Day 77 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Connected rates of change (All boards)

The volume of a sphere increases at 50 cm^3/s.
Find the rate of increase of the radius when r = 4. Give your answer to 3 s.f.

$V = \frac{4}{3}\pi r^3$, so $\frac{dV}{dr} = 4\pi r^2$

$\frac{dr}{dt} = \frac{dV}{dt} \div \frac{dV}{dr} = \frac{50}{4\pi \times 4^2} = 0.249$

Answer: 0.249 cm/s

2 Expanding brackets with surds (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Expand and simplify $(1 + \sqrt{5})(1 - \sqrt{5})$.

$= 1^2 - (\sqrt{5})^2$
$= 1 - 5$
Answer: -4

3 Box plots (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The box plot summarises the delivery times, in minutes, of a pizza company.
Find the range and the interquartile range.

Range = 70 − 10 = 60
IQR = 50 − 15 = 35
Answer: range = 60, IQR = 35

4 Differentiate tan, sec, cosec, cot (All boards)

Differentiate y = 2 tan x with respect to x.

Use the standard result: $d/dx(\tan x) = \sec^2 x$
Answer: $dy/dx = 2\sec^2 x$

5 The remainder theorem (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the remainder when $3x^3 + 2x^2 + 6x - 4$ is divided by $(3x - 5)$.

Put $3x - 5 = 0$: $x = \frac{5}{3}$

Remainder = $f(\frac{5}{3}) = \frac{125}{9} + \frac{50}{9} + 10 + (-4)$

$= \frac{229}{9}$

Answer: $\frac{229}{9}$

6 Equilibrium of a particle under three forces (diagram) (All boards)

A particle is in equilibrium under the three forces shown. $\cos\alpha = \frac{12}{13}$. Find P and Q.

Horizontally: $P = 78\cos\alpha = 78 \times \frac{12}{13}$

Vertically: $Q = 78\sin\alpha = 78 \times \frac{5}{13}$

Answer: P = 72, Q = 30

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7 Trapezium rule from a table (AQA, Edexcel, OCR, MEI, Eduqas)

The table shows values of y = f(x).

x: 1 2 3 4 5 6

y: 5.3 7.7 6.8 6 4.6 5.4

Use the trapezium rule to estimate the area under the curve between x = 1 and x = 6.

h = 1 with 5 strips

Area $\approx \frac{1}{2}[5.3 + 5.4 + 2(7.7 + 6.8 + 6 + 4.6)]$

$= \frac{1}{2} \times 60.9$

$= 30.45$

Answer: 30.45

8 Energy: falling object (potential and kinetic energy) (CIE)

A particle of mass 10 kg is released from rest and falls 19.6 m. Take g = 9.8 m s^{-2}. Use energy to find (a) the loss in potential energy (3 s.f.), (b) the speed of the particle after falling 19.6 m.

(a) Loss in PE = mgh = 10 × 9.8 × 19.6 = 1920.8

(b) $\frac{1}{2} \times 10 \times v^2 = 1920.8$

$v^2 = 384.16$

Answer: (a) 1920 J (b) 19.6 m s^{-1}

9 Normal approximation to the binomial (CIE)

X ~ B(120, 0.2). Use a normal approximation to find P(X ≤ 28), to 3 s.f.

np = 24 and npq = 19.2, so use Y ~ N(24, 19.2)

Continuity correction: P(Y < 28.5)

$z = (28.5 - 24) \div \sqrt{19.2}$

Answer: 0.848

10 Modulus equations (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve |x − 6| < 3.

−3 < x − 6 < 3

Add 6 to each part.

Answer: 3 < x < 9