Day 361 **A Tier 10-a-day: Model Solutions**

1 Exchange rates

£1 = $1.35.
(a) Change £40 to dollars.
(b) Change $378 to pounds.

(a) 40 × 1.35 = 54
(b) 378 ÷ 1.35 = 280
Answer: (a) $54 (b) £280

2 Laws of indices

Write $(2^4)^2 \div 2^3$ as a single power of 2.

Multiply the powers: $(2^4)^2 = 2^8$
Subtract when dividing: $8 - 3 = 5$
$= 2^5$
Answer: 2^5

3 Functions

$f(x) = -2x + 5$
$g(x) = x^2 - 8$
Find fg(1)

$g(1) = 1^2 - 8 = -7$
$f(-7) = -2 \times (-7) + 5 = 19$
Answer: 19

4 Time

(a) A flight takes off at 3:50 pm. The journey takes 3 hours 28 minutes. Work out the time it ends.
(b) Change 150 minutes into hours. Give your answer as a decimal.

(a) 3:50 pm + 3 hours 28 minutes = 7:18 pm
(b) 150 ÷ 60 = 2.5 hours
Answer: (a) 7:18 pm (b) 2.5 hours

5 Converting area and volume units

Change 0.01 m^3 to cm^3.

1 m = 100 cm, so 1 m^3 = 100 × 100 × 100 = 1 000 000 cm^3
0.01 × 1 000 000 = 10000
Answer: 10000 cm^3

6 Similar triangles with parallel lines

In triangle ABC, DE is parallel to BC.
D is on AB and E is on AC.
Work out the value of x.
The diagram is not drawn accurately.

Triangles ADE and ABC are similar (DE is parallel to BC)

Scale factor = AB ÷ AD = 14 ÷ 6 = $\frac{7}{3}$

$x = 9 \times \frac{7}{3} = 21$

Answer: x = 21

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7 Standard form in context

One grain of sand has a mass of 4×10^{-3} kg.
A sample contains 3×10^{4} grains of sand.
Work out the total mass of the sample.
Give your answer in standard form.

Total mass = $(4 \times 10^{-3}) \times (3 \times 10^{4})$
$4 \times 3 = 12$ and $10^{-3} \times 10^{4} = 10^{1}$
$12 \times 10^{1} = 1.2 \times 10^{2}$
Answer: 1.2×10^{2} kg

8 Quadratic sequences

Here are the first five terms of a quadratic sequence.
$-7, -6, -1, 8, 21$
(a) Find an expression for the nth term.
(b) Work out the 12th term.

First differences: 1, 5, 9
Second differences: 4, 4, so $a = 4 \div 2 = 2$
Subtract $2n^2$ from each term (2, 8, 18, 32): $-9, -14, -19, -24$
This is linear: $-5n - 4$
nth term = $2n^2 - 5n - 4$
(b) Substitute $n = 12$: $2 \times 12^2 - 5 \times 12 - 4 = 224$
Answer: (a) $2n^2 - 5n - 4$ (b) 224

9 Pythagoras in three dimensions

The diagram shows a cuboid.
Work out the length of the diagonal AG. (Calculator)
Give your answer to 3 significant figures.
The diagram is not drawn accurately.

$AG^2 = 7^2 + 7^2 + 8^2$
$= 49 + 49 + 64 = 162$
$AG = \sqrt{162} = 12.7$
Answer: 12.7 cm

10 Rearranging formulae (subject twice)

Make x the subject of $y = \frac{3x - 1}{-x + 1}$

Multiply both sides by $(-x + 1)$: $y(-x + 1) = 3x - 1$
Expand the bracket: $-xy + y = 3x - 1$
Collect the x terms on one side: $-xy - 3x = -y - 1$
Factorise: $x(-y - 3) = -y - 1$
Divide by $(-y - 3)$: $x = \frac{-y - 1}{-y - 3}$
Multiply the top and bottom by -1: $x = \frac{y + 1}{y + 3}$
Answer: $x = \frac{y + 1}{y + 3}$