



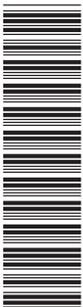
Oxford Cambridge and RSA

H

GCSE (9–1) Mathematics
J560/06 Paper 6 (Higher Tier)
 Sample Question Paper

Date – Morning/Afternoon

Time allowed: 1 hour 30 minutes



You may use:

- A scientific or graphical calculator
- Geometrical instruments
- Tracing paper

Model Solutions



First name										
Last name										
Centre number						Candidate number				

INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Read each question carefully before you start to write your answer.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION

- The total mark for this paper is **100**.
- The marks for each question are shown in brackets [].
- Use the π button on your calculator or take π to be 3.142 unless the question says otherwise.
- This document consists of **20** pages.

Answer **all** the questions

- 1 180 g of copper is mixed with 105 g of zinc to make an alloy.

The density of copper is 9 g/cm^3 .

The density of zinc is 7 g/cm^3 .

- (a) Work out the volume of copper used in the alloy.

$$\text{Density} = \frac{\text{mass}}{\text{volume}} \quad \text{volume} = \frac{\text{Mass}}{\text{Density}}$$

$$\frac{180}{9} = \underline{\underline{20 \text{ cm}^3}}$$

(a)20..... cm^3 [2]

- (b) What is the density of the alloy?

$$\text{Volume of zinc} \rightarrow \frac{105}{7} = 15 \text{ cm}^3$$

$$\text{Total density} \rightarrow \frac{180+105}{20+15} = \frac{285}{35} = \underline{\underline{\frac{15}{7} \text{ g/cm}^3}}$$

(b)15/7..... g/cm^3 [4]

2 (a) (i) Solve.

$$5x + 1 > x + 13$$

$$5x + 1 > x + 13$$

$$4x > 12$$

$$\underline{\underline{x > 3}}$$

(a)(i) $x > 3$ [3]

(ii) Write down the largest integer that satisfies $5x - 1 < 10$.

$$5x - 1 < 10$$

$$5x < 11$$

$$x < \frac{11}{5}$$

(ii) $x < \frac{11}{5}$ [1]

(b) Solve.

$$3x^2 = 75$$

$$3x^2 = 75$$

$$x^2 = 25$$

$$x = \sqrt{25} = \underline{\underline{\pm 5}}$$

(b) $x = \underline{\pm 5}$ [2]

(c) Solve.

$$4x + 3y = 5$$

$$2x + 3y = 1$$

$$\begin{array}{r} 4x + 3y = 5 \\ - 2x + 3y = 1 \\ \hline 2x = 4 \\ \underline{\underline{x = 2}} \end{array}$$

$$\begin{array}{r} 2x + 3y = 1 \\ 2(2) + 3y = 1 \\ 4 + 3y = 1 \\ 3y = -3 \\ \underline{\underline{y = -1}} \end{array}$$

(c) $x = \underline{2}$

$y = \underline{-1}$

[3]

- 3 (a) This expression can be used to generate a sequence of numbers.

$$n^2 - n + 11$$

- (i) Work out the first three terms of this sequence.

$$(1)^2 - (1) + 11 \rightarrow 1 - 1 + 11 = \underline{\underline{11}}$$

$$(2)^2 - (2) + 11 \rightarrow 4 - 2 + 11 = \underline{\underline{13}}$$

$$(3)^2 - (3) + 11 \rightarrow 9 - 3 + 11 = \underline{\underline{17}} \quad \text{(a)(i) } \dots 11 \dots, \dots 13 \dots, \dots 17 \dots \quad [2]$$

- (ii) Show that this expression does not only generate prime numbers.

$$\dots (11)^2 - (11) + 11 = \underline{\underline{121}} \dots \text{ which is not a prime number} \dots$$

..... [2]

- (b) Marta says

odd square numbers have exactly three factors.

Give one example where this is correct and another where this is not correct. In each case, write down the number and its factors.

Correct ... $9 \rightarrow 1, 3, 9$

Not correct ... $1 \rightarrow 1$

[2]

(c) Here are some properties of a number.

