Day 219 **A Tier 10-a-day: Model Solutions**

1 Time

(a) A flight takes off at 0915. The journey takes 1 hours 22 minutes. Work out the time it ends.
(b) Change 3.1 hours into hours and minutes.

(a) 0915 + 1 hours = 1015, then + 22 minutes = 1037
(b) 0.1 hours = 0.1 × 60 = 6 minutes, so 3.1 hours = 3 hours 6 minutes
Answer: (a) 1037 (b) 3 hours 6 minutes

2 Solving quadratic equations

Solve $3x^2 + x - 2 = 0$

Factorise: $(3x - 2)(x + 1) = 0$
$3x - 2 = 0$ or $x + 1 = 0$
$x = \frac{2}{3}$ or $x = -1$

Answer: $x = \frac{2}{3}$ or $x = -1$

3 Probabilities adding to 1

The table shows the probabilities of the outcomes of a biased spinner.
(a) Work out the value of p.
(b) The spinner is spun 800 times. Estimate the number of times it lands on 3.

(a) Probabilities add to 1: $0.25 + p + 2p + 0.45 = 1$
$0.7 + 3p = 1$, so $3p = 0.3$
$p = 0.1$
(b) P(3) = 0.2, so expected number = 0.2 × 800 = 160
Answer: (a) p = 0.1 (b) 160

4 HCF and LCM in index form

$A = 2^4 \times 3 \times 7^3$
$B = 2^3 \times 7^4$
Find the highest common factor (HCF) and the lowest common multiple (LCM) of A and B.
Give your answers as products of prime factors.

HCF: for each prime take the lower power (a missing prime has power 0): $2^3 \times 7^3$
LCM: for each prime take the higher power: $2^4 \times 3 \times 7^4$
Answer: HCF = $2^3 \times 7^3$, LCM = $2^4 \times 3 \times 7^4$

5 Converting area and volume units

Change 1500 cm^3 to litres.

1 litre = 1000 cm^3
1500 ÷ 1000 = 1.5
Answer: 1.5 litres

6 Completing the square

(a) Write $x^2 + 6x + 5$ in the form $(x + a)^2 + b$
(b) Write down the coordinates of the turning point of the curve $y = x^2 + 6x + 5$

(a) Half of 6 is 3, so $(x + 3)^2$
$(x + 3)^2 = x^2 + 6x + 9$, so subtract 9 to get back to 5
So $x^2 + 6x + 5 = (x + 3)^2 - 4$
(b) The turning point is where the bracket is 0, so $x = -3$ and $y = -4$
Answer: (a) $(x + 3)^2 - 4$ (b) $(-3, -4)$

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7 LCM in context

Zara runs around a track in 100 seconds.
Tom runs around the same track in 60 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 100 and 60: LCM = 300 seconds.
Zara: 300 ÷ 100 = 3 laps
Tom: 300 ÷ 60 = 5 laps
Answer: Zara 3 laps, Tom 5 laps

8 The cosine rule: finding a side

Work out the value of x. (Calculator)
Give your answer to 3 significant figures.
The diagram is not drawn accurately.

$x^2 = 12^2 + 6^2 - 2 \times 12 \times 6 \times \cos 71°$
$x^2 = 144 + 36 - 144 \cos 71°$
$x^2 = 133.12$
$x = 11.5$
Answer: x = 11.5 m

9 Expanding three brackets

Expand and simplify
$(x - 5)(x + 2)(x - 1)$

Expand the first two brackets: $(x - 5)(x + 2) = x^2 - 3x - 10$
Multiply by the third bracket: $(x^2 - 3x - 10)(x - 1)$
$= x^3 - 3x^2 - 10x - x^2 + 3x + 10$
$= x^3 - 4x^2 - 7x + 10$
Answer: $x^3 - 4x^2 - 7x + 10$

10 Vector geometry

OAB is a triangle. $\rightarrow OA = \mathbf{a}$ and $\rightarrow OB = \mathbf{b}$.
P is the point on AB such that AP : PB = 3 : 4.
Find $\rightarrow OP$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

$\rightarrow AB = -\mathbf{a} + \mathbf{b}$
$\rightarrow AP = \frac{3}{7} \rightarrow AB = \frac{3}{7}(\mathbf{b} - \mathbf{a})$
$\rightarrow OP = \rightarrow OA + \rightarrow AP = \mathbf{a} + \frac{3}{7}(\mathbf{b} - \mathbf{a})$
$= \frac{4}{7}\mathbf{a} + \frac{3}{7}\mathbf{b}$
Answer: $\rightarrow OP = \frac{4}{7}\mathbf{a} + \frac{3}{7}\mathbf{b}$