



GCSE MATHEMATICS

S21-C300

Non-Calculator Assessment Resource J

Higher Tier

Formula list

Area and volume formulae

Where r is the radius of the sphere or cone, l is the slant height of a cone and h is the perpendicular height of a cone:

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

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

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

Kinematics formulae

Where a is constant acceleration, u is initial velocity, v is final velocity, s is displacement from the position when $t = 0$ and t is time taken:

$$v = u + at$$

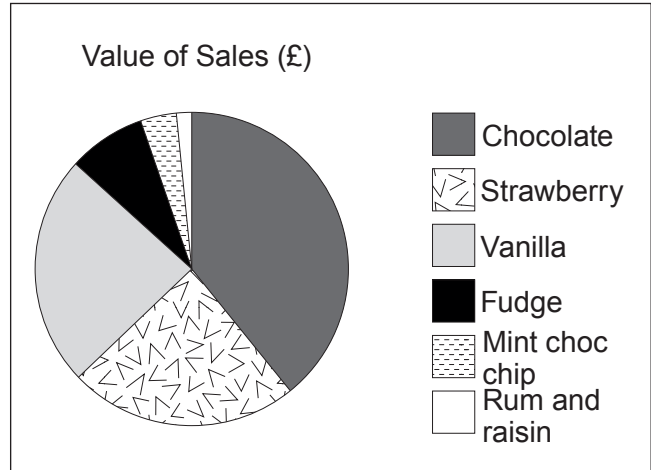
$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

1. Cherie is in charge of marketing for a tourist attraction.

(a) One weekend, she collects some data about the value of ice cream sales from the café. She records her data in a table and uses it to draw a pie chart.

Ice cream flavour	Value of sales (£)
Chocolate	500
Strawberry	300
Coffee	0
Vanilla	300
Fudge	100
Green tea	0
Mint choc chip	50
Rum and raisin	20



State one criticism of the use of a pie chart to display her data.

[1]

You can not see the actual values of her data

(b) Cherie also records the number of visitors to the tourist attraction each season for 4 years. Her results are shown in the table.

	Season	Winter	Spring	Summer	Autumn
Visitors (thousands)	2015	9	14	19	13
	2016	9	13 ↓	17 ↓	12 ↓
	2017	6 ↓	11 ↓	14 ↓	9 ↓
	2018	4 ↓	8 ↓	15 ↓	10 ↑

Comment on the trend in the **annual** number of visitors shown by the data in the table.

[1]

Over the years the annual number of visitors has decreased as shown by the data in the table.

2. Huw is paid a weekly wage.

Every week he:

- saves $\frac{1}{5}$ of his wage,
- spends 70% of the money **he has left** on his living expenses (70% of his $\frac{4}{5}$ remaining)
- spends all that remains on his social life.
30% of $\frac{4}{5}$.

(a) One week, Huw saves £40.

How much does Huw spend on his social life?

[3]

$$\frac{1}{5} = £40, \quad \text{Total wage} = £40 \times 5 = £200.$$

$$\frac{4}{5} = £160$$

$$10\% \text{ of his remaining } \frac{4}{5} \text{ of wage} = £16$$

$$30\% = 16 \times 3 = 48$$

\therefore he spent £48 on his social life.

(b) What percentage of his weekly wage does Huw spend on his social life?

[2]

$$\frac{48}{200} \times 100 = 24\%$$

\therefore 24% of his wage is spent on his social life.

3.

$$\mathbf{p} = \begin{pmatrix} 4 \\ 2 \end{pmatrix} \text{ and } \mathbf{q} = \begin{pmatrix} -3 \\ 2 \end{pmatrix}$$

Work out the column vector $\frac{1}{2}\mathbf{p} - \mathbf{q}$.