- It is a common factor of 288 and 360.
- It is a common multiple of 4 and 6.
- It is larger than 25.

Find the **two** possible numbers with these properties.

$$288 = \cancel{1}, \cancel{2}, \cancel{3}, \cancel{4}, \cancel{6}, \cancel{8}, \cancel{9}, \cancel{12}, \cancel{16}, \cancel{18}, \cancel{24}, \cancel{36}, \underline{36}, \cancel{48}, \underline{72}, \cancel{96}, \cancel{144}, \cancel{288}$$

$$360 = \cancel{1}, \cancel{2}, \cancel{3}, \cancel{4}, \cancel{5}, \cancel{6}, \cancel{8}, \cancel{9}, \cancel{10}, \cancel{12}, \cancel{15}, \cancel{18}, \cancel{20}, \cancel{24}, \cancel{30}, \underline{36}, \cancel{40}, \cancel{45}, \cancel{60}, \underline{72}, \cancel{90}, \cancel{120}, \cancel{180}, \cancel{360}$$

Cross out numbers that are not multiples of 4 or 6.

Cross out numbers under 25.

Cross out numbers that are not common factors of both 288 and 360.

36 and 72

(c) 36 and 72 [4]

4 Here are the interest rates for two accounts.

Account A
Interest: 3% per year compound interest.
No withdrawals until the end of three years.

Account B
Interest: 4% for the first year, 3% for the second year and 2% for the third year.
Withdrawals allowed at any time.

Derrick has £10 000 he wants to invest.

- (a) Calculate which account would give him most money if he invests his money for 3 years. Give the difference in the interest to the nearest penny.

$$\underline{A} \rightarrow \pounds 10,000 \times (1.03)^3 = \underline{\underline{\pounds 10,927.27}}$$

$$\underline{B} \rightarrow \pounds 10,000 \times 1.02 \times 1.03 \times 1.04 = \underline{\underline{\pounds 10,926.24}}$$

$$\begin{aligned} \pounds 10927.27 - \pounds 10926.24 &= \underline{\underline{\pounds 1.03}} \\ &= \underline{\underline{103 \text{ p}}} \end{aligned}$$

(a) Account A by 103 p [5]

- (b) Explain why he might **not** want to use Account A.

..... Because he won't be able to withdraw money in the 3 years. [1]

- 5 Lei is in a class of 28 students, 3 of whom are left-handed.
There are 1250 students in the school.

(a) Use this information to estimate how many students in the school are left-handed.

$$\frac{3}{28} \times 1250 = 133.9285714$$

$$= \underline{\underline{134 \text{ students}}}$$

(a) 134 [3]

(b) Is your solution to (a) likely to be an overestimate or an underestimate?
Explain your reasoning.

Overestimate as I rounded up

..... [1]

(c) Vid is at a different school.
He is in a class of 26 students, 6 of whom are left-handed.

Vid says to Lei

In our two classes there are 54 students, 9 of whom are left-handed.
We can use this bigger sample to improve the estimate for your school.

