Day 1 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Degrees and radians (All boards)

(a) Convert 45° to radians, giving your answer in terms of π.

(b) Convert $\frac{3\pi}{2}$ radians to degrees.

(a) $45° = 45 \times \frac{\pi}{180} = \frac{\pi}{4}$

(b) $\frac{3\pi}{2}$ radians $= \frac{3\pi}{2} \times \frac{180}{\pi} = 270°$

Answer: (a) $\frac{\pi}{4}$ radians (b) 270°

2 Starting from rest: find the time (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A train starts from rest and moves in a straight line with constant acceleration 1 m s^{-2}.
It travels 18 m. Find the time taken.

$s = ut + \frac{1}{2}at^2$ with $u = 0$

$18 = \frac{1}{2} \times 1 \times t^2$

$t^2 = 36$

Answer: 6 s

3 Normal approximation to the binomial (CIE)

X ~ B(50, 0.3). Use a normal approximation to find P(X ≤ 17), to 3 s.f.

np = 15 and npq = 10.5, so use Y ~ N(15, 10.5)
Continuity correction: P(Y < 17.5)
$z = (17.5 - 15) \div \sqrt{10.5}$
Answer: 0.780

4 Transforming a graph with a labelled turning point (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the curve y = f(x). The maximum point is shown. Write down the coordinates of the maximum point on the curve with equation
(a) y = f(x + 3) (b) y = −f(x)

(a) y = f(x + 3): the maximum point moves to (−4, 4).
(b) y = −f(x): the point moves (it becomes a minimum) to (−1, −4).
Answer: (a) (−4, 4) (b) (−1, −4)

5 Normal distribution: inverse (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

X ~ N(130, 3^2). Given that P(X < a) = 0.7, find a to 3 s.f.

P(Z < z) = 0.7, so z = 0.5244 (from the inverse normal function)
a = 130 + 0.5244 × 3
Answer: 132

6 Quotient rule (All boards)

Use the quotient rule to find the derivative of
$y = \frac{\sin x}{x}$.

Quotient rule: if $y = \frac{u}{v}$ then $dy/dx = \frac{u'v - uv'}{v^2}$

Differentiate the numerator and denominator, then substitute and simplify.

Answer: $dy/dx = \frac{x \cos x - \sin x}{x^2}$

Day 1 **A Level Maths: C Tier 10-a-day: Model Solutions**

7 Two particles over a smooth pulley (All boards)

Two particles of masses 6 kg and 8 kg hang from the ends of a light inextensible string over a smooth pulley and are released from rest. Take g = 9.8 m s^{-2}. Find the acceleration and the tension in the string.

8 kg: $8 \times 9.8 - T = 8a$
6 kg: $T - 6 \times 9.8 = 6a$
Adding: $19.6 = 14a$, then $T = 6(9.8 + a)$
Answer: a = 1.4 m s^{-2}, T = 67.2 N

8 Partial fractions (Edexcel, OCR, MEI, CIE, AQA, Eduqas)

Express $\frac{-x + 17}{(x - 1)(x - 5)}$ in partial fractions.

Write $\frac{-x + 17}{(x - 1)(x - 5)} = \frac{A}{(x - 1)} + \frac{B}{(x - 5)}$
$-x + 17 = A(x - 5) + B(x - 1)$
$x = 1$: $16 = A(-4)$ so $A = -4$
$x = 5$: $12 = B(4)$ so $B = 3$
Answer: $\frac{-4}{(x - 1)} + \frac{3}{(x - 5)}$

9 Connected rates of change (All boards)

The volume of a sphere increases at 18 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 $\frac{dV}{dr} = 4\pi r^2$

$\frac{dr}{dt} = \frac{dV}{dt} \div \frac{dV}{dr} = \frac{18}{4\pi \times 4^2} = 0.0895$

Answer: 0.0895 cm/s

10 Exponential graph through two points (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the curve $y = ab^x$, where $b > 0$.
Find the values of a and b.

Through (0, 3): $a \times b^0 = 3$, so $a = 3$.
Through (2, 48): $3b^2 = 48$
$b^2 = 16$, so $b = 4$ ($b > 0$)
Answer: a = 3, b = 4