[2]

$$\frac{1}{2}\mathbf{p} - \mathbf{q} = \frac{1}{2} \begin{pmatrix} 4 \\ 2 \end{pmatrix} - \begin{pmatrix} -3 \\ 2 \end{pmatrix} = \begin{pmatrix} 2 \\ 1 \end{pmatrix} - \begin{pmatrix} -3 \\ 2 \end{pmatrix} = \begin{pmatrix} 5 \\ -1 \end{pmatrix}$$

$$\frac{1}{2}\mathbf{p} - \mathbf{q} = \begin{pmatrix} 5 \\ -1 \end{pmatrix}$$

4. Jon bought a car.
The price of Jon's car had been reduced by 20%.
Jon paid £7680 for his car.

What was the price of the car before the reduction?

[3]

80% of original value is £7680.

$$\frac{7680}{\text{total price}} \times 100 = 80$$

total price

$$\frac{7680}{\text{total}} = 0.8 \rightarrow \text{total} = \frac{7680}{0.8} = \frac{76800}{8}$$

$$8 \sqrt{\begin{array}{r} 09600 \\ 76800 \end{array}}$$

$$8 \times 9 = 72$$

$$8 \times 6 = 48$$

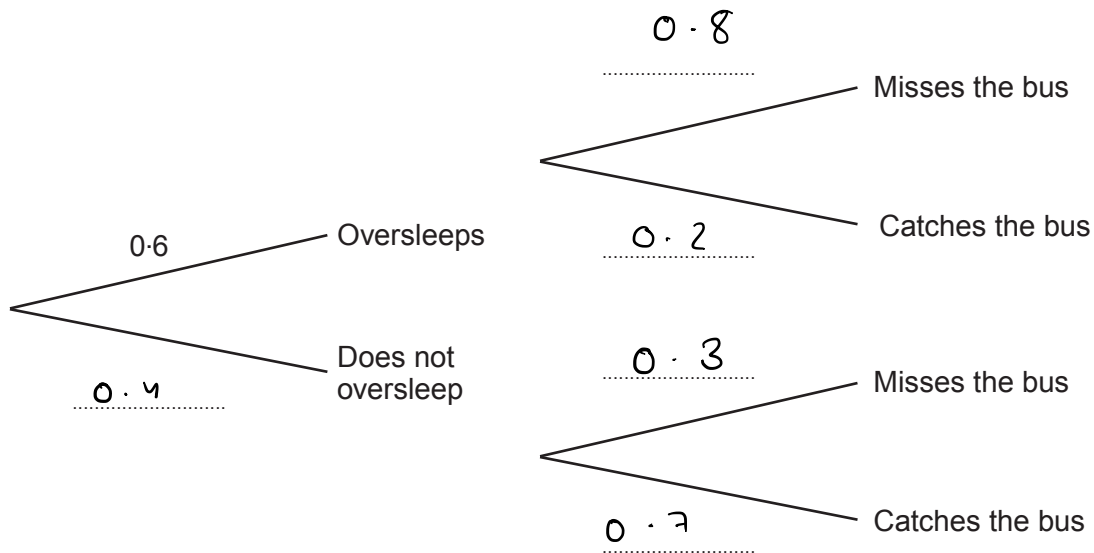
\therefore original price was £9600

5. Sam needs to catch the 8 a.m. bus to get to work on time.
The probability that Sam oversleeps is 0.6.

When Sam oversleeps, the probability that he misses the bus is 0.8.
When Sam does not oversleep, the probability that he misses the bus is 0.3.

- (a) Complete the following tree diagram to show this information.

[2]



- (b) Calculate the probability that Sam oversleeps and misses the bus.

[2]

$$0.6 \times 0.8 = 0.48$$

- (c) Calculate the probability that Sam catches the bus.
You must show all your working.

[3]

$$\begin{aligned} & (0.6 \times 0.2) + (0.4 \times 0.7) \\ & = 0.12 + 0.28 \\ & = 0.40 \end{aligned}$$

6. (a) Find the value of $(3 \times 10^{17}) \times (8 \times 10^9)$.
Give your answer in standard form.

