**Day 253** **A Tier 10-a-day: Model Solutions**

## 1 Mixed number multiplication and division

Work out $1\frac{1}{5} \times 1\frac{1}{2}$

Give your answer as a mixed number in its simplest form.

Improper fractions: $\frac{6}{5}$ and $\frac{3}{2}$

Multiply: $\frac{6}{5} \times \frac{3}{2} = \frac{18}{10}$

Simplify: $1\frac{4}{5}$

**Answer: $1\frac{4}{5}$**

## 2 Circle area and circumference

A circular pond has diameter 4 m.
Work out, in terms of $\pi$,
(a) the circumference,
(b) the area.

(a) Circumference = $\pi d = \pi \times 4 = 4\pi$

(b) Area = $\pi r^2 = \pi \times 2^2 = 4\pi$

**Answer: (a) $4\pi$ m (b) $4\pi$ m$^2$**

## 3 Direct proportion

Here are the ingredients for 4 muffins.
Flour: 200 g
Milk: 120 ml
Butter: 40 g
(a) Work out how much flour is needed for 9 muffins.
(b) Hannah has 772 ml of milk. What is the greatest number of muffins she can make?

(a) flour for one: 200 ÷ 4 = 50 g
For 9: 50 × 9 = 450 g
(b) milk for one: 120 ÷ 4 = 30 ml
772 ÷ 30 = 25 remainder 22, so she can make 25
**Answer: (a) 450 g (b) 25**

## 4 Straight line graphs

A straight line has equation $2x + 5y = -6$
(a) Find the gradient of the line.
(b) Find the coordinates of the point where the line crosses the x-axis.

(a) Rearrange into $y = mx + c$: $5y = -2x - 6$

$y = -\frac{2}{5}x - \frac{6}{5}$

The gradient is $-\frac{2}{5}$

(b) On the x-axis, $y = 0$: $2x = -6$, so $x = -3$

**Answer: (a) $-\frac{2}{5}$ (b) $(-3, 0)$**

## 5 Index equations

Solve $9^x = \frac{1}{3}$

Write both sides as powers of 3: $9 = 3^2$, so $9^x = 3^{2x}$

$\frac{1}{3} = 3^{-1}$, so $2x = -1$

$x = -\frac{1}{2}$

**Answer: $x = -\frac{1}{2}$**

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## 6 Box plots

The box plot shows the masses, in kg, of the parcels in delivery A.
(a) Write down the median and the interquartile range.
For delivery B the median is 70 and the interquartile range is 30.
(b) Compare the distributions of the two deliveries.

(a) Median = 60
Interquartile range = 80 − 40 = 40
(b) The median for Delivery B is higher (70 compared with 60), so it has the higher values on average
The IQR for Delivery B is smaller (30 compared with 40), so its values are more consistent
**Answer: (a) Median 60, IQR 40 (b) Delivery B has the higher median; Delivery B has the smaller IQR so is more consistent**

## 7 Transformations of graphs

The graph of y = f(x) has a minimum point at (2, −2).
Write down the coordinates of the turning point of the graph of
(a) y = f(−x)
(b) y = f(x − 2)

(a) The graph is reflected in the y-axis, so the x-coordinate changes sign
The minimum point is (−2, −2)
(b) Replacing x by (x − 2) moves the graph 2 units right
The minimum point is (4, −2)
**Answer: (a) (−2, −2) (b) (4, −2)**

## 8 Circle theorems: angle at the centre

X, Y and Z are points on a circle with centre O.
Angle XOY = 76°.
Work out the size of angle x.
Give a reason for your answer.

The angle at the centre is twice the angle at the circumference
x = 76 ÷ 2 = 38
**Answer: x = 38°**

## 9 Finding a percentage change

The number of visitors to a museum was 140 and is now 161.
Work out the percentage increase.

Change = 161 − 140 = 21
Percentage increase = $\frac{21}{140} \times 100 = 15\%$
**Answer: 15% increase**

## 10 Bearings with the cosine rule

Boat P sails 15 km from a harbour on a bearing of 065°.
Boat Q sails 14 km from the same harbour on a bearing of 290°. (Calculator)
Work out the distance between the two boats.
Give your answer to 3 significant figures.

The angle between the two paths = 360° − |65° − 290°| = 135°
$d^2 = 15^2 + 14^2 - 2 \times 15 \times 14 \times \cos 135°$
$d^2 = 717.98$
d = 26.8
**Answer: 26.8 km**