Day 168 **A Tier 10-a-day: Model Solutions**

1 Forming and solving equations

The sum of 5 consecutive whole numbers is 155.
Work out the largest of the numbers.

Let the smallest number be n. The numbers are n, n + 1, n + 2, n + 3, n + 4
Sum = 5n + 10 = 155
5n = 145
n = 29
The numbers are 29, 30, 31, 32, 33
Answer: 33

2 Loci and constructions

PQ is a straight line.
A point S moves so that it is always 5 cm from the line PQ, on one side of it.
Describe the locus of S.

Points a fixed distance from a straight line, on one side, form a parallel line
It is parallel to PQ and 5 cm from it
Answer: A straight line parallel to PQ, 5 cm away from it

3 Density

A piece of wood has a mass of 156 g.
The density of the material is 1.2 g/cm^3.
Work out the volume of the piece of wood.

Volume = mass ÷ density
= 156 ÷ 1.2 = 130 cm^3
Answer: 130 cm^3

4 Simplifying surds

(a) Simplify $\sqrt{150}$
(b) Simplify $\sqrt{150} - \sqrt{24}$

(a) $\sqrt{150} = \sqrt{25} \times \sqrt{6} = 5\sqrt{6}$
(b) $\sqrt{24} = 2\sqrt{6}$, so $5\sqrt{6} - 2\sqrt{6} = 3\sqrt{6}$
Answer: (a) $5\sqrt{6}$ (b) $3\sqrt{6}$

5 Volume of a prism

The diagram shows a prism with a right-angled triangle as its cross-section.
The volume of the prism is 160 cm^3.
Work out the value of x.
The diagram is not drawn accurately.

Area of cross-section = $\frac{1}{2} \times 8 \times 10 = 40$
Volume = area × length
160 = 40 × length
length = 160 ÷ 40 = 4
Answer: x = 4

6 Equation of a straight line

A straight line passes through the points (2, 5) and (5, −4).
Find the equation of the line.

Gradient = $\frac{-4 - 5}{5 - 2} = \frac{-9}{3} = -3$
Use y = mx + c with m = −3 and the point (2, 5): 5 = −3 × 2 + c
c = 11
y = −3x + 11
Answer: y = −3x + 11

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7 Compound shapes with circles

The diagram shows a shape made from a rectangle and a semicircle.
Work out the area of the shape.
Give your answer in terms of π.
The diagram is not drawn accurately.

Rectangle: $18 \times 10 = 180$

Semicircle: $\frac{1}{2} \times \pi \times 9^2 = \frac{81}{2}\pi$

Total = $180 + \frac{81}{2}\pi$

Answer: $180 + \frac{81}{2}\pi$ cm^2

8 Simultaneous equations (one quadratic)

Solve the simultaneous equations
$x^2 + y^2 = 289$
$y = -x + 23$

Substitute $y = -x + 23$ into $x^2 + y^2 = 289$
$x^2 + (-x + 23)^2 = 289$
$2x^2 - 46x + 240 = 0$
Divide by 2: $x^2 - 23x + 120 = 0$
$(x - 8)(x - 15) = 0$
$x = 8$ or $x = 15$
Use $y = -x + 23$ to find y: when $x = 8$, $y = 15$; when $x = 15$, $y = 8$
Answer: $x = 8$, $y = 15$ and $x = 15$, $y = 8$

9 Finding an interest rate

Owen invests £2000 in a savings account. (Calculator)
The account pays compound interest at a fixed rate each year.
After 2 years there is £2080.80 in the account.
Work out the annual rate of interest.

Let the yearly multiplier be m. Then $2000 \times m^2 = 2080.8$
$m^2 = 2080.8 \div 2000 = 1.0404$
$m = \sqrt{1.0404} = 1.02$
Rate = $(1.02 - 1) \times 100 = 2\%$
Answer: 2%

10 Fraction calculations

Work out $(4\frac{1}{2} - 2\frac{1}{6}) \times 2\frac{2}{3}$
Give your answer as a mixed number in its simplest form.

Brackets first, as improper fractions: $\frac{9}{2} - \frac{13}{6} = \frac{7}{3}$

Then multiply: $\frac{7}{3} \times \frac{8}{3} = \frac{56}{9}$

$= 6\frac{2}{9}$

Answer: $6\frac{2}{9}$