[2]

$$3 \times 8 = 24.$$

$$\begin{aligned} \therefore (3 \times 10^{17}) \times (8 \times 10^9) &= 24 \times 10^{17+9} = 24 \times 10^{26} \\ &= 2.4 \times 10^{27} \end{aligned}$$

- (b) In a particular country for one year:

- the total energy consumption was 5.4×10^{11} kilowatt hours,
- the average energy consumption per person was 6000 kilowatt hours.

Work out the population of the country.
Give your answer in standard form.

[3]

$$TE = 5.4 \times 10^{11}$$

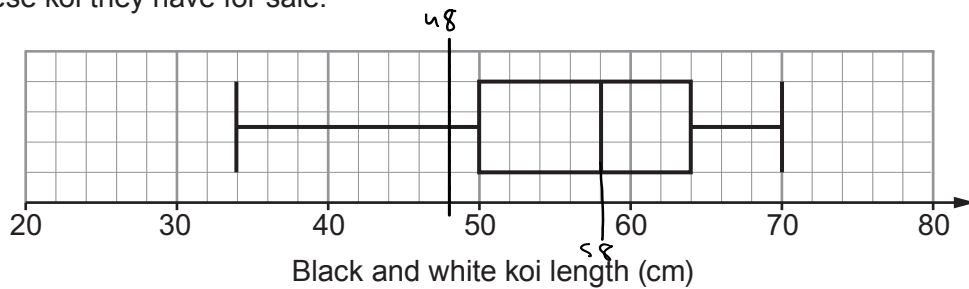
$$1 \text{ Person} = 6 \times 10^3$$

$$\frac{5.4 \times 10^{11}}{6 \times 10^3} = \frac{5.4}{6} \times 10^8 = \frac{54}{60} \times 10^8$$

$$\begin{aligned} &= \frac{27}{30} \times 10^8 = \frac{9}{10} \times 10^8 \\ &= 9 \times 10^7 \end{aligned}$$

7. A garden centre sells fish.

This box plot summarises data about the length, in cm, of a sample of 50 black and white Japanese koi they have for sale.



(a) What is the length of the longest black and white koi? [1]

70 cm

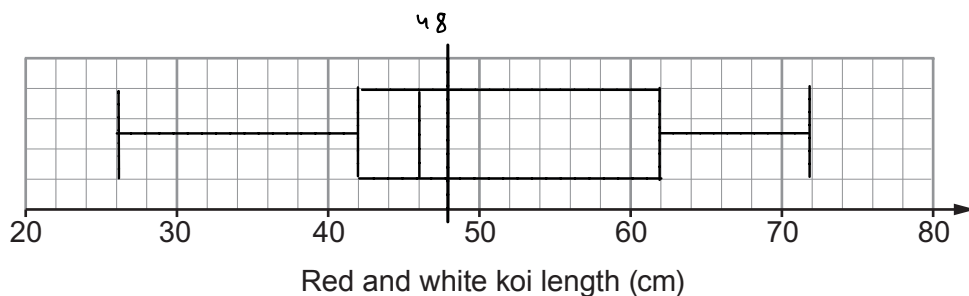
(b) What is the median length of the black and white koi? [1]

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(c) The garden centre also sells red and white Japanese koi. The table shows information about the length, in cm, of a sample of 50 of the red and white koi they have for sale.

