Day 218 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Exact trigonometric values (All boards)

Write down the exact value of sin 30°.

Use the special angle values: $\sin 30° = \frac{1}{2}$

Answer: $\frac{1}{2}$

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

Simplify $\sqrt{6} \times \sqrt{3}$, giving your answer in the form $p\sqrt{q}$, or as an integer.

$\sqrt{6} \times \sqrt{3} = \sqrt{18}$

$= 3\sqrt{2}$

Answer: $3\sqrt{2}$

3 Average speed over two stages (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A runner travels 6 m at a constant speed of 3 m s^{-1}, then a further 15 m at a constant speed of 5 m s^{-1}. Find the average speed for the whole journey.

Time for first stage = 6 ÷ 3 = 2 s

Time for second stage = 15 ÷ 5 = 3 s

Average speed = $\frac{\text{total distance}}{\text{total time}} = \frac{21}{5}$

Answer: **4.2 m s^{-1}**

4 Describing transformations of graphs (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Describe the single transformation that maps the graph of y = f(x) onto the graph of y = f(x + 2).

y = f(x + 2) is obtained from y = f(x) by a:

translation by the vector $\begin{pmatrix} -2 \\ 0 \end{pmatrix}$

Answer: translation by the vector $\begin{pmatrix} \mathbf{-2} \\ \mathbf{0} \end{pmatrix}$

5 Normal distribution: diagram and symmetry (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows the density of X ~ N(130, 4^2).

a and b are equal distances from the mean. The shaded area, P(X > b), is 0.34.

Find P(a < X < b).

By symmetry P(X < a) = 0.34

P(a < X < b) = 1 − 2 × 0.34

Answer: **0.32**

6 3D vectors: distance, magnitude and midpoint (All boards)

OA = $\begin{pmatrix} 0 \\ 5 \\ 1 \end{pmatrix}$ and OB = $\begin{pmatrix} -7 \\ 11 \\ 7 \end{pmatrix}$.

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

AB = OB − OA = $\begin{pmatrix} -7 \\ 6 \\ 6 \end{pmatrix}$

$|AB| = \sqrt{7^2 + 6^2 + 6^2} = 11$

Unit vector = $\frac{1}{11}$ AB

Answer: **AB =** $\begin{pmatrix} \mathbf{-7} \\ \mathbf{6} \\ \mathbf{6} \end{pmatrix}$**, |AB| = 11, unit vector** $\frac{\mathbf{1}}{\mathbf{11}}\begin{pmatrix} \mathbf{-7} \\ \mathbf{6} \\ \mathbf{6} \end{pmatrix}$

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7 Finding an unknown using the factor theorem (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

When $x^3 + kx^2 - x + 4$ is divided by $(x + 1)$, the remainder is -1. Find the value of k.

$f(-1) = -1$
$-1 + k + 5 = -1$
$k = -5$
Answer: $k = -5$

8 Catching up: constant speed against acceleration (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Car P passes a point O at constant speed 16 m s^{-1}.

At that instant car Q starts from rest at O with constant acceleration 4 m s^{-2} in the same direction. Find the time when Q catches up P.

Distances equal: $16\,t = \frac{1}{2} \times 4 \times t^2$

$t(16 - 2\,t) = 0$, so $t = 0$ or $t = 16 \div 2$
Answer: 8 s

9 Conditional probability (Bayes) (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The probability that a machine is set up wrongly is 0.3. If so, the probability that an item is faulty is 0.5; otherwise it is 0.2. Given that an item is faulty, find the probability that a machine is set up wrongly.

P(both) = 0.3 × 0.5 = 0.15; P(not first and second) = 0.7 × 0.2 = 0.14
P(second) = 0.15 + 0.14 = 0.29
P = 0.15 ÷ 0.29
Answer: $\frac{15}{29} = 0.517$

10 Vector geometry with a diagram (OAB) (All boards)

In the diagram, OA = $\mathbf{a}$, OB = $\mathbf{b}$, and P lies on AB with AP : PB = 4 : 1.
Find AB and OP in terms of $\mathbf{a}$ and $\mathbf{b}$.

$\mathrm{AB} = \mathrm{OB} - \mathrm{OA} = \mathbf{b} - \mathbf{a}$

$\mathrm{AP} = \frac{4}{5}\,\mathrm{AB} = \frac{4}{5}(\mathbf{b} - \mathbf{a})$

$\mathrm{OP} = \mathrm{OA} + \mathrm{AP} = \mathbf{a} + \frac{4}{5}(\mathbf{b} - \mathbf{a})$

$= \frac{1}{5}\mathbf{a} + \frac{4}{5}\mathbf{b}$

Answer: $\mathbf{AB} = \mathbf{b} - \mathbf{a}$; $\mathbf{OP} = \frac{1}{5}\mathbf{a} + \frac{4}{5}\mathbf{b}$