Day 304 **A Tier 10-a-day: Model Solutions**

1 Area of shaded regions with circles

2 identical circles of radius 9 cm fit exactly inside a rectangle.
The circles touch each other and the sides of the rectangle. (Calculator)
Work out the area of the shaded region.
Give your answer to 3 significant figures.

Rectangle: $36 \times 18 = 648$ cm^2
2 circles: $2 \times \pi \times 9^2 = 162\pi$
Shaded area $= 648 - 162\pi = 139$
Answer: 139 cm^2

2 Standard form in context

One grain of sand has a mass of 1.5×10^{-7} kg.
A sample contains 3×10^4 grains of sand.
Work out the total mass of the sample.
Give your answer in standard form.

Total mass $= (1.5 \times 10^{-7}) \times (3 \times 10^4)$
$1.5 \times 3 = 4.5$ and $10^{-7} \times 10^4 = 10^{-3}$
Answer: 4.5×10^{-3} kg

3 Area of parallelograms and kites

The area of this parallelogram is 200 cm^2.
Work out the value of h.
The diagram is not drawn accurately.

$20 \times h = 200$
$h = 200 \div 20 = 10$
Answer: h = 10

4 Simplifying surds

(a) Simplify $\sqrt{75}$
(b) Simplify $\sqrt{75} - \sqrt{48}$

(a) $\sqrt{75} = \sqrt{25} \times \sqrt{3} = 5\sqrt{3}$
(b) $\sqrt{48} = 4\sqrt{3}$, so $5\sqrt{3} - 4\sqrt{3} = \sqrt{3}$
Answer: (a) $5\sqrt{3}$ (b) $\sqrt{3}$

5 Direct proportion formulae

y is directly proportional to the square of x.
When x = 3, y = 36.
(a) Find a formula for y in terms of x.
(b) Work out the value of y when x = 1.

(a) $y = kx^2$. Substitute: $36 = k \times 9$, so $k = 4$
$y = 4x^2$
(b) $y = 4 \times 1 = 4$
Answer: (a) $y = 4x^2$ (b) 4

6 Factorising

Factorise $6x^2 + 5x - 6$

Multiply $6 \times -6 = -36$. Find two numbers that multiply to -36 and add to 5: 9 and -4
$6x^2 + 5x - 6 = 6x^2 + 9x - 4x - 6$
Factorise in pairs to get $(3x - 2)(2x + 3)$
Answer: $(3x - 2)(2x + 3)$

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7 Converting area and volume units

Change 10000 cm^2 to m^2.

1 m^2 = 10 000 cm^2
10000 ÷ 10 000 = 1
Answer: 1 m^2

8 Rearranging formulae (subject twice)

Make x the subject of $y = \frac{4x - 5}{2x + 6}$

Multiply both sides by (2x + 6): $y(2x + 6) = 4x - 5$
Expand the bracket: $2xy + 6y = 4x - 5$
Collect the x terms on one side: $2xy - 4x = -6y - 5$
Factorise: $x(2y - 4) = -6y - 5$
Divide by (2y − 4): $x = \frac{-6y - 5}{2y - 4}$

Answer: $x = \frac{-6y - 5}{2y - 4}$

9 Bounds in measurement

The length and width of a rectangular poster are 16.8 cm and 9.4 cm.
Each measurement is correct to 1 decimal place.
Work out the lower bound for the area.

Lower bound of length = 16.8 cm, lower bound of width = 9.3 cm
Lower bound of area = 16.75 × 9.35 = 156.6125
Answer: 156.6125 cm^2

10 Recurring decimals, show that

(a) Show that $0.\dot{1}\dot{0} = \frac{10}{99}$

(b) Hence write $2.\dot{1}\dot{0}$ as a mixed number in its simplest form.

(a) Let x = 0.101010..., so 100x = 10.1010...

$100x - x = 10$, so $99x = 10$ and $x = \frac{10}{99}$

(b) $2.\dot{1}\dot{0} = 2 + \frac{10}{99} = 2\frac{10}{99}$

Answer: (b) $2\frac{10}{99}$