Minimum	Maximum	Lower Quartile	Median	Interquartile range
26	72	42	46	20

Draw a box plot to represent this data on the grid below. [3]



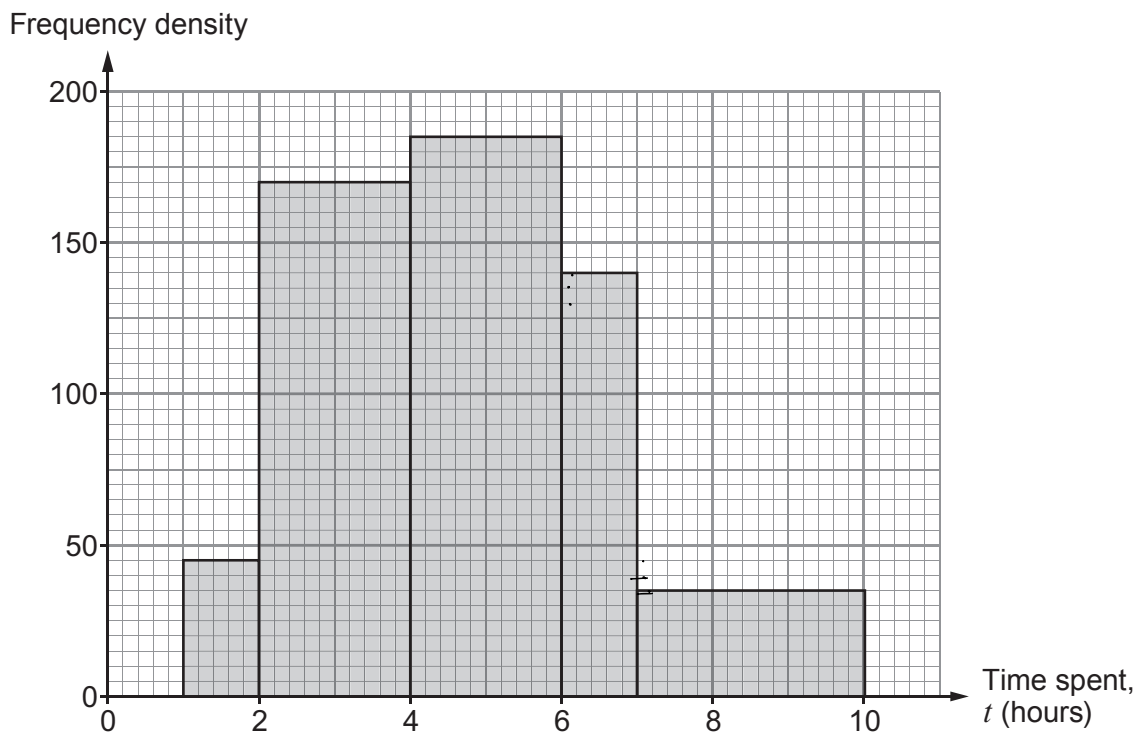
(d) The garden centre calls its koi 'mature' if they are more than 48 cm in length. Which of the two samples of fish contains more 'mature' koi?

Black and white Red and white

Explain how you decide. [1]

As the 48 is below the median, there is a larger spread of fish above 48 cm

8. The histogram summarises the time spent by 1000 visitors at a flower show.



Calculate the percentage of visitors who spent 6 or more hours at the flower show. [3]

$$\text{frequency density} = \frac{\text{frequency}}{\text{class width}}$$

$$6 - 7 \text{ hours, } CW = 1$$

$$\therefore f = 140 \times 1 = 140$$

$$7 - 10 \text{ hours, } CW = 3$$

$$\therefore f = 35 \times 3 = 105$$

$$\frac{140 + 105}{1000} \times 100 = \frac{245}{1000} \times 100 = 24.5\%$$

9.