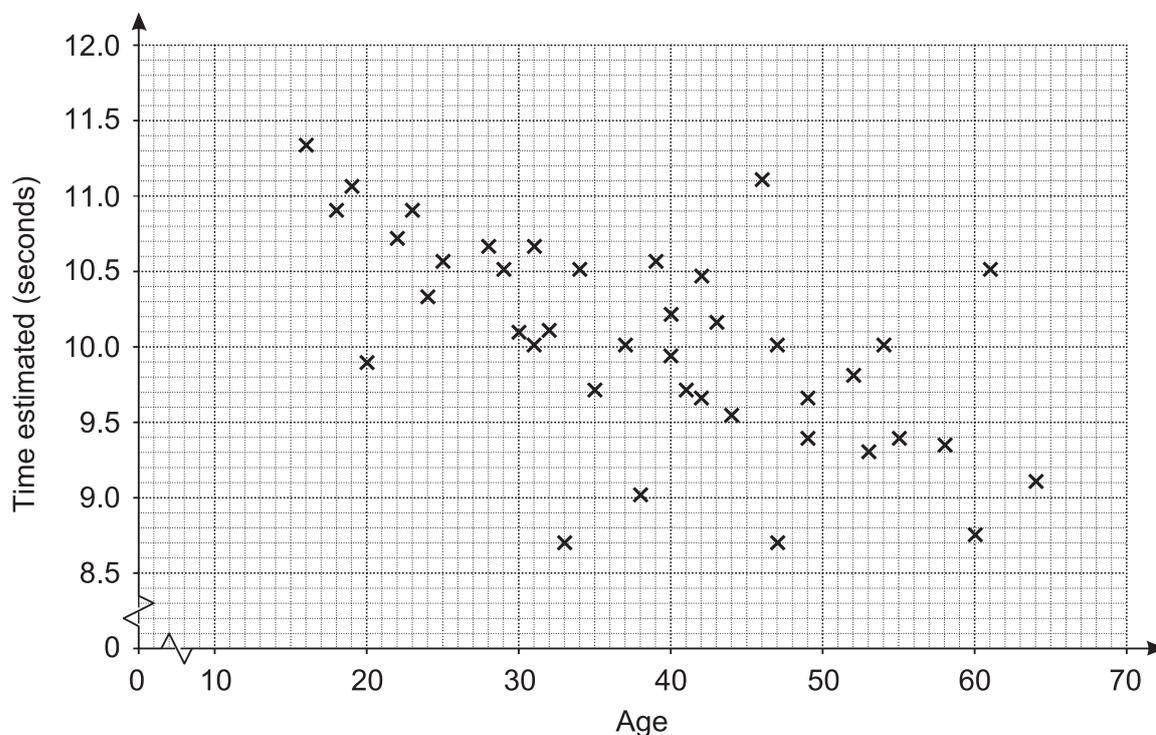
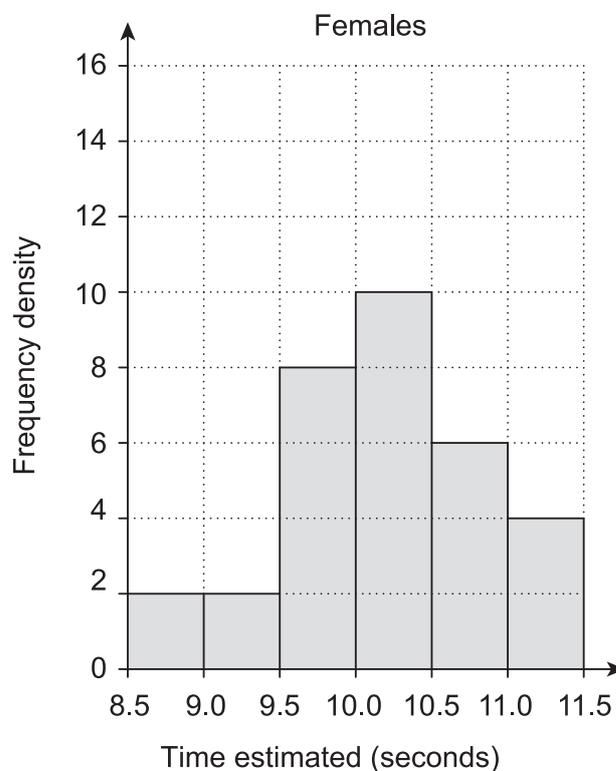
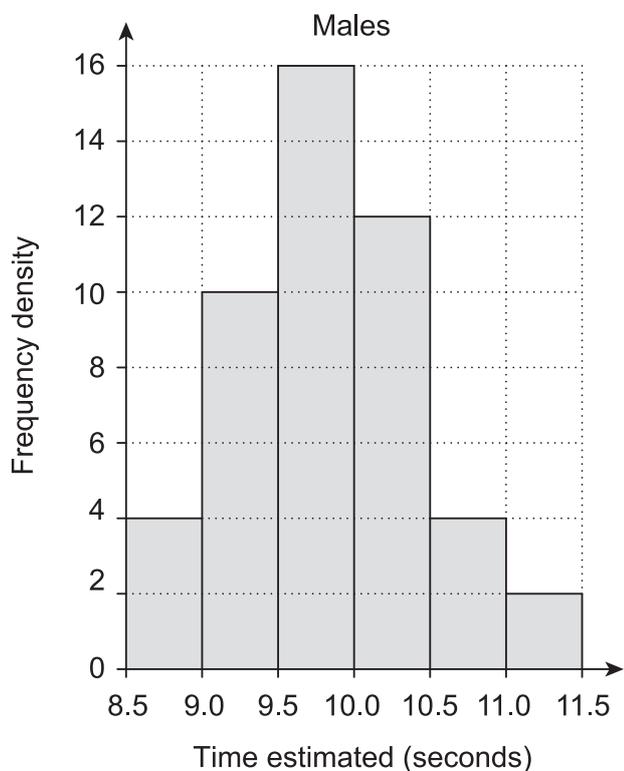
What assumption has Vid made?
Explain whether you think that his argument is correct.

