Day 347 **A Tier 10-a-day: Model Solutions**

1 Converting speeds

A bus travels at 7 m/s.
Work out this speed in kilometres per hour.

In 1 hour there are 3600 seconds, so 7 m/s = 7 × 3600 m/h
= 25200 m/h = 25200 ÷ 1000 km/h
= 25.2
Answer: 25.2 km/h

2 Inverse functions

$f(x) = \frac{x - 5}{3}$

(a) Find $f^{-1}(x)$
(b) Work out $f^{-1}(-3)$

Let $y = \frac{x - 5}{3}$
Multiply by 3: $3y = x - 5$, so $x = 3y + 5$
Swap y for x: $f^{-1}(x) = 3x + 5$
(b) $f^{-1}(-3) = -4$
Answer: (a) $f^{-1}(x) = 3x + 5$ (b) -4

3 Exchange rates

The exchange rate is £1 = $1.25. (Calculator)
Ben changes £700 into US dollars.
How much does Ben get in US dollars?

£700 × 1.25 = $875
Answer: $875

4 Trigonometry: finding an angle

Work out the size of angle x. (Calculator)
Give your answer to 1 decimal place.
The diagram is not drawn accurately.

The sides given are the adjacent (4) and the hypotenuse (9), so use cos
$\cos x = \frac{4}{9}$
$x = \cos^{-1}(\frac{4}{9})$
x = 63.6°
Answer: x = 63.6°

5 Growth and decay

The population of a town is 5000. (Calculator)
It increases by 10% each year.
Work out the population after 2 years.
Give your answer to the nearest whole number.

Multiplier = 100% + 10% = 1.1
$5000 \times 1.1^2 = 6050.00$
= 6050 to the nearest whole number
Answer: 6050

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6 Expanding and simplifying

Expand and simplify

$(x + 2)^2 - (x - 6)(x - 2)$

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

$(x - 6)(x - 2) = x^2 - 8x + 12$

Subtract (take care with the signs): $(x^2 + 4x + 4) - (x^2 - 8x + 12)$

$= 12x - 8$

Answer: $12x - 8$

7 Reverse percentages

A bike costs £84 including VAT at 20%. (Calculator)

Work out the price of the bike before VAT is added.

Price including VAT is 120% of the price before VAT.

120% = £84, so 1% = £84 ÷ 120 = £0.70

100% = £0.70 × 100 = £70

Answer: £70

8 Direct proportion formulae

y is directly proportional to the square root of x.

When x = 36, y = 54.

(a) Find a formula for y in terms of x.

(b) Work out the positive value of x when y = 27.

(a) $y = k\sqrt{x}$. Substitute: $54 = k \times 6$, so $k = 9$

$y = 9\sqrt{x}$

(b) $27 = 9\sqrt{x}$, so $\sqrt{x} = 27 \div 9 = 3$, so $x = 3^2 = 9$

Answer: (a) $y = 9\sqrt{x}$ (b) $x = 9$

9 Volume of a cylinder

A water tank is a cylinder with radius 12 cm and height 8 cm.

Work out the volume. Give your answer in terms of π.

Volume $= \pi r^2 h$

$= \pi \times 12^2 \times 8$

$= 1152\pi$

Answer: 1152π cm^3

10 Reverse compound change

The value of a car falls by 20% each year. (Calculator)

After 3 years it is worth £19,968.

Work out its value at the start.

Yearly multiplier = 0.8

Overall multiplier $= 0.8^3 = 0.512$

Original value = £19,968 ÷ 0.512 = £39,000

Answer: £39,000