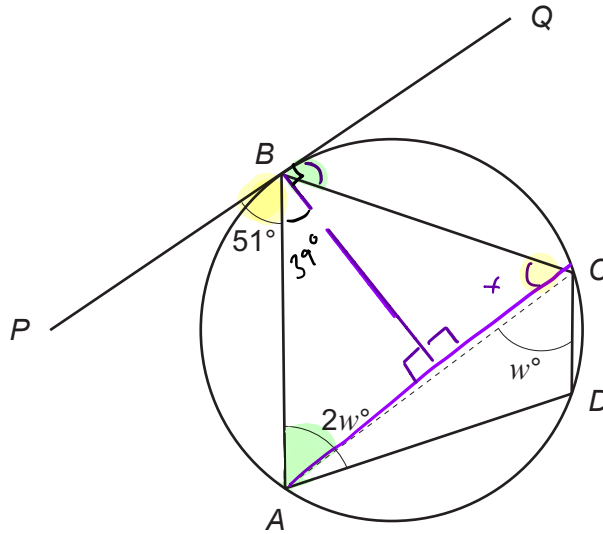


Diagram not drawn to scale

A, B, C and D are points on a circle.
The line PQ is a tangent to the circle at B .

$\hat{PBA} = 51^\circ$, $\hat{ACD} = w^\circ$ and $\hat{BAD} = 2w^\circ$.

Find the value of w .
You must show all your working.

[3]

$$2w + w + x = 180$$

$$3w + x = 180$$

$$x = 51^\circ$$

$$\therefore 3w + 51 = 180$$

$$3w = 129$$

$$w = 43^\circ$$

$$w = 43^\circ$$

10.

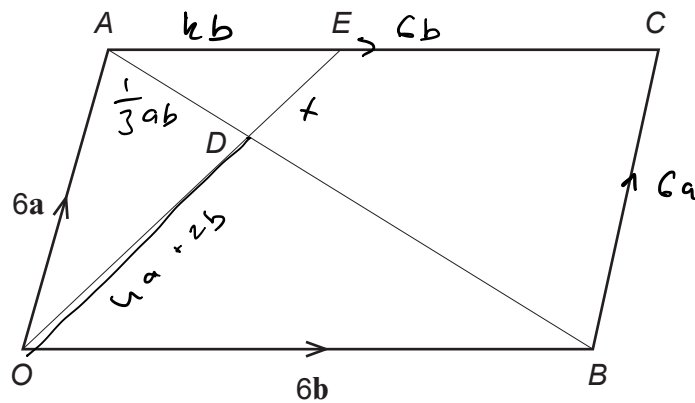


Diagram not drawn to scale

The diagram shows a parallelogram, $OACB$, and the vectors \mathbf{OA} and \mathbf{OB} . E lies on AC .

D is the point of intersection of OE and AB so that $\mathbf{AD} = \frac{1}{3}\mathbf{AB}$.

(a) Complete this proof to show that $\mathbf{OE} = 6\mathbf{a} + 3\mathbf{b}$.

[4]

Proof:

$$\mathbf{OE} = \mathbf{OA} + \mathbf{AE} = 6\mathbf{a} + k\mathbf{b} \text{ for some positive scalar } k$$

$$\mathbf{OE} = n\mathbf{OD}, \text{ for some positive scalar } n$$

$$\mathbf{OD} = 6\mathbf{a} + \frac{1}{3}\mathbf{AB}$$

$$\mathbf{AB} = -6\mathbf{a} + 6\mathbf{b}$$

$$\mathbf{OD} = 6\mathbf{a} + \frac{1}{3}(-6\mathbf{a} + 6\mathbf{b})$$

$$= 6\mathbf{a} + (-2\mathbf{a} + 2\mathbf{b})$$

$$= 4\mathbf{a} + 2\mathbf{b}$$

$$6\mathbf{a} + k\mathbf{b} = n(4\mathbf{a} + 2\mathbf{b})$$

$$6\mathbf{a} = n(4\mathbf{a})$$

$$\frac{6\mathbf{a}}{4\mathbf{a}} = \frac{3}{2} = n$$

$$\therefore \mathbf{OE} = \frac{3}{2}(4\mathbf{a} + 2\mathbf{b})$$

$$= 6\mathbf{a} + 3\mathbf{b}$$

(b) What does the proof in part (a) also tell you about the point E ?

[1]

It is the midpoint of AC