both times.

$$P(5, 5) = \frac{1}{4} \times \frac{1}{4}$$

$$\frac{1}{16}$$

(2)

Derek is going to spin the spinner a large number of times.

(b) Work out an estimate for the percentage of times Derek can expect to get a score of 1

$$\frac{6}{40} = \frac{3}{20} = \frac{15}{100}$$

$$\frac{15}{100} = 15\%$$

(2)

(Total for Question 10 is 4 marks)

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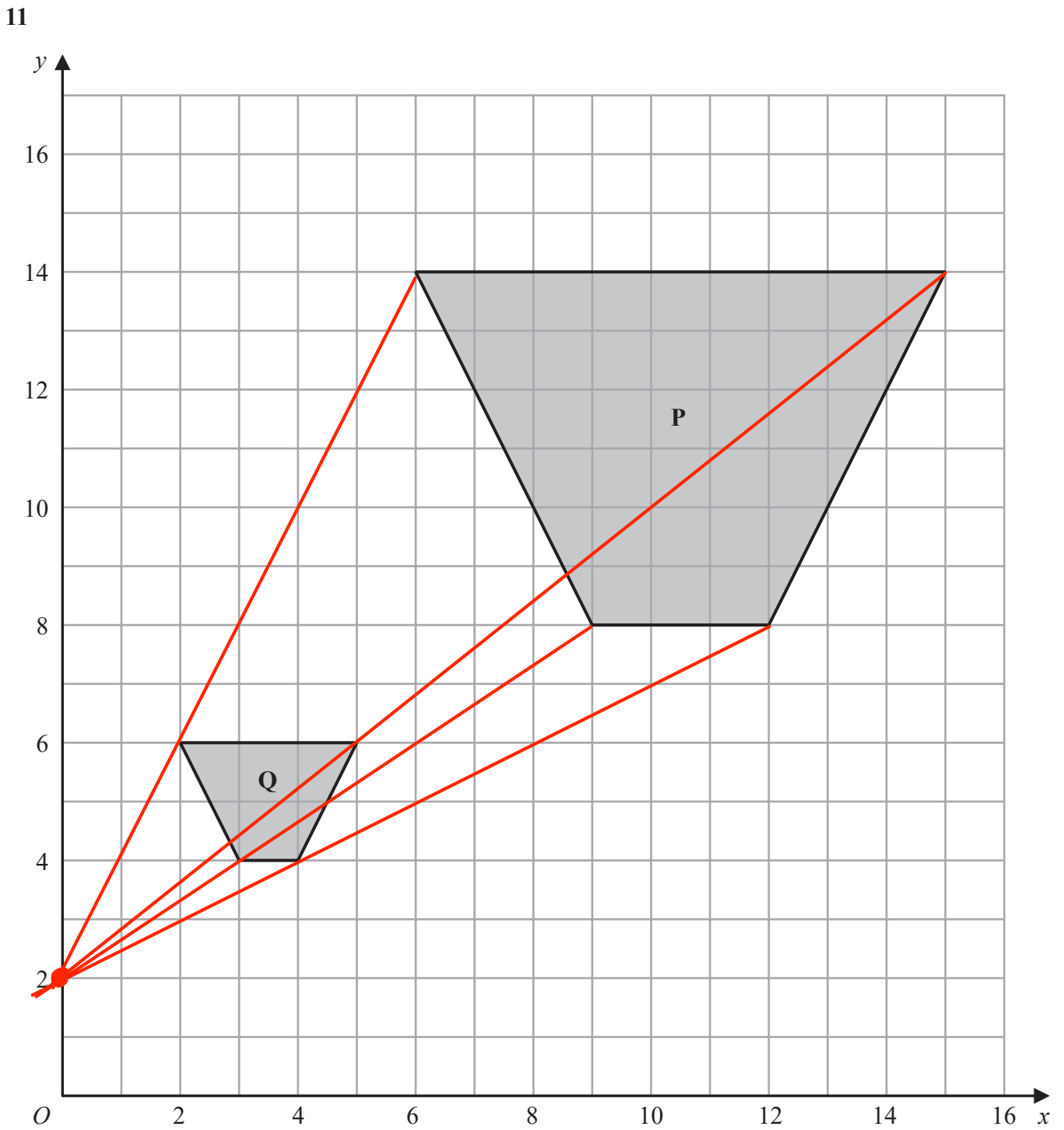
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Describe fully the single transformation that maps shape **P** onto shape **Q**.