He has assumed that the population of the two schools have
approximately the same proportion of left-handers.

..... [2]

- 6 John wants to investigate whether men in the UK are better at estimating a time interval of 10 seconds than women in the UK. He decides to sample the population by asking his work colleagues to take the test.

The diagrams below summarise John's results.



(a) What information from the diagrams can be used to support each of these statements?

(i) The older John's colleagues are, the lower their estimate is.

Scatter graphs show negative correlation.

[1]

(ii) Males in the sample tend to underestimate the interval and females in the sample tend to overestimate the interval.

[Using diagrams 1 and 2] 15/24 males have less than 10, so

more than half under-estimate. 10/16 females have more than 10 so more than half over-estimate. [2]

(b) Comment on whether any conclusions can be drawn for the UK population from the results of this sample.

No, its a very small sample, so it doesnt represent the population very well. [2]

7 Without using a calculator, show clearly that $64^{\frac{2}{3}}$ is equal to 16. [2]

$$(64^{1/3})^2 \rightarrow (\sqrt[3]{64})^2 \rightarrow (4)^2 = \underline{\underline{16}}$$

- 8 (a) Prove that the sum of four consecutive whole numbers is always even. [3]

$$\begin{aligned} n, n+1, n+2, n+3 \\ n+n+1+n+2+n+3 &= 4n+6 \\ &= 2(2n+3) \rightarrow \text{anything which is a multiple of 2} \\ &\text{is even.} \end{aligned}$$

- (b) Give an example to show that the sum of four consecutive integers is **not** always divisible by 4.

$$\begin{aligned} 1+2+3+4 &= 10 \\ 10 &\text{ is not a multiple of 4.} \end{aligned}$$

..... [2]

9 Alexander, Reiner and Wim each watch a different film.

- Alexander's film is thirty minutes longer than Wim's film.
- Reiner's film is twice as long as Wim's film.
- Altogether the films last 390 minutes.

How long is each of their films?

