Day 216 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 3D vectors: distance, magnitude and midpoint (All boards)

OA = $\begin{pmatrix}-3\\-1\\3\end{pmatrix}$ and OB = $\begin{pmatrix}-9\\-3\\0\end{pmatrix}$.

Find AB and |AB|, and a unit vector in the direction of AB.

AB = OB − OA = $\begin{pmatrix}-6\\-2\\-3\end{pmatrix}$

$|AB| = \sqrt{6^2 + 2^2 + 3^2} = 7$

Unit vector = $\frac{1}{7}$ AB

Answer: AB = $\begin{pmatrix}-6\\-2\\-3\end{pmatrix}$, |AB| = 7, unit vector $\frac{1}{7}\begin{pmatrix}-6\\-2\\-3\end{pmatrix}$

2 Standard deviation from raw data (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Here are 7 values: 9, 9, 20, 2, 9, 5, 7

Find the mean and the standard deviation, to 3 s.f.

$\Sigma x = 61$, $\Sigma x^2 = 721$, $n = 7$

Mean = 61 ÷ 7 = 8.714

Variance = $\frac{721}{7} - (8.714)^2 = 27.06$

Standard deviation = $\sqrt{27.06}$

Answer: mean = 8.71, standard deviation = 5.20

3 Friction: constant speed, find the coefficient (All boards)

A block of mass 2 kg is pulled along rough horizontal ground at constant speed by a horizontal force of 11.76 N. Take g = 9.8 m s^{-2}. Find the coefficient of friction between the block and ground.

R = 2 × 9.8 = 19.6

Constant speed: F = P = 11.76

F = μR: 11.76 = μ × 19.6

Answer: 0.6

4 Solving equations with indices (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $4^x = 64$.

$4 = 2^2$ and $64 = 2^6$

$2^{2x} = 2^6$, so 2x = 6

Answer: x = 3

5 Friction: acceleration along rough ground (All boards)

A block of mass 10 kg is pulled along rough horizontal ground by a horizontal force of 44.2 N.

The coefficient of friction is 0.4. Take g = 9.8 m s^{-2}. Find the acceleration.

R = 10 × 9.8 = 98

F = μR = 0.4 × 98 = 39.2

P − F = ma: 44.2 − 39.2 = 10 a

Answer: 0.5 m s^{-2}

Day 216 **A Level Maths: C Tier 10-a-day: Model Solutions**

6 Maximum value from R form (All boards)

f(x) = 8 sin x + 15 cos x + 3.
Write f(x) in the form R sin(x + α) + 3, with α in degrees to 1 d.p., and state the maximum value of f(x).

$R = \sqrt{8^2 + 15^2} = 17$, $\tan \alpha = \frac{15}{8}$ so $\alpha = 61.9°$

f(x) = 17 sin(x + 61.9°) + 3
sin(x + α) has maximum value 1, so f(max) = 17 + 3
Answer: f(x) = 17 sin(x + 61.9°) + 3; maximum 20

7 Real roots and the discriminant (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the set of values of k for which
$x^2 + kx + 25 = 0$ has no real roots.

$b^2 - 4ac < 0$
$k^2 - 100 < 0$, so $k^2 < 100$
Answer: $-10 < k < 10$

8 Binomial: P(X = k) (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

X ~ B(9, 0.2). Find P(X = 0), giving your answer to 3 s.f.

$P(X = 0) = {}^9C_0 \times 0.2^0 \times 0.8^9$
$= 1 \times 0.2^0 \times 0.8^9$
Answer: 0.134

9 Solve a logarithmic equation (two logs) (All boards)

Solve ln (x + 1) − ln x = ln 2.

$\ln \frac{x+1}{x} = \ln 2$, so $\frac{x+1}{x} = 2$
x + 1 = 2x, so 1 = 1x
x = 1
Answer: x = 1

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

Solve the simultaneous equations:
$y = x^2 - x - 22$, $y = -x - 6$.

$x^2 - x - 22 = -x - 6$
$x^2 - 16 = 0$
(x + 4)(x − 4) = 0
Use $y = -x - 6$ to find each y.
Answer: x = −4, y = −2 and x = 4, y = −10