Day 131 **A Tier 10-a-day: Model Solutions**

1 Two dice

Two fair dice are thrown.
The two scores are added together.
Work out the probability that the sum is less than 9.

Easier to count the outcomes that do not work: (3, 6), (4, 5), (4, 6), (5, 4), (5, 5), (5, 6), (6, 3), (6, 4), (6, 5), (6, 6)
That is 10 outcomes, so 26 work
$\frac{26}{36} = \frac{13}{18}$

Answer: $\mathbf{\frac{13}{18}}$

2 Is it a right-angled triangle?

A triangle has sides of length 6 cm, 8 cm and 10 cm.
Is the triangle right-angled?
You must show your working.

Longest side^2 = 10^2 = 100
Sum of the squares of the other two sides = $6^2 + 8^2 = 36 + 64 = 100$
100 = 100, so the triangle is right-angled
Answer: Yes, it is right-angled

3 Compound interest

Ella invests £2000 in a savings account. (Calculator)
The account pays 5% compound interest per year.
Work out the amount in the account after 2 years.

Multiplier = 100% + 5% = 1.05
£2000 × 1.05^2 = £2205.000
= £2205.00 to the nearest penny
Answer: £2205.00

4 Laws of indices

Simplify fully
(a) $\frac{9x^6y^3}{5x^5y}$
(b) $(2x^4y^2)^3$

(a) Divide the numbers: $9 \div 5 = \frac{9}{5}$
Subtract the powers: $x^6 \div x^5 = x$ and $y^3 \div y = y^2$
$= \frac{9xy^2}{5}$

(b) Raise every part to the power 3: $2^3 = 8$, $(x^4)^3 = x^{12}$, $(y^2)^3 = y^6$
$= 8x^{12}y^6$

Answer: (a) $\mathbf{\frac{9xy^2}{5}}$ **(b)** $\mathbf{8x^{12}y^6}$

5 Converting area and volume units

Change 0.1 cm^2 to mm^2.

1 cm = 10 mm, so 1 cm^2 = 10 × 10 = 100 mm^2
0.1 × 100 = 10
Answer: 10 mm^2

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6 Trigonometry in context

A ladder of length 5 m rests against a vertical wall. (Calculator)
The foot of the ladder is 2 m from the wall on horizontal ground.
Work out the angle between the ladder and the ground. Give your answer to 1 decimal place.

$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}} = \frac{2}{5}$

$\theta = \cos^{-1}(\frac{2}{5})$

$\theta = 66.4°$

Answer: 66.4°

7 Recurring decimals, show that

(a) Show that $0.\dot{6}\dot{2} = \frac{62}{99}$

(b) Hence write $4.\dot{6}\dot{2}$ as a mixed number in its simplest form.

(a) Let x = 0.626262..., so 100x = 62.6262...

$100x - x = 62$, so $99x = 62$ and $x = \frac{62}{99}$

(b) $4.\dot{6}\dot{2} = 4 + \frac{62}{99} = 4\frac{62}{99}$

Answer: (b) $4\frac{62}{99}$

8 Bearings with the cosine rule

Ship A sails 15 km from a port on a bearing of 315°.
Ship B sails 7 km from the same port on a bearing of 100°. (Calculator)
Work out the distance between the two ships.
Give your answer to 3 significant figures.

The angle between the two paths = $360° - |315° - 100°| = 145°$

$d^2 = 15^2 + 7^2 - 2 \times 15 \times 7 \times \cos 145°$

$d^2 = 446.02$

$d = 21.1$

Answer: 21.1 km

9 Forming quadratic equations

A rectangle has width x cm and length (x + 3) cm.
The area of the rectangle is 54 cm^2.
(a) Show that $x^2 + 3x - 54 = 0$
(b) Work out the value of x.

(a) Area = length × width, so $x(x + 3) = 54$

$x^2 + 3x = 54$

$x^2 + 3x - 54 = 0$

(b) Factorise: $(x - 6)(x + 9) = 0$

$x = 6$ or $x = -9$

A length cannot be negative, so $x = 6$

Answer: (a) Shown (b) x = 6

10 Finding a rate of compound change

Priya invests £16,500 in a savings account. (Calculator)
Compound interest is paid at a fixed rate each year.
After 3 years the investment is worth £28,512.
Work out the annual rate of interest.

Overall multiplier = £28,512 ÷ £16,500 = 1.728

Take the cube root: $\sqrt[3]{1.728} = 1.2$

Rate = (1.2 − 1) × 100 = 20%

Answer: 20%