$$A = W + 30$$

$$R = 2W$$

$$A + R + W = 390$$

$$(W + 30) + (2W) + W = 390$$

$$4W + 30 = 390$$

$$4W = 360$$

$$\underline{\underline{W = 90}}$$

$$R = 2W$$

$$\underline{\underline{= 180}}$$

$$A = W + 30$$

$$\underline{\underline{= 120}}$$

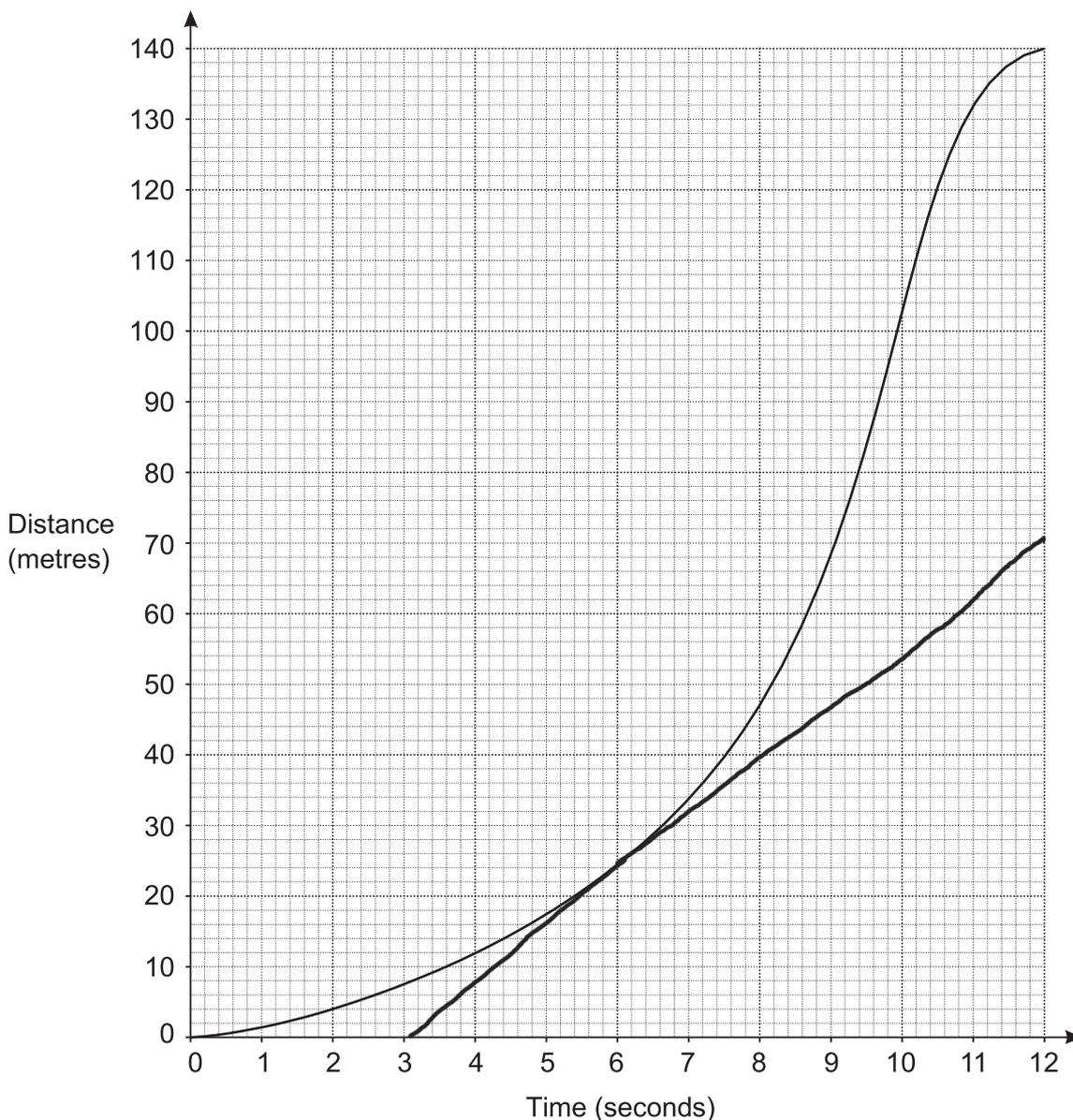
Alexander's film 120 minutes

Reiner's film 180 minutes

Wim's film 90 minutes

[4]

10 The graph shows the distance travelled by an animal over 12 seconds.



(a) Work out the average speed between 2 and 8 seconds.

Work out gradient

At 2 seconds (2, 4) and at 8 seconds (8, 47)

$$\frac{y_2 - y_1}{x_2 - x_1} \rightarrow \frac{47 - 4}{8 - 2} = \frac{43}{6} = \underline{\underline{7.2 \text{ m/s}}}$$

(a) 7.2... m/s [2]

(b) Estimate the speed of the animal at 6 seconds.

