Day 333 **A Tier 10-a-day: Model Solutions**

1 Direct proportion formulae

y is directly proportional to the square of x.
When x = 10, y = 700.
(a) Find a formula for y in terms of x.
(b) Work out the value of y when x = 8.

(a) $y = kx^2$. Substitute: $700 = k \times 100$, so $k = 7$
$y = 7x^2$
(b) $y = 7 \times 64 = 448$
Answer: (a) $y = 7x^2$ (b) 448

2 Equations with brackets

Solve $2(x - 3) = 5(x - 5) + 1$

Expand the brackets: $2x - 6 = 5x - 25 + 1$
Simplify: $2x - 6 = 5x - 24$
Collect x terms on one side and numbers on the other: $-3x = -18$
$x = 6$
Answer: x = 6

3 Interior angles of polygons

The size of each angle of a quadrilateral is shown as an expression:
$(2x - 15)°$, $(3x + 35)°$, $(x + 10)°$, $(3x + 42)°$
Work out the value of x.

Sum of angles = $(4 - 2) \times 180 = 360°$
$2x - 15 + 3x + 35 + x + 10 + 3x + 42 = 360$
$9x + 72 = 360$
$9x = 288$
$x = 32$
Answer: x = 32

4 Negative and fractional indices

Work out the value of
(a) $100^{\frac{3}{2}}$
(b) $(\frac{1}{2})^{-2}$

(a) $100^{\frac{3}{2}} = (\sqrt{100})^3 = 10^3 = 1000$
(b) $(\frac{1}{2})^{-2} = 2^2 = 4$
Answer: (a) 1000 (b) 4

5 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 opposite (5) and the adjacent (9), so use tan
$\tan x = \frac{5}{9}$
$x = \tan^{-1}(\frac{5}{9})$
$x = 29.1°$
Answer: x = 29.1°

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6 Venn diagram probability

The Venn diagram shows information about 26 people.
One person is chosen at random.
(a) Find the probability that the person is in Cinema only.
(b) Find the probability that the person is in neither set.

(a) Cinema only: 8 out of 26 = $\frac{4}{13}$

(b) Neither: 2 out of 26 = $\frac{1}{13}$

Answer: (a) $\frac{4}{13}$ (b) $\frac{1}{13}$

7 Adding algebraic fractions

Write as a single fraction

$\frac{-2}{(x+5)} - \frac{2}{(x+4)}$

Common denominator is $(x + 5)(x + 4)$

$= \frac{-2(x+4) - 2(x+5)}{(x+5)(x+4)}$

$= \frac{-4x - 18}{(x+5)(x+4)}$

Answer: $\frac{-4x - 18}{(x+5)(x+4)}$

8 Area of a segment

The diagram shows a circle with centre O and radius 8 cm.
Angle AOB = 80°. (Calculator)
Work out the area of the shaded segment.
Give your answer to 3 significant figures.

Area of sector = $\frac{80}{360} \times \pi \times 8^2 = 44.680$

Area of triangle OAB = $\frac{1}{2} \times 8 \times 8 \times \sin 80° = 31.514$

Segment = $44.680 - 31.514 = 13.2$

Answer: 13.2 cm^2

9 Probability with three selections

A bag contains 4 mint sweets and 3 toffee sweets.
Three sweets are taken at random without replacement.
Work out the probability that exactly one of the three sweets is toffee.

One order, for example toffee, mint, mint: $\frac{3}{7} \times \frac{4}{6} \times \frac{3}{5} = \frac{6}{35}$

There are 3 possible orders, each with the same probability

$3 \times \frac{6}{35} = \frac{18}{35}$

Answer: $\frac{18}{35}$

10 Bounds of a speed or density

A metal block has mass 540 g and volume 179 cm^3. The mass is measured to the nearest 10 grams and the volume to the nearest cm^3. (Calculator)
Work out the upper bound for the density of the metal in g/cm^3.
Give your answer correct to 3 significant figures.

density = mass ÷ volume
For the upper bound of density use the upper bound of mass and the lower bound of volume.
545 ÷ 178.5 = 3.05322
= 3.05 g/cm^3 (3 s.f.)
Answer: 3.05 g/cm^3