Enlargement SF $\frac{1}{3}$ centre (0, 2)

(Total for Question 11 is 2 marks)

12 Solve the simultaneous equations

$$\begin{array}{l} \times 4 \quad \times 4 \quad \times 4 \\ 5x + 2y = 11 \\ 4x + 3y = 6 \\ \times 5 \quad \times 5 \quad \times 5 \end{array}$$

$$\begin{array}{r} 20x + 8y = 44 \\ - 20x + 15y = 30 \\ \hline \end{array}$$

$$\begin{array}{r} -7y = 14 \\ \div -7 \quad \quad \quad \div -7 \\ y = -2 \end{array}$$

$$\begin{array}{l} 5x + 2y = 11 \\ 5x + 2(-2) = 11 \\ 5x - 4 = 11 \\ +4 \quad \quad \quad +4 \\ 5x = 15 \\ \div 5 \quad \quad \quad \div 5 \\ x = 3 \end{array}$$

$$x = \dots \dots \dots 3 \dots \dots \dots$$

$$y = \dots \dots \dots -2 \dots \dots \dots$$

(Total for Question 12 is 4 marks)

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13 p is inversely proportional to t

Tip: Inversely proportional means as t decreases in size, p will increase.

Complete the table of values.

t	100	25	20	2
p	1	4	5	50

$\div 5$ (from 100 to 20)
 $\div 4$ (from 100 to 25)
 $\div 10$ (from 20 to 2)
 $\times 4$ (from 1 to 4)
 $\times 5$ (from 1 to 5)
 $\times 10$ (from 5 to 50)

(Total for Question 13 is 3 marks)

14 The table shows information about the weights, in grams, of some potatoes.



Weight (w grams)	Number of potatoes
$50 < w \leq 70$	20
$70 < w \leq 80$	50
$80 < w \leq 90$	60
$90 < w \leq 110$	30

