Day 343 **A Tier 10-a-day: Model Solutions**

1 Mixed number multiplication and division

Work out $3\frac{1}{2} \times 4\frac{1}{3}$

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

Improper fractions: $\frac{7}{2}$ and $\frac{13}{3}$

Multiply: $\frac{7}{2} \times \frac{13}{3} = \frac{91}{6}$

Simplify: $15\frac{1}{6}$

Answer: $15\frac{1}{6}$

2 Direct proportion

Here are the ingredients for 10 cupcakes.
Sugar: 300 g
Oats: 200 g
Flour: 250 g
(a) Work out how much sugar is needed for 9 cupcakes.
(b) Hannah has 508 g of oats. What is the greatest number of cupcakes she can make?

(a) sugar for one: 300 ÷ 10 = 30 g
For 9: 30 × 9 = 270 g
(b) oats for one: 200 ÷ 10 = 20 g
508 ÷ 20 = 25 remainder 8, so she can make 25
Answer: (a) 270 g (b) 25

3 The quadratic formula

Solve $x^2 - 6x + 1 = 0$

Give your solutions correct to 2 decimal places. (Calculator)

Use $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ with a = 1, b = −6, c = 1

$x = \frac{6 \pm \sqrt{(-6)^2 - 4 \times 1 \times 1}}{2}$

$x = \frac{6 \pm \sqrt{32}}{2}$

x = 5.83 or x = 0.17
Answer: x = 5.83 or x = 0.17

4 Pressure

A block exerts a force of 125 N on the floor.
The area in contact with the floor is 2.5 m^2.
Work out the pressure on the floor in N/m^2.

Pressure = force ÷ area
= 125 ÷ 2.5 = 50
Answer: 50 N/m^2

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5 Straight line graphs

A straight line has equation $3x + 5y = -3$
(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: $5y = -3x - 3$

$y = -\frac{3}{5}x - \frac{3}{5}$

The gradient is $-\frac{3}{5}$

(b) On the x-axis, y = 0: $3x = -3$, so $x = -1$

Answer: (a) $-\frac{3}{5}$ (b) $(-1, 0)$

6 Circle theorems: cyclic quadrilaterals

A, B, C and D are points on a circle.
Angle B = $(5x - 20)°$ and angle D = $(2x + 39)°$.
(a) Work out the value of x.
(b) Work out the size of angle B.
The diagram is not drawn accurately.

(a) Opposite angles of a cyclic quadrilateral add up to 180°
$5x - 20 + 2x + 39 = 180$
$7x + 19 = 180$
$7x = 161$
$x = 23$
(b) $5 \times 23 - 20 = 95$
Answer: (a) x = 23 (b) 95°

7 Cumulative frequency graphs

The cumulative frequency graph shows information about the mass of 40 parcels.
Use the graph to find an estimate for
(a) the median,
(b) the number of parcels with a mass greater than 20 kg.

(a) Median at cumulative frequency $40 \div 2 = 20$
Read across from 20 to the graph, then down to the axis
Median = 48 kg
(b) At 20 kg the cumulative frequency is 6
$40 - 6 = 34$
Answer: (a) 48 kg (b) 34

8 LCM in context

Mo runs around a track in 30 seconds.
Femi runs around the same track in 50 seconds.
They start together at the start line and keep running.
How many laps will each have run when they are next together at the start line?

Find the LCM of 30 and 50: LCM = 150 seconds.
Mo: $150 \div 30 = 5$ laps
Femi: $150 \div 50 = 3$ laps
Answer: Mo 5 laps, Femi 3 laps

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9 Simultaneous equations (one quadratic)

Solve the simultaneous equations

$y = x^2 - 2x + 4$

$y = x + 8$

Set the y values equal: $x^2 - 2x + 4 = x + 8$

$x^2 - 3x - 4 = 0$

$(x + 1)(x - 4) = 0$

$x = -1$ or $x = 4$

Substitute into $y = x + 8$: $y = 7$ and $y = 12$

Answer: $x = -1$, $y = 7$ and $x = 4$, $y = 12$

10 Bearings with the cosine rule

Ship A sails 16 miles from a port on a bearing of 075°.

Ship B sails 24 miles from the same port on a bearing of 195°. (Calculator)

Work out the distance between the two ships.

Give your answer to 3 significant figures.

The angle between the two paths = $|75° - 195°| = 120°$

$d^2 = 16^2 + 24^2 - 2 \times 16 \times 24 \times \cos 120°$

$d^2 = 1216.0$

$d = 34.9$

Answer: 34.9 miles