Day 169 **A Tier 10-a-day: Model Solutions**

1 Growth and decay

A new car is worth £25000. (Calculator)
Its value falls by 20% each year.
Work out its value after 3 years.

Multiplier = 100% − 20% = 0.8

$25000 \times 0.8^3 = 12800.00$

= £12800 to the nearest whole number

Answer: £12800

2 Expanding double brackets

Expand and simplify
$(3x - 7)(2x + 7)$

Multiply every term in the first bracket by every term in the second

$= 6x^2 + 21x - 14x - 49$

$= 6x^2 + 7x - 49$

Answer: $6x^2 + 7x - 49$

3 Converting units

(a) Change 1.5 m^2 to cm^2.
(b) Change 25,000 cm^2 to m^2.

(a) 1.5 $m^2 \times 10{,}000 = 15{,}000\ cm^2$

(b) 25,000 $cm^2 \div 10\,000 = 2.5\ m^2$

Answer: (a) 15,000 cm^2 (b) 2.5 m^2

4 Loci: area of a region

A dog is tied by a rope of length 6 m to the corner of a rectangular shed.
The shed measures 8 m by 11 m.
The dog can graze on any grass it can reach outside the shed.
Work out the area it can graze. Give your answer in terms of π.
The diagram is not drawn accurately.

The rope can sweep a sector of angle 360° − 90° = 270°

$\text{Area} = \frac{270}{360} \times \pi \times 6^2$

$= \frac{3}{4} \times 36\pi$

$= 27\pi$

Answer: $27\pi\ m^2$

5 Finding a missing value from an average

The mean of the five numbers 14, 16, x, 11, 6 is 11.
Work out the value of x.

Total = 5 × 11 = 55

Known numbers add to 47

x = 55 − 47 = 8

Answer: x = 8

6 Bounds

A plank is 15.7 m long and a pipe is 9.5 m long.
Each length is correct to the nearest 0.1 m.
Work out the lower bound for the difference in their lengths.

To make the difference as small as possible, use the lower bound of the plank and the upper bound of the pipe.

15.65 − 9.55 = 6.1 m

Answer: 6.1 m

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7 Surface area of a prism

The diagram shows a triangular prism.
The cross-section is a right-angled triangle.
Work out the total surface area of the prism.
The diagram is not drawn accurately.

Hypotenuse = $\sqrt{15^2 + 8^2}$ = 17 cm

Two triangular ends: $2 \times \frac{1}{2} \times 15 \times 8 = 120$

Three rectangles: (15 + 8 + 17) × 11 = 440
Total = 120 + 440 = 560

Answer: 560 cm^2

8 Forming quadratic equations

A rectangle has width x cm and length (x + 6) cm.
The area of the rectangle is 40 cm^2.
(a) Show that $x^2 + 6x - 40 = 0$
(b) Work out the value of x.

(a) Area = length × width, so x(x + 6) = 40
$x^2 + 6x = 40$
$x^2 + 6x - 40 = 0$
(b) Factorise: (x − 4)(x + 10) = 0
x = 4 or x = −10
A length cannot be negative, so x = 4

Answer: (a) Shown (b) x = 4

9 Successive percentage changes

The price of a games console is decreased by 30%.
The new price is then increased by 20%.
Work out the overall percentage change.

First change: multiplier 0.7. Second change: multiplier 1.2
Overall multiplier = 0.7 × 1.2 = 0.84
0.84 − 1 = −0.16, so the overall change is 16%

Answer: 16% decrease

10 Bearings with the cosine rule

Ship A sails 19 miles from a port on a bearing of 325°.
Ship B sails 20 miles from the same port on a bearing of 080°. (Calculator)
Work out the distance between the two ships.
Give your answer to 3 significant figures.

The angle between the two paths = 360° − |325° − 80°| = 115°
$d^2 = 19^2 + 20^2 - 2 \times 19 \times 20 \times \cos 115°$
$d^2 = 1082.2$
d = 32.9

Answer: 32.9 miles