FD

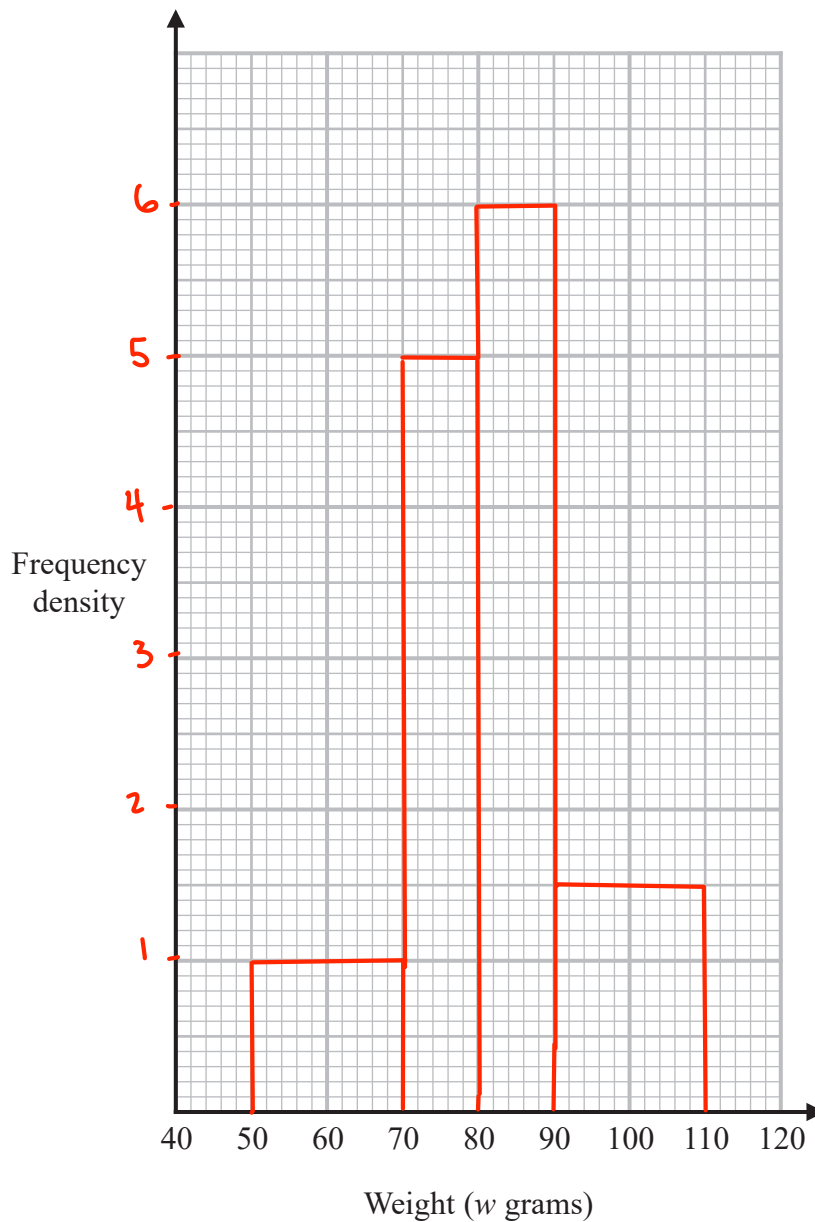
$$20 \div 20 = 1$$

$$50 \div 10 = 5$$

$$60 \div 10 = 6$$

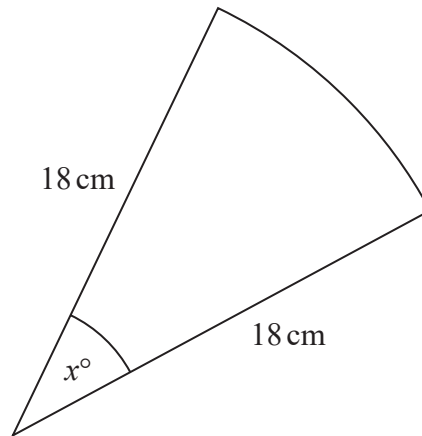
$$30 \div 20 = 1.5$$

On the grid, draw a histogram for this information.



(Total for Question 14 is 3 marks)

15 The diagram shows a sector of a circle of radius 18 cm.



The length of the arc is 4π cm.

Tip: The arc length is just a fraction of the whole circumference

Work out the value of x .

$$\frac{x}{360} \times \pi \times 36 = 4\pi$$

$$\frac{x}{360} \times 36 = 4$$

$$\frac{36x}{360} = 4$$

$$\begin{array}{l} \div 36 \\ \frac{x}{10} = 4 \\ \times 10 \\ x = 40 \end{array}$$

$$x = 40$$

(Total for Question 15 is 3 marks)

16 (a) Prove that

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

LHS:

$$\begin{aligned}(2m+1)(2m+1) &= 4m^2 + 2m + 2m + 1 \\ &= 4m^2 + 4m + 1\end{aligned}$$

$$\begin{aligned}(2n-1)(2n-1) &= 4n^2 - 2n - 2n + 1 \\ &= 4n^2 - 4n + 1\end{aligned}$$

$$\begin{aligned}4m^2 + 4m + 1 - (4n^2 - 4n + 1) \\ = 4m^2 + 4m + 1 - 4n^2 + 4n - 1 &= 4m^2 - 4n^2 + 4m + 4n\end{aligned}$$

$$\begin{aligned}\text{RHS: } 4(m+n)(m-n+1) &= (4m+4n)(m-n+1) \\ &= 4m^2 - \cancel{4mn} + 4m + \cancel{4n^2} - 4n^2 + 4n \\ &= 4m^2 - 4n^2 + 4m + 4n\end{aligned}$$

(3)

Sophia says that the result in part (a) shows that the difference of the squares of any two odd numbers must be a multiple of 4

(b) Is Sophia correct?

You must give reasons for your answer.

yes, $2m+1$ and $2n-1$ are always odd,
and the factor of 4 shows the result
will always be a multiple of 4.

