**Day 338** **A Tier 10-a-day: Model Solutions**

## 1 Growth and decay

A culture starts with 2500 bacteria. (Calculator)
The number of bacteria increases by 25% every hour.
Work out the number of bacteria after 2 hours.
Give your answer to the nearest whole number.

Multiplier = 100% + 25% = 1.25
$2500 \times 1.25^2 = 3906.25$
= 3906 to the nearest whole number
**Answer: 3906**

## 2 Factorising quadratics

Factorise $x^2 + x - 30$

Find two numbers that multiply to $-30$ and add to 1
The numbers are $-5$ and 6
$(x - 5)(x + 6)$
**Answer: $(x - 5)(x + 6)$**

## 3 Best buys

A shop sells pasta in 2 different sizes.
Small bag: 250 g for £2.45
Large bag: 1000 g for £7.60
Which bag is the best value for money? You must show your working.

Small bag: 245p ÷ 2.5 = 98p per 100 g
Large bag: 760p ÷ 10 = 76p per 100 g
The large bag has the lowest price per 100 g, so it is the best value
**Answer: The large bag**

## 4 Volume of a cylinder

A tin of soup is a cylinder with radius 11 cm and height 16 cm.
Work out the volume. Give your answer in terms of $\pi$.

Volume = $\pi r^2 h$
$= \pi \times 11^2 \times 16$
$= 1936\pi$
**Answer: $1936\pi$ cm$^3$**

## 5 LCM in context

Chloe runs around a track in 50 seconds.
Jack runs around the same track in 80 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 50 and 80: LCM = 400 seconds.
Chloe: 400 ÷ 50 = 8 laps
Jack: 400 ÷ 80 = 5 laps
**Answer: Chloe 8 laps, Jack 5 laps**

## 6 Describing transformations

Describe fully the single transformation that maps shape A onto shape B.

Matching points swap their x and y coordinates
So the mirror line is the diagonal y = x
**Answer: Reflection in the line y = x**

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## 7 Algebraic rearrangement and change of sign

(a) Show that the equation $x^3 + 6x - 29 = 0$ can be rearranged to give $x = \sqrt[3]{29 - 6x}$
(b) Show that the equation has a solution between x = 2 and x = 3

(a) Add 29 and subtract 6x from both sides: $x^3 = 29 - 6x$
Take the cube root of both sides: $x = \sqrt[3]{29 - 6x}$
(b) Let $f(x) = x^3 + 6x - 29$
$f(2) = -9$
$f(3) = 16$
There is a change of sign (negative to positive) and f is continuous, so there is a solution between x = 2 and x = 3
**Answer: Shown: f(2) = −9, f(3) = 16 (change of sign)**

## 8 Compound interest

Mo invests £2,000 in a bank account. (Calculator)
The account pays compound interest at 6% per year.
Work out the value of the investment after 5 years.

Multiplier = 1 + 6 ÷ 100 = 1.06
£2,000 × $1.06^5$ = £2,676.45
**Answer: £2,676.45**

## 9 Decimal calculations

(a) Work out 0.9 × 0.2
(b) Work out 0.18 ÷ 0.02

(a) 9 × 2 = 18, and there are 2 decimal places in total, so 0.18
(b) Multiply both numbers by 100: 18 ÷ 2 = 9
**Answer: (a) 0.18 (b) 9**

## 10 Bearings with the cosine rule

Ship A sails 16 km from a port on a bearing of 270°.
Ship B sails 19 km from the same port on a bearing of 130°. (Calculator)
Work out the distance between the two ships.
Give your answer to 3 significant figures.

The angle between the two paths = |270° − 130°| = 140°
$d^2 = 16^2 + 19^2 - 2 \times 16 \times 19 \times \cos 140°$
$d^2 = 1082.8$
d = 32.9
**Answer: 32.9 km**