Day 302 **A Tier 10-a-day: Model Solutions**

1 Surface area of a cuboid

A cuboid has length 13 cm and width 9 cm.
Its total surface area is 498 cm^2.
Work out the height of the cuboid.

$2 \times (13 \times 9 + 13\ h + 9\ h) = 498$
$117 + 22h = 249$
$22h = 132$
$h = 132 \div 22 = 6$
Answer: 6 cm

2 Pressure

A table rests on an area of 0.5 m^2 of the floor.
The pressure on the floor is 120 N/m^2.
Work out the force exerted by the table.

Force = pressure × area
$= 120 \times 0.5 = 60$
Answer: 60 N

3 Functions

$f(x) = -3x + 4$
$g(x) = x^2 - 7$
Find $fg(-1)$

$g(-1) = (-1)^2 - 7 = -6$
$f(-6) = -3 \times (-6) + 4 = 22$
Answer: 22

4 The sine rule

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

$$\frac{\sin x}{20} = \frac{\sin 69°}{21}$$

$$\sin x = \frac{20 \times \sin 69°}{21}$$

$x = \sin^{-1}(0.8891)$
$x = 62.8°$
Answer: x = 62.8°

5 Square and cube numbers

n is the smallest positive integer such that 96 × n is a cube number.
Find the value of n.

Write 96 as a product of prime factors: $96 = 2^5 \times 3$
For a cube number every prime must have a power that is a multiple of 3.
Extra primes needed: 2 (needs 1 more), 3 (needs 2 more)
$n = 18$
Answer: n = 18

6 Pythagoras' theorem

Work out the length of x.
The diagram is not drawn accurately.

$41^2 = x^2 + 9^2$
$x^2 = 1681 - 81 = 1600$
$x = \sqrt{1600} = 40$
Answer: x = 40 m

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7 Venn diagram probability

The Venn diagram shows information about 21 people.
One person is chosen at random.
(a) The person is in set Tea. Find the probability that they are also in set Coffee.
(b) The person is not in set Coffee. Find the probability that they are in set Tea.

(a) In Tea: 6 + 5 = 11 people, of whom 5 are also in Coffee: $\frac{5}{11}$

(b) Not in Coffee: 6 + 5 = 11 people, of whom 6 are in Tea: $\frac{6}{11}$

Answer: (a) $\frac{5}{11}$ (b) $\frac{6}{11}$

8 Circles and tangents

The point P(−5, 12) lies on a circle with centre O(0, 0).
(a) Work out the equation of the circle, in the form $x^2 + y^2 = r^2$.
(b) Find the equation of the tangent to the circle at P.

(a) The circle is $x^2 + y^2 = r^2$, so $r^2 = (-5)^2 + 12^2 = 169$

(b) Gradient of the radius OP = $\frac{12}{-5} = -\frac{12}{5}$

The tangent is perpendicular to the radius, so its gradient = $-1 \div (-\frac{12}{5}) = \frac{5}{12}$

$y = \frac{5}{12}x + c$ through (−5, 12): $12 = \frac{5}{12} \times (-5) + c$, so $c = \frac{169}{12}$

$y = \frac{5}{12}x + \frac{169}{12}$

Answer: (a) $x^2 + y^2 = 169$ (b) $y = \frac{5}{12}x + \frac{169}{12}$

9 Recurring decimals (mixed)

Write $0.2\dot{8}$ as a fraction in its simplest form.

Let x = 0.288...
Multiply by 10: 10x = 2.88...
Multiply by 100: 100x = 28.88...
Subtract: 90x = 28 − 2 = 26
$x = \frac{26}{90} = \frac{13}{45}$

Answer: $\frac{13}{45}$

10 Probability with three selections

A bag contains 6 mint sweets and 4 toffee sweets.
Three sweets are taken at random without replacement.
Work out the probability that all three sweets are mint.

P(all mint) = $\frac{6}{10} \times \frac{5}{9} \times \frac{4}{8}$

$= \frac{120}{720} = \frac{1}{6}$

Answer: $\frac{1}{6}$