(1)

(Total for Question 16 is 4 marks)

17 Work out the value of $\left(\frac{8}{27}\right)^{\frac{4}{3}}$

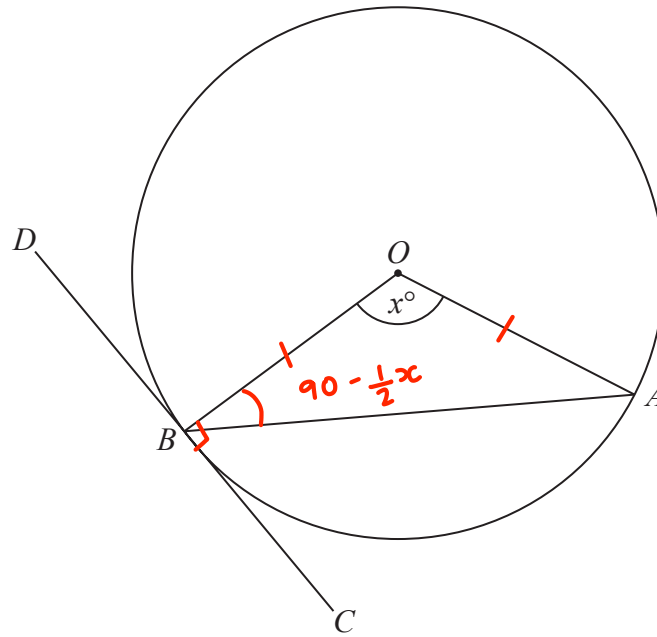
$$\sqrt[3]{\frac{8}{27}} = \frac{2}{3}$$

$$\left(\frac{2}{3}\right)^4 = \frac{16}{81}$$

$$\frac{16}{81}$$

(Total for Question 17 is 2 marks)

18



A and B are points on a circle, centre O .
 DBC is the tangent to the circle at B .
 Angle $AOB = x^\circ$

Show that angle $ABC = \frac{1}{2}x^\circ$

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

$$\angle OBA = \angle OAB = \frac{180 - x}{2} = 90 - \frac{1}{2}x$$

Base angles of an Isosceles triangle are equal

$$\angle ABC = 90 - \left(90 - \frac{1}{2}x\right) = \frac{1}{2}x$$

The radius meets the tangent at 90°

(Total for Question 18 is 3 marks)

19 Solve $\frac{1}{x} - \frac{1}{x+1} = 4$

Give your answer in the form $a \pm b\sqrt{2}$ where a and b are fractions.

$$\frac{1(x+1)}{x(x+1)} - \frac{1(x)}{x(x+1)} = 4$$

$$\frac{x+1-x}{x(x+1)} = 4$$

$$\begin{array}{l|l} \frac{1}{x^2+x} & = 4 \\ \times (x^2+x) & \times (x^2+x) \\ 1 & = 4x^2+4x \\ -1 & - \\ \hline 0 & = 4x^2+4x-1 \end{array}$$

$$\frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

$$a=4, b=4, c=-1$$

$$\frac{-(4) \pm \sqrt{(4)^2 - 4(4)(-1)}}{2(4)}$$

$$= \frac{-4 \pm \sqrt{16+16}}{8}$$

$$\frac{-1}{2} \pm \frac{1}{2}\sqrt{2}$$

(Total for Question 19 is 5 marks)

$$= \frac{-4 \pm \sqrt{32}}{8} = \frac{-4 \pm 4\sqrt{2}}{8} = \frac{-1 \pm \sqrt{2}}{2}$$

$$\sqrt{32} = \sqrt{16} \times \sqrt{2} = 4\sqrt{2}$$

20 Alfie has 11 cards.

He has

3 blue cards
7 green cards
and 1 white card.

Tip: To find the probability that he takes two cards of different colours, you can find the probability that he takes two cards of the same colour and take your answer away from 1

Alfie takes at random 2 of these cards.

Work out the probability that he takes cards of different colours.

The same colour :