Draw tangent at time = 6 seconds and work out gradient

(3, 0) (12, 70)

$$\frac{70 - 0}{12 - 3} = \frac{70}{9} = \underline{\underline{7.7}}$$

(b) 7.7..... m/s [4]

(c) Nuri says

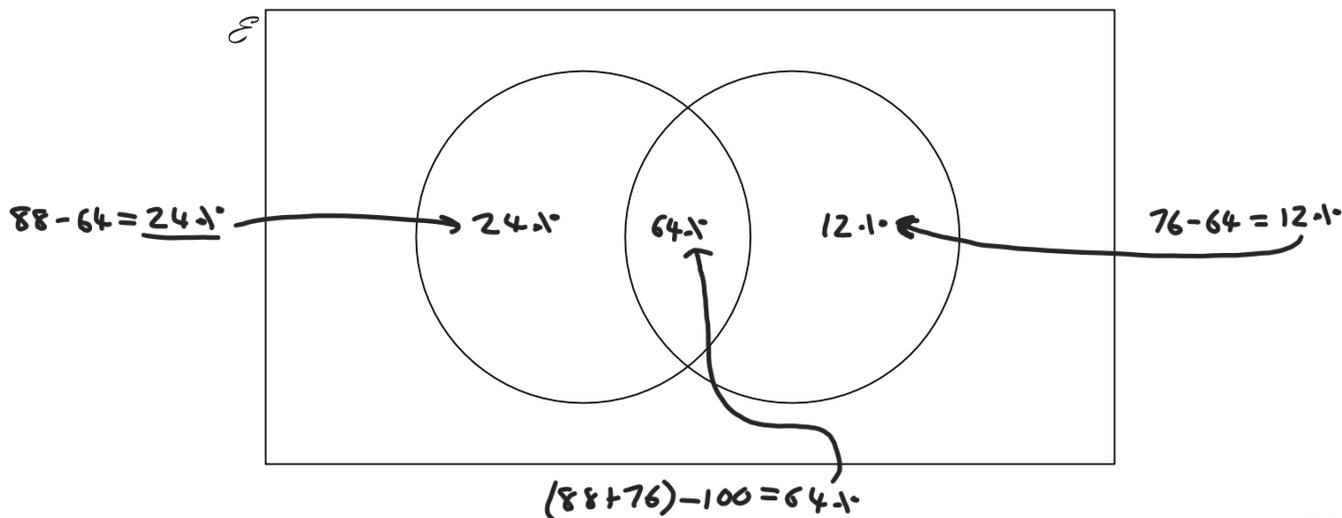
I think this animal must be able to move at over 20 m/s!

Do you agree with Nuri?
Explain your decision.

Yes, because the gradient of curve between 8s and 11s is significantly deeper. Speed = gradient of the curve. [2]

11 A skills test has two sections, literacy (L) and numeracy (N).
One day everyone who took the skills test passed at least one section.
88% passed the literacy section and 76% passed the numeracy section.

(a) Represent this information on a Venn diagram.
Show clearly the **percentage** in each section of the diagram.



[3]

(b) One person is chosen at random from all the people who took the skills test that day.

What is the probability that this person

(i) passed the numeracy section, given that they passed the literacy section,

$$\frac{64}{24+64} = \frac{8}{11}$$

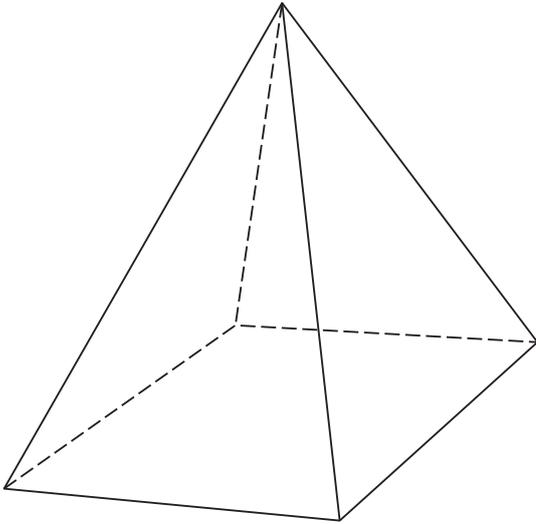
(b)(i) $\frac{8}{11}$ [2]

(ii) passed the literacy section, given that they passed only one section?

