Day 71 **A Tier 10-a-day: Model Solutions**

1 Mixed number addition and subtraction

Work out $5\frac{2}{3} + 3\frac{2}{7}$

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

Write as improper fractions: $5\frac{2}{3} = \frac{17}{3}$ and $3\frac{2}{7} = \frac{23}{7}$

Common denominator 21: $\frac{119}{21} + \frac{69}{21}$

$= \frac{188}{21}$

$= 8\frac{20}{21}$

Answer: $8\frac{20}{21}$

2 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 = $15 \times \frac{7}{5} = 21$

x = EC = 21 − 15 = 6

Answer: x = 6

3 Functions

f(x) = 3x + 6

$g(x) = x^2 - 9$

(a) Find g(1)

(b) Find gf(x). Expand and simplify your answer.

(a) $g(1) = 1^2 - 9 = -8$

(b) gf(x) means g(f(x)), so replace x in g with 3x + 6

$gf(x) = (3x + 6)^2 - 9$

$= 9x^2 + 36x + 27$

Answer: (a) −8 (b) $9x^2 + 36x + 27$

4 Box plots

The box plot shows the scores of the students in Class A in a test.

(a) Write down the median and the interquartile range.

For Class B the median is 55 and the interquartile range is 25.

(b) Compare the distributions of the two classes.

(a) Median = 65

Interquartile range = 85 − 50 = 35

(b) The median for Class A is higher (65 compared with 55), so it has the higher values on average

The IQR for Class B is smaller (25 compared with 35), so its values are more consistent

Answer: (a) Median 65, IQR 35 (b) Class A has the higher median; Class B has the smaller IQR so is more consistent

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5 Parallel and perpendicular lines

The line L has equation $y = -\frac{3}{4}x - 5$

Find the equation of the line that is perpendicular to L and passes through the point (3, 5).

The gradient of L is $-\frac{3}{4}$

Perpendicular gradient = $-1 \div (-\frac{3}{4}) = \frac{4}{3}$

$y = \frac{4}{3}x + c$, so $5 = \frac{4}{3} \times 3 + c$

$c = 1$

$y = \frac{4}{3}x + 1$

Answer: $y = \frac{4}{3}x + 1$

6 Area of a triangle using sine

Work out the area of triangle ABC. (Calculator)
Give your answer to 3 significant figures.
The diagram is not drawn accurately.

Area = $\frac{1}{2} \times a \times b \times \sin C$

$= \frac{1}{2} \times 10 \times 7 \times \sin 35°$

$= 20.1$

Answer: 20.1 cm^2

7 Combined means

The mean age of 7 workers is 58 years.
One of them, aged 73, leaves.
Work out the mean age of the remaining workers.

Total age = $7 \times 58 = 406$
Total after one leaves = $406 - 73 = 333$
Mean = $333 \div 6 = 55.5$
Answer: 55.5 years

8 Reverse compound change

The value of a car falls by 20% each year. (Calculator)
After 2 years it is worth £23,040.
Work out its value at the start.

Yearly multiplier = 0.8
Overall multiplier = $0.8^2 = 0.64$
Original value = £23,040 ÷ 0.64 = £36,000
Answer: £36,000

9 Equations with algebraic fractions

Solve $\frac{4}{(x+2)} + \frac{5}{(x-5)} = 1$

Multiply every term by $(x + 2)(x - 5)$
$4(x - 5) + 5(x + 2) = (x + 2)(x - 5)$
$9x - 10 = x^2 - 3x - 10$
$x^2 - 12x = 0$
$x(x - 12) = 0$
$x = 0$ or $x = 12$
Answer: x = 0 or x = 12

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10 Volume of cones and spheres

A sphere has radius 6 cm.

Work out the volume of the sphere. Give your answer in terms of π.

Volume $= \frac{4}{3} \times \pi \times r^3$

$= \frac{4}{3} \times \pi \times 6^3$

$= \frac{4}{3} \times 216\ \pi$

$= 288\pi$

Answer: 288π cm^3