Day 175 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 F = ma: find the force or the mass (All boards)

A resultant force of 8 N gives a body an acceleration of 4 m s^{-2}. Find the mass of the body.

$F = ma$

$8 = m \times 4$

Answer: 2 kg

2 Laws of logarithms: single log (All boards)

Given that $\log_2 x = p$, write the following in terms of p:

(a) $\log_2 x^2$ (b) $\log_2 (4x)$

(a) $\log_2 x^2 = 2 \log_2 x = 2p$

(b) $\log_2 (4x) = \log_2 4 + \log_2 x = 2 + p$

Answer: (a) 2p (b) p + 2

3 Work done and kinetic energy (CIE)

A particle of mass 8 kg changes its speed from 5 m s^{-1} to 8 m s^{-1}. Find the increase in its kinetic energy.

$KE = \frac{1}{2}mv^2$

$\text{Increase} = \frac{1}{2} \times 8 \times 8^2 - \frac{1}{2} \times 8 \times 5^2$

Answer: 156 J

4 Simplifying surds (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Simplify $\sqrt{45} + \sqrt{125}$, giving your answer in the form $p\sqrt{5}$.

$\sqrt{45} = 3\sqrt{5}$ and $\sqrt{125} = 5\sqrt{5}$

Sum $= (3 + 5)\sqrt{5}$

Answer: $8\sqrt{5}$

5 Sector: arc length and area (diagram) (All boards)

The diagram shows sector OAB of a circle.

Find, in terms of π, (a) the arc length AB, (b) the area of the sector.

(a) Arc length $= r\theta = 10 \times \frac{\pi}{4} = \frac{5\pi}{2}$ cm

(b) Area $= \frac{1}{2}r^2\theta = \frac{1}{2} \times 10^2 \times \frac{\pi}{4} = \frac{25\pi}{2}$ cm^2

Answer: (a) $\frac{5\pi}{2}$ cm (b) $\frac{25\pi}{2}$ cm^2

6 Perpendicular bisector (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A is (0, 3) and B is (−8, −1).

Find the equation of the perpendicular bisector of AB, in the form ax + by = c with integer a, b and c.

Midpoint of AB = (−4, 1)

Gradient of AB $= \frac{-4}{-8} = \frac{1}{2}$, so perpendicular gradient = −2

$y - 1 = -2(x - (-4))$

Multiply out and rearrange.

Answer: $2x + y = -7$

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7 Separable differential equations (All boards)

Given that $dy/dx = \frac{x}{y}$ and $y = 5$ when $x = 0$,

find y^2 in terms of x.

$y\,dy = x\,dx$, so $\frac{y^2}{2} = \frac{x^2}{2} + c$

$x = 0, y = 5$: $c = \frac{25}{2}$

$y^2 = x^2 + 25$

Answer: $y^2 = x^2 + 25$

8 Normal approximation to the binomial (CIE)

$X \sim B(60, 0.4)$. Use a normal approximation to find $P(X \leq 20)$, to 3 s.f.

$np = 24$ and $npq = 14.4$, so use $Y \sim N(24, 14.4)$

Continuity correction: $P(Y < 20.5)$

$z = (20.5 - 24) \div \sqrt{14.4}$

Answer: 0.178

9 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 $(2, 12)$: $3b^2 = 12$

$b^2 = 4$, so $b = 2$ $(b > 0)$

Answer: $a = 3, b = 2$

10 Continuous random variable: probability and mean (CIE)

X has probability density function $f(x) = \frac{1}{8}x$ for $0 \leq x \leq 4$, and 0 otherwise.

Find $P(X < 3)$.

$P(X < 3) = \int$ from 0 to 3 of $\frac{1}{8}x\,dx$

$= [\frac{1}{16}x^2]$ from 0 to 3

Answer: $\frac{9}{16}$