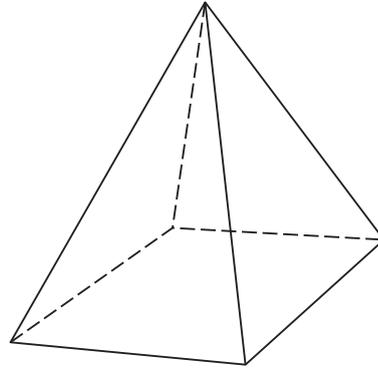
$$\frac{24}{24+12} = \frac{2}{3}$$

(ii) $\frac{2}{3}$ [2]

- 12 Two similar pyramids A and B have surface areas 180 cm^2 and 80 cm^2 respectively.



Pyramid A



Pyramid B

The volume of pyramid A is 810 cm^3 .

Show that the volume of pyramid B is 240 cm^3 .

[5]

$$\frac{A^2}{B^2} = \frac{180}{80}$$

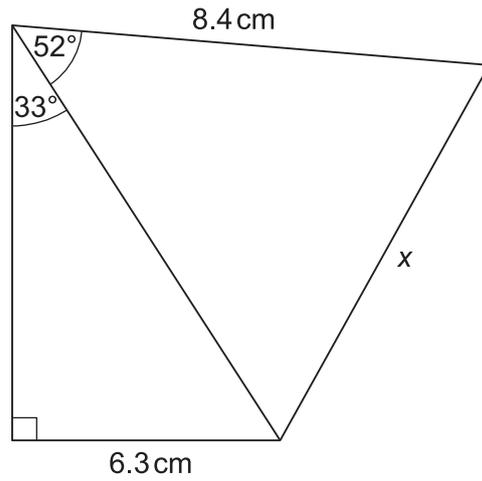
$$\frac{A}{B} = \frac{6\sqrt{5}}{4\sqrt{5}} = \frac{3}{2}$$

$$\frac{A^3}{B^3} = \frac{27}{8} \rightarrow \frac{27}{8} = \frac{810}{V}$$

$$\frac{27}{8}V = 810$$

$$V = 810 \div \frac{27}{8} \\ = \underline{\underline{240 \text{ cm}^3}}$$

13 Calculate x.



Not to scale



$$\sin 33 = \frac{6.3}{h} \rightarrow \frac{6.3}{\sin 33} = h = \underline{11.6 \text{ cm}}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$x^2 = 8.4^2 + 11.6^2 - 2 \times 8.4 \times 11.6 \times \cos 52$$

$$x^2 = 95.1$$

$$x = \underline{\underline{9.2 \text{ cm}}}$$

..... 9.2 cm [5]

14 A straight line goes through the points (p, q) and (r, s) , where

- $p + 2 = r$
- $q + 4 = s$.

Find the gradient of the line.

$$\frac{y_2 - y_1}{x_2 - x_1} \rightarrow \frac{s - q}{r - p} \rightarrow \frac{q + 4 - q}{p + 2 - p} = \frac{4}{2} = \underline{\underline{2}}$$

..... 2 [3]

- 15 A unit fraction has a numerator equal to 1, for example $\frac{1}{3}$, $\frac{1}{7}$ and $\frac{1}{25}$.

Unit fractions can be written as the sum of two different unit fractions, for example

$$\frac{1}{2} = \frac{1}{3} + \frac{1}{6}$$

Write each of the following unit fractions as the sum of two **different** unit fractions.

