Day 166 **A Tier 10-a-day: Model Solutions**

1 Substitution

$E = \frac{1}{2}mv^2$

Work out the value of E when m = 2 and v = −5

$E = \frac{1}{2} \times 2 \times (-5)^2$

$= 1 \times 25$

$= 25$

Answer: 25

2 Mixed number addition and subtraction

Work out $1\frac{1}{2} + 2\frac{4}{9}$

Give your answer as a mixed number in its simplest form.

Write as improper fractions: $1\frac{1}{2} = \frac{3}{2}$ and $2\frac{4}{9} = \frac{22}{9}$

Common denominator 18: $\frac{27}{18} + \frac{44}{18}$

$= \frac{71}{18}$

$= 3\frac{17}{18}$

Answer: $3\frac{17}{18}$

3 Pie charts

The pie chart shows how some students chose a drink.
16 students chose tea.
(a) Work out the angle for water.
(b) How many students chose water?

(a) 360 − 128 − 48 − 104 = 80°
(b) 16 students is 128°, so 1 student is 128 ÷ 16 = 8°
Water: 80 ÷ 8 = 10
Answer: (a) 80° (b) 10

4 Interior angles of polygons

The size of each angle of a quadrilateral is shown as an expression:
(x + 55)°, (2x + 40)°, (3x − 30)°, (3x + 16)°
Work out the value of x.

Sum of angles = (4 − 2) × 180 = 360°
x + 55 + 2x + 40 + 3x − 30 + 3x + 16 = 360
9x + 81 = 360
9x = 279
x = 31
Answer: x = 31

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5 Parallel and perpendicular lines

The line L has equation $y = -\frac{1}{3}x + 8$

Find the equation of the line that is parallel to L and passes through the point (3, 1).

Parallel lines have the same gradient, so the gradient is $-\frac{1}{3}$

$y = -\frac{1}{3}x + c$, so $1 = -\frac{1}{3} \times 3 + c$

$c = 2$

$y = -\frac{1}{3}x + 2$

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

6 Probability without replacement

A bag contains 5 yellow and 5 white balls.
Two balls are taken at random without replacement.
Work out the probability that the two balls are different colours.

P(same colour) = $\frac{5}{10} \times \frac{4}{9} + \frac{5}{10} \times \frac{4}{9} = \frac{4}{9}$

P(different) = $1 - \frac{4}{9} = \frac{5}{9}$

Answer: $\frac{5}{9}$

7 Bounds of a speed or density

A runner travels 170 m in 9.7 s. The distance is measured to the nearest 10 metres and the time to the nearest 0.1 second. (Calculator)
Work out the upper bound for the runner's speed in m/s.
Give your answer correct to 3 significant figures.

speed = distance ÷ time
For the upper bound of speed use the upper bound of distance and the lower bound of time.
175 ÷ 9.65 = 18.13472
= 18.1 m/s (3 s.f.)
Answer: 18.1 m/s

8 Circle theorems: tangents

PA and PB are tangents to a circle with centre O.
Angle APB = 82°.
Work out the size of angle x (angle AOB).
Give a reason for each step of your working.

A tangent is perpendicular to the radius, so angles OAP and OBP are both 90°
The angles in quadrilateral OAPB add up to 360°
$x = 360 - 90 - 90 - 82 = 98$
Answer: $x = 98°$

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9 Inverse proportion formulae

y is inversely proportional to $\sqrt{x}$.
When x = 100, y = 8.
(a) Find a formula for y in terms of x.
(b) Work out the positive value of x when y = 20.

(a) $y = \frac{k}{\sqrt{x}}$. Substitute: $8 = \frac{k}{10}$, so $k = 8 \times 10 = 80$

$y = \frac{80}{\sqrt{x}}$

(b) $20 = \frac{80}{\sqrt{x}}$, so $\sqrt{x} = 80 \div 20 = 4$, so $x = 4^2 = 16$

Answer: (a) $y = \frac{80}{\sqrt{x}}$ (b) x = 16

10 Reverse compound change

The value of a car falls by 20% each year. (Calculator)
After 2 years it is worth £640.
Work out its value at the start.

Yearly multiplier = 0.8
Overall multiplier = $0.8^2 = 0.64$
Original value = £640 ÷ 0.64 = £1,000
Answer: £1,000