$$b, b = \frac{3}{11} \times \frac{2}{10} = \frac{6}{110}$$

$$g, g = \frac{7}{11} \times \frac{6}{10} = \frac{42}{110}$$

w, w = not possible

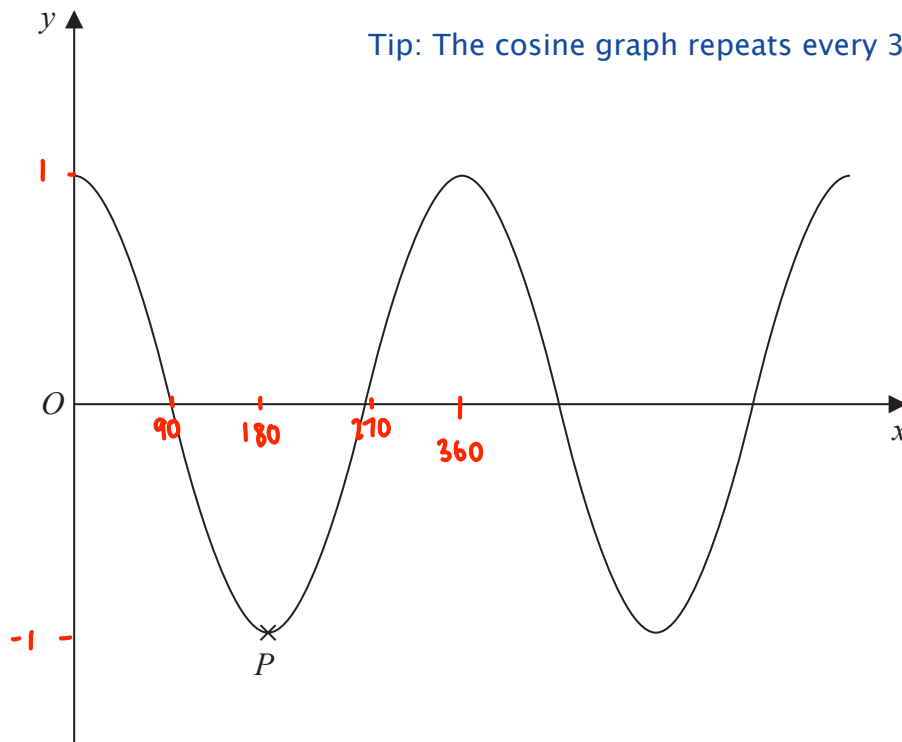
$$\frac{6}{110} + \frac{42}{110} = \frac{48}{110}$$

$$1 - \frac{48}{110} = \frac{62}{110}$$

$$\frac{62}{110}$$

(Total for Question 20 is 3 marks)

21



The diagram shows a sketch of part of the curve with equation $y = \cos x^\circ$
 P is a minimum point on the curve.

Write down the coordinates of P .

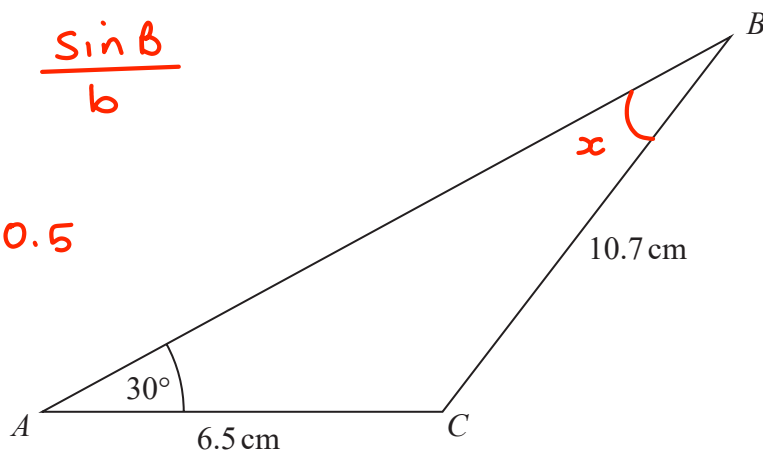
(180 , -1)

(Total for Question 21 is 2 marks)

22 Here is a triangle ABC .

$$\frac{\sin A}{a} = \frac{\sin B}{b}$$

$$\sin(30) = 0.5$$



Work out the value of $\sin ABC$

Give your answer in the form $\frac{m}{n}$ where m and n are integers.

$$\frac{\sin x}{6.5} = \frac{\sin(30)}{10.7}$$

$$\frac{\sin x}{6.5} = \frac{0.5}{10.7}$$

$$\times 6.5$$

$$\times 6.5$$

$$\sin x = \frac{3.25}{10.7} = \frac{325}{1070}$$

$$\times 100$$

$$6.5 \times 0.5 = 3.25$$

$$\frac{325}{1070}$$

(Total for Question 22 is 4 marks)

Tip: Geometric means you multiply by the same number each time

23 Here are the first five terms of a geometric sequence.

$$\sqrt{5} \quad 10 \quad 20\sqrt{5} \quad 200 \quad 400\sqrt{5}$$

(a) Work out the next term of the sequence.

$$\begin{array}{c} \curvearrowright \\ \times 2\sqrt{5} \end{array}$$

$$400\sqrt{5} \times 2\sqrt{5} = 800(5)$$

$$4000$$

(2)

The 4th term of a different geometric sequence is $\frac{5\sqrt{2}}{4}$

The 6th term of this sequence is $\frac{5\sqrt{2}}{8}$

Given that the terms of this sequence are all positive,

(b) work out the first term of this sequence.
You must show all your working.