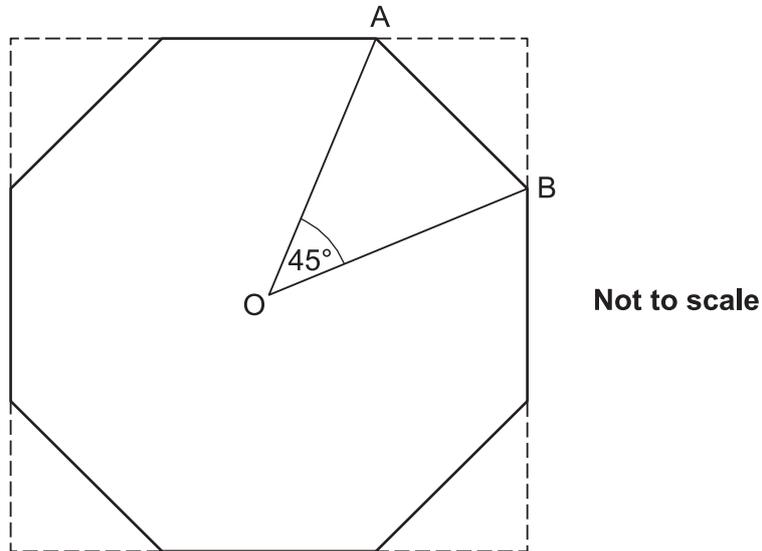
$$\frac{1}{4} = \frac{1}{\boxed{6}} + \frac{1}{\boxed{12}}$$

$$\frac{1}{5} = \frac{1}{\boxed{6}} + \frac{1}{\boxed{30}}$$

$$\frac{1}{6} = \frac{1}{\boxed{9}} + \frac{1}{\boxed{18}}$$

[3]

- 16 Simon cuts the corners off a square piece of card to leave the regular octagon shown below.
 O is the centre of the octagon.
 A and B are vertices of the octagon.
 $OA = OB = 5 \text{ cm}$.
 Angle $AOB = 45^\circ$.



- (a) (i) Work out the area of the octagon.

Triangle $\rightarrow \frac{1}{2} ab \sin C$

$$\frac{1}{2} \times 5 \times 5 \times \sin 45 = \frac{25\sqrt{2}}{4}$$

$$\begin{aligned} 8 \text{ triangles in octagon} &\rightarrow 8 \times \frac{25\sqrt{2}}{4} \\ &= 50\sqrt{2} \\ &= \underline{\underline{70.7 \text{ cm}^2}} \end{aligned}$$

(a)(i) 70.7 cm^2 [3]

(ii) Work out the area of the original square piece of card.

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$AB^2 = 5^2 + 5^2 - 2 \times 5 \times 5 \times \cos 45$$

$$= \underline{50 - 25\sqrt{2}}$$

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

$$a^2 + b^2 = AB^2 = 50 - 25\sqrt{2}$$

$$a = b$$

$$2a^2 = 50 - 25\sqrt{2}$$

$$a^2 = \frac{50 - 25\sqrt{2}}{2}$$

$$a = 2.71$$

$$\underline{\text{Area of triangle}} = \frac{1}{2}bh$$

$$\frac{1}{2} \times 2.71 \times 2.71$$

$$= 3.67205$$

$$\underline{\text{Octagon} + 4 \text{ triangles}} \rightarrow 70.7 + 4 \times 3.67205$$

$$= \underline{\underline{85.4 \text{ cm}^2}}$$

(ii) 85.4 cm² [5]

(b) Simon now makes a table top using the card as a model.

The sides of the table top are 8 times as long as the sides of the card model.

Find the ratio of the **area** of Simon's table top to the **area** of the card model.

$$\begin{array}{c} \text{square} \\ \text{it} \end{array} \left\{ \begin{array}{l} 1:8 \\ 1:64 \end{array} \right. \begin{array}{c} \text{square it} \\ \end{array}$$

(b) 1 : 64 [2]

17 $y = 6x^4 + 7x^2$ and $x = \sqrt{w+1}$.

Find the value of w when $y = 10$.

Show your working.

$$x = \sqrt{w+1}$$

$$x^2 = w+1$$

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

$$10 = 6(w+1)^2 + 7(w+1)$$

$$10 = 6(w^2 + 2w + 1) + 7w + 7$$

$$10 = 6w^2 + 12w + 6 + 7w + 7$$

$$0 = 6w^2 + 12w + 3$$

$$w = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-12 \pm \sqrt{12^2 - 4 \times 6 \times 3}}{2 \times 6}$$

$$= -1/6 \text{ and } -3$$

$w = -1/6$ only because $\rightarrow \sqrt{w+1}$ If $w = -3$, $w+1$ is negative and you cannot square root a negative number.

$w = \dots\dots\dots$ [6]

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