Day 350 **A Tier 10-a-day: Model Solutions**

1 Income tax

No tax is paid on the first £12,500 of income. Tax of 15% is paid on the next £35,000. Tax of 45% is paid on all income above £47,500. (Calculator)
Isla earns £68,500 a year.
Work out the income tax paid.

Next £35,000 at 15%: £35,000 × 0.15 = £5,250
Above £47,500: £68,500 − £47,500 = £21,000, taxed at 45%: £21,000 × 0.45 = £9,450
Total tax = £5,250 + £9,450 = £14,700
Answer: £14,700

2 Angles in parallel lines

The diagram shows two parallel lines crossed by a straight line.
(a) Work out the value of x.
(b) Work out the size of the angle marked $(2x - 10)°$.
The diagram is not drawn accurately.

(a) Co-interior angles add up to 180°
$2x - 10 + 3x + 50 = 180$
$5x + 40 = 180$
$5x = 140$
$x = 28$
(b) $2 \times 28 - 10 = 46$
Answer: (a) x = 28 (b) 46°

3 Estimation

By rounding each number to 1 significant figure, estimate the value of

$$\frac{87.4 + 5.8}{0.83}$$

Round each number to 1 significant figure: 90, 6, 0.8

$$\frac{90 + 6}{0.8} = 120$$

Answer: 120

4 Circle theorems: isosceles triangles with radii

A, B and C are points on a circle with centre O.
Angle OAB = 38°.
(a) Work out angle AOB.
(b) Work out the size of angle x.
Give reasons for your answers.

(a) OA = OB (radii), so triangle OAB is isosceles and angle OBA = 38°
Angle AOB = 180 − 38 − 38 = 104°
(b) The angle at the centre is twice the angle at the circumference
x = 104 ÷ 2 = 52
Answer: (a) 104° (b) x = 52°

5 Iteration

$x_{n+1} = \sqrt{6x_n + 11}$
$x_0 = 4$
Work out the values of x_1, x_2 and x_3.
Give your answers correct to 3 decimal places. (Calculator)

Substitute $x_0 = 4$ into the formula, then use each answer in the next step (keep the full calculator display)
$x_1 = 5.91608$
$x_2 = 6.81883$
$x_3 = 7.20507$
Answer: $x_1 = 5.916$, $x_2 = 6.819$, $x_3 = 7.205$

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6 Venn diagram probability

The Venn diagram shows information about 35 people.
One person is chosen at random.
(a) The person is in set French. Find the probability that they are also in set Spanish.
(b) The person is not in set Spanish. Find the probability that they are in set French.

(a) In French: 13 + 5 = 18 people, of whom 5 are also in Spanish: $\frac{5}{18}$

(b) Not in Spanish: 13 + 3 = 16 people, of whom 13 are in French: $\frac{13}{16}$

Answer: (a) $\frac{5}{18}$ (b) $\frac{13}{16}$

7 Adding algebraic fractions

Write as a single fraction

$\frac{5}{(x + 4)} + \frac{4}{(x - 3)}$

Common denominator is $(x + 4)(x - 3)$

$= \frac{5(x - 3) + 4(x + 4)}{(x + 4)(x - 3)}$

$= \frac{9x + 1}{(x + 4)(x - 3)}$

Answer: $\frac{9x + 1}{(x + 4)(x - 3)}$

8 Bounds of a speed or density

A runner travels 370 m in 16.6 s. The distance is measured to the nearest 10 metres and the time to the nearest 0.1 second. (Calculator)
Work out the lower bound for the runner's speed in m/s.
Give your answer correct to 3 significant figures.

speed = distance ÷ time
For the lower bound of speed use the lower bound of distance and the upper bound of time.
365 ÷ 16.65 = 21.92192
= 21.9 m/s (3 s.f.)
Answer: 21.9 m/s

9 Rearranging formulae

Make a the subject of $b = \frac{4a + 1}{6}$

Multiply both sides by 6: $6b = 4a + 1$
Subtract 1 from both sides: $4a = 6b - 1$
Divide both sides by 4
$a = \frac{6b - 1}{4}$

Answer: $a = \frac{6b - 1}{4}$

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10 Inverse proportion formulae

y is inversely proportional to x.
When x = 4, y = 9.
(a) Find a formula for y in terms of x.
(b) Work out the positive value of x when y = 7.2.

(a) $y = \frac{k}{x}$. Substitute: $9 = \frac{k}{4}$, so $k = 9 \times 4 = 36$

$y = \frac{36}{x}$

(b) $7.2 = \frac{36}{x}$, so $x = 36 \div 7.2 = 5$

Answer: (a) $y = \frac{36}{x}$ (b) x = 5