Day 280 **A Tier 10-a-day: Model Solutions**

1 Time

(a) A film starts at 8:45 pm. The film lasts 1 hours 52 minutes. Work out the time it ends.
(b) Change 210 minutes into hours. Give your answer as a decimal.

(a) 8:45 pm + 1 hours 52 minutes = 10:37 pm
(b) 210 ÷ 60 = 3.5 hours
Answer: (a) 10:37 pm (b) 3.5 hours

2 Factorising quadratics

Factorise $x^2 - 9x + 20$

Find two numbers that multiply to 20 and add to −9
The numbers are −5 and −4
$(x - 5)(x - 4)$
Answer: $(x - 5)(x - 4)$

3 Similar triangles with parallel lines

In triangle ABC, DE is parallel to BC.
D is on AB and E is on AC.
Work out the value of x.
The diagram is not drawn accurately.

Triangles ADE and ABC are similar (DE is parallel to BC)

AE ÷ AC = AD ÷ AB, so $AC = 8 \times \frac{7}{4} = 14$

x = EC = 14 − 8 = 6
Answer: x = 6

4 Stem and leaf diagrams

The stem and leaf diagram shows the ages of 15 people.
Key: 3 | 0 represents 30 years
(a) Work out the median age.
(b) Work out the interquartile range.

(a) 15 values, so the median is the 8th value
Counting along the leaves gives 51
(b) LQ is the middle of the lower 7 values = 36
UQ is the middle of the upper 7 values = 63
IQR = 63 − 36 = 27
Answer: (a) 51 years (b) 27 years

5 Difference of two squares

(a) Factorise $x^2 - 25$
(b) Use the same idea to work out $78^2 - 22^2$ without a calculator.

(a) Difference of two squares: $x^2 - 25 = x^2 - 5^2$
$(x - 5)(x + 5)$
(b) $a^2 - b^2 = (a + b)(a - b)$, so $78^2 - 22^2 = (78 + 22)(78 - 22)$
$= 100 \times 56 = 5600$
Answer: (a) $(x - 5)(x + 5)$ (b) 5600

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6 Standard form in context

Light travels at 3×10^5 kilometres per second.
The Sun is 7.8×10^7 kilometres from Earth.
Work out how many seconds light takes to travel from the Sun to Earth.
Give your answer in standard form.

time = distance ÷ speed = $(7.8 \times 10^7) \div (3 \times 10^5)$
$7.8 \div 3 = 2.6$ and $10^7 \div 10^5 = 10^2$
$= 2.6 \times 10^2$ seconds
Answer: 2.6×10^2 seconds

7 Circle theorems: angles in the same segment

A, B, C and D are points on a circle. AC and BD meet at E.
Angle BAC = 40° and angle ACD = 59°.
Work out the size of angle x (angle AEB).
Give reasons for your working.

Angles in the same segment are equal, so angle ABD = angle ACD = 59°
In triangle ABE: angle BAE = 40° and angle ABE = 59°
$x = 180 - 40 - 59 = 81$
Answer: x = 81°

8 Mixing in a ratio

Jug A contains 36 litres of a mixture of red paint and white paint in the ratio 2 : 7.
Jug B contains 12 litres of a mixture of red paint and white paint in the ratio 1 : 2.
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 = $2 \times 36 \div 9 = 8$ litres, white paint = 28 litres
Jug B: red paint = 4 litres, white paint = 8 litres
Total: red paint = 12 litres, white paint = 36 litres
Ratio = 12 : 36 = 1 : 3
Answer: 1 : 3

9 Transformations of graphs

The graph of y = f(x) has a minimum point at (−1, 4).
Write down the coordinates of the turning point of the graph of
(a) y = f(x + 2)
(b) y = 2f(x)

(a) Replacing x by (x + 2) moves the graph 2 units left
The minimum point is (−3, 4)
(b) Multiplying f(x) by 2 stretches the graph vertically by a factor of 2, so the y-coordinate is multiplied by 2
The minimum point is (−1, 8)
Answer: (a) (−3, 4) (b) (−1, 8)

10 The cosine rule: finding an angle

Work out the size of angle x. (Calculator)
Give your answer to 1 decimal place.
The diagram is not drawn accurately.

$$\cos x = \frac{18^2 + 11^2 - 14^2}{2 \times 18 \times 11}$$

$$\cos x = \frac{249}{396}$$

$x = \cos^{-1}(0.6288)$
$x = 51.0°$
Answer: x = 51.0°