Day 150 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Constant acceleration: distance from average speed (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A lorry moving in a straight line with constant acceleration increases its speed from 8 m s^{-1} to 19 m s^{-1} in 14 s. Find the distance it travels in this time.

$s = \frac{(u + v)}{2} t$

$s = \frac{(8 + 19)}{2} \times 14$

Answer: 189 m

2 Finding a quadratic from its turning point (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows a sketch of a quadratic curve.

Find its equation in the form $y = a(x - p)^2 + q$.

The turning point is (3, 5), so $y = a(x - 3)^2 + 5$.

The curve passes through (0, −13):

$-13 = a(-3)^2 + 5$, so $-18 = 9a$

$a = -2$

Answer: $y = -2(x - 3)^2 + 5$

3 Solve a^x = b using logarithms (All boards)

Solve $2^{x+2} = 500$.

Give your answer to 3 significant figures.

Take logs: $(x + 2) \log 2 = \log 500$

$x + 2 = 8.966$, so $x = 6.97$

Answer: x = 6.97

4 Normal distribution: symmetry (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim N(105, 3^2)$ and $P(105 < X < 109.5) = 0.025$.

Find $P(X > 109.5)$.

$P(X > 105) = 0.5$ as the mean is 105

$P(X > 109.5) = 0.5 - 0.025$

Answer: 0.475

5 Domain and range (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$f(x) = \sqrt{x - 1} + 1$.

State the largest possible domain and the range of f.

$x - 1 \geq 0$, so $x \geq 1$.

$\sqrt{...} \geq 0$, so $f(x) \geq 1$.

Answer: Domain $x \geq 1$, range $f(x) \geq 1$

6 Resultant of perpendicular forces (All boards)

Two forces of magnitudes 6 N and 8 N act on a particle at right angles to each other. Find (a) the magnitude of the resultant, (b) the angle it makes with the 6 N force, to 1 d.p.

(a) $R^2 = 6^2 + 8^2 = 100$

$R = \sqrt{100}$

(b) $\tan \theta = \frac{8}{6}$

Answer: (a) 10 N (b) 53.1°

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7 Linear and quadratic simultaneous equations (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve the simultaneous equations:

$y = x^2 - 3x - 19$, $y = -x - 4$.

$x^2 - 3x - 19 = -x - 4$

$x^2 - 2x - 15 = 0$

$(x - 5)(x + 3) = 0$

Use $y = -x - 4$ to find each y.

Answer: $x = -3$, $y = -1$ and $x = 5$, $y = -9$

8 Area between a line and a curve (All boards)

The curve $y = 8x - x^2$ and the line $y = 3x$ meet at the origin and at P.

Find the area enclosed between them.

$8x - x^2 = 3x$ gives $5x - x^2 = 0$, so $x = 0$ or $x = 5$

Area $= \int_0^5 (5x - x^2)\,dx = \left[\frac{5x^2}{2} - \frac{x^3}{3}\right]$ from 0 to 5

$= \frac{5^3}{2} - \frac{5^3}{3} = \frac{125}{6}$

Answer: $\frac{125}{6}$

9 Normal approximation to the binomial (CIE)

$X \sim B(80, 0.6)$. Use a normal approximation to find $P(X \leq 52)$, to 3 s.f.

$np = 48$ and $npq = 19.2$, so use $Y \sim N(48, 19.2)$

Continuity correction: $P(Y < 52.5)$

$z = (52.5 - 48) \div \sqrt{19.2}$

Answer: 0.848

10 Change of sign to locate a root (All boards)

$f(x) = x^2 - \ln x - 3$.

Show that $f(x) = 0$ has a root between $x = 1$ and $x = 2$.

$f(1) = -2.00$

$f(2) = 0.307$

f is continuous and there is a change of sign, so a root lies in the interval

Answer: f(1) = −2.00, f(2) = 0.307: change of sign