2nd term

$$\frac{5\sqrt{2}}{2}$$

$$\leftarrow \times 2$$

4th term

$$\frac{5\sqrt{2}}{4}$$

$$\leftarrow \times 2$$

6th term

$$\frac{5\sqrt{2}}{8}$$

2nd term \rightarrow 1st term \times by $\sqrt{2}$

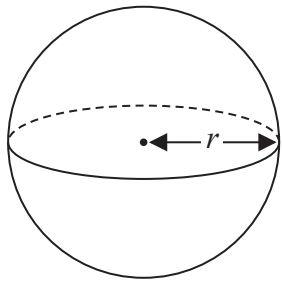
$$\frac{5\sqrt{2}}{2} \times \frac{\sqrt{2}}{1} = \frac{5(2)}{2} = \frac{10}{2} = 5$$

$$5$$

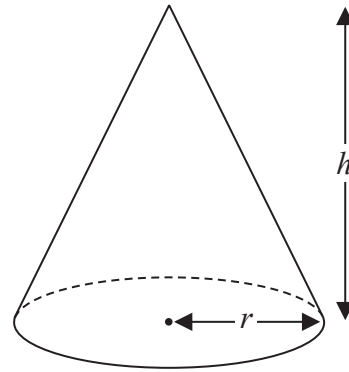
(3)

(Total for Question 23 is 5 marks)

24 Here is a solid sphere and a solid cone.



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



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

All measurements are in cm.

The volume of the sphere is equal to the volume of the cone.

(a) Find $r:h$

Give your answer in its simplest form.

$$\begin{array}{l} \frac{4}{3} \pi r^3 = \frac{1}{3} \pi r^2 h \\ \times 3 \quad \times 3 \\ 4\pi r^3 = \pi r^2 h \\ \div r^2 \quad \div r^2 \\ 4r = h \end{array}$$

$$r : h$$

$$1 : 4$$

$$\frac{1 : 4}{(2)}$$

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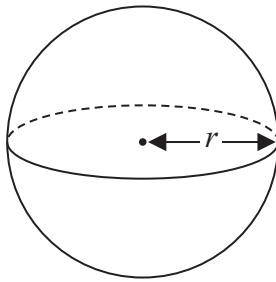
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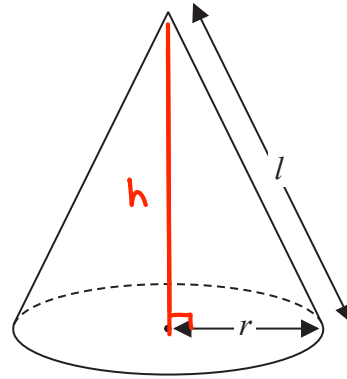
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Here is a different solid sphere and a different solid cone.



Surface area of sphere = $4\pi r^2$



Curved area of cone = $\pi r l$

All measurements are in cm.

The surface area of the sphere is equal to the **total** surface area of the cone.

(b) Find $r:h$

Give your answer in the form $1:\sqrt{n}$ where n is an integer.

$$4\pi r^2 = \pi r l + \pi r^2$$

$$4\pi r^2 = \pi r (\sqrt{h^2 + r^2}) + \pi r^2$$

$$- \pi r^2 \qquad - \pi r^2$$

$$3\pi r^2 = \pi r (\sqrt{h^2 + r^2})$$

$$\div \pi r \qquad \div \pi r$$

$$3r = \sqrt{h^2 + r^2}$$

$$r^2 = h^2 + r^2$$

$$- r^2 \qquad - r^2$$

$$8r^2 = h^2$$

$$\sqrt{\quad} \qquad \sqrt{\quad}$$

$$\sqrt{8} r = h$$

$$r : h$$

$$1 : \sqrt{8}$$

$$1 : \sqrt{8}$$

(4)

(Total for Question 24 is 6 marks)

TOTAL FOR PAPER IS 80 MARKS