Day 274 **A Tier 10-a-day: Model Solutions**

1 Algebraic formulae in context

A hall is hired for £50 plus £10 for each hour.
(a) Write a formula for the total cost, £C, after h hours.
(b) Leo pays £200 in total. Work out the number of hours.

(a) $C = 50 + 10h$
(b) $50 + 10h = 200$
$10h = 150$
$h = 15$
Answer: (a) $C = 50 + 10h$ (b) 15

2 Median from a frequency table

The frequency table shows data for 27 matches.
(a) Find the median.
(b) Work out the range.

(a) The median is the 14th value $(27 + 1) \div 2 = 14$
Cumulative frequencies: 4, 10, 17, 26, 27
The 14th value is 2
(b) Range $= 4 - 0 = 4$
Answer: (a) 2 (b) 4

3 Expanding and simplifying

Expand and simplify
$4(x + 5)(x + 6) - (x + 6)(x - 6)$

$4(x + 5)(x + 6) = 4(x^2 + 11x + 30) = 4x^2 + 44x + 120$
$(x + 6)(x - 6) = x^2 - 36$
Subtract: $3x^2 + 44x + 156$
Answer: $3x^2 + 44x + 156$

4 Midpoints and length of a line segment

C is the point $(-2, 1)$ and D is the point $(3, 0)$.
(a) Find the midpoint of CD.
(b) Work out the length of CD. Give your answer as a surd in its simplest form.

(a) Midpoint $= \left(\frac{-2 + 3}{2}, \frac{1 + 0}{2}\right) = (0.5, 0.5)$

(b) Length $= \sqrt{(5)^2 + (-1)^2}$
$= \sqrt{26} = \sqrt{26}$
Answer: (a) (0.5, 0.5) (b) $\sqrt{26}$

5 The quadratic formula

Solve $5x^2 + 4x - 5 = 0$
Give your solutions correct to 2 decimal places. (Calculator)

Use $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ with $a = 5$, $b = 4$, $c = -5$

$x = \frac{-4 \pm \sqrt{4^2 - 4 \times 5 \times (-5)}}{10}$

$x = \frac{-4 \pm \sqrt{116}}{10}$

$x = 0.68$ or $x = -1.48$
Answer: $x = 0.68$ or $x = -1.48$

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6 Expanding with surds

Expand and simplify $(3 + 3\sqrt{6})^2$

Give your answer in the form $a + b\sqrt{c}$

$(3 + 3\sqrt{6})(3 + 3\sqrt{6}) = 9 + 9\sqrt{6} + 9\sqrt{6} + 54$

Collect: $63 + 18\sqrt{6}$

Answer: $63 + 18\sqrt{6}$

7 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 (16) and the adjacent (20), so use tan

$\tan x = \frac{16}{20}$

$x = \tan^{-1}(\frac{16}{20})$

$x = 38.7°$

Answer: x = 38.7°

8 Negative and fractional indices

Work out the value of

(a) 3^{-3}

(b) $27^{\frac{-2}{3}}$

(a) $3^{-3} = \frac{1}{3^3} = \frac{1}{27}$

(b) $27^{\frac{-2}{3}} = \frac{1}{27^{\frac{2}{3}}} = \frac{1}{(\sqrt[3]{27})^2} = \frac{1}{3^2} = \frac{1}{9}$

Answer: (a) $\frac{1}{27}$ (b) $\frac{1}{9}$

9 Mixing in a ratio

Jug A contains 11 litres of a mixture of red paint and white paint in the ratio 4 : 7.

Jug B contains 28 litres of a mixture of red paint and white paint in the ratio 4 : 3.

The contents of both jugs are mixed together.

Work out the ratio of red paint to white paint in the mixture. Give your answer in its simplest form.

Jug A: red paint = 4 × 11 ÷ 11 = 4 litres, white paint = 7 litres

Jug B: red paint = 16 litres, white paint = 12 litres

Total: red paint = 20 litres, white paint = 19 litres

Ratio = 20 : 19 = 20 : 19

Answer: 20 : 19

10 Finding a rate of compound change

Ben invests £4,500 in a savings account. (Calculator)

Compound interest is paid at a fixed rate each year.

After 2 years the investment is worth £4,681.80.

Work out the annual rate of interest.

Overall multiplier = £4,681.80 ÷ £4,500 = 1.0404

Take the square root: $\sqrt{1.0404} = 1.02$

Rate = (1.02 − 1) × 100 = 2%

Answer: 2%