Day 198 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Exact trigonometric values (All boards)

Write down the exact value of tan 330°.

tan 330° has the same size as tan 30°, and the sign comes from the quadrant (CAST).

tan 30° = $\frac{\sqrt{3}}{3}$, so tan 330° = $-\frac{\sqrt{3}}{3}$

Answer: $\mathbf{-\frac{\sqrt{3}}{3}}$

2 Scatter diagrams and correlation (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The scatter diagram shows temperature and ice cream sales for a group.
Describe the correlation.

The points lie loosely around a line with positive gradient.
As temperature increases, ice cream sales tends to increase.
Answer: weak positive correlation

3 Parallel vectors (All boards)

$\mathbf{a} = \begin{pmatrix} 2 \\ 1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 1 \\ \frac{1}{2} \end{pmatrix}$.

Show that a and b are parallel and find the ratio |b| : |a|.

$\mathbf{b} = \frac{1}{2} \times \mathbf{a}$, since $\frac{1}{2} \times 2 = 1$ and $\frac{1}{2} \times 1 = \frac{1}{2}$

So a and b are parallel and |b| : |a| = $\frac{1}{2}$: 1

Answer: $\mathbf{b = \frac{1}{2} a}$**, so parallel; ratio** $\mathbf{\frac{1}{2} : 1}$

4 Velocity-time graph: acceleration and distance (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The graph shows the velocity of a car over 24 seconds as it moves in a straight line.
(a) Find its acceleration in the first 8 s.
(b) Find the total distance travelled.

(a) acceleration = gradient = $\frac{16}{8}$

(b) distance = area of trapezium

= $\frac{1}{2}(12 + 24) \times 16$

Answer: (a) $\mathbf{2\ m\ s^{-2}}$ **(b) 288 m**

5 Modulus equations (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Solve $|x - 5| = |x + 1|$.

Squaring: $(x - 5)^2 = (x + 1)^2$
$x - 5 = -(x + 1)$ (the case $x - 5 = x + 1$ has no solution)
$2x = 4$
Answer: $\mathbf{x = 2}$

6 Binomial: finding parameters (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

X ~ B(n, p) has mean 3 and variance 2.25.
Find n and p.

$np = 3$ and $npq = 2.25$
$q = 2.25 \div 3 = 0.75$, so $p = 0.25$
$n = 3 \div 0.25$
Answer: $\mathbf{n = 12, p = 0.25}$

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7 The remainder theorem (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Find the remainder when $2x^3 - 4x^2 - 6x + 6$ is divided by $(x + 3)$.

Remainder = $f(-3)$
$= (-54) + (-36) + 18 + 6$
$= -66$
Answer: -66

8 Identity then solve ($\sin^2$ to cos) (All boards)

Solve $-2\sin^2 x + 2\cos x + 2 = 0$
for $0° \leq x \leq 360°$.

Use $\sin^2 x = 1 - \cos^2 x$: $2\cos^2 x + 2\cos x = 0$
Factorise and solve: $\cos x = 0$ or $\cos x = -1$
$x = 90°, 180°, 270°$
Answer: $x = 90°, 180°, 270°$

9 The factor theorem and factorising (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$f(x) = 2x^3 - 4x^2 - 10x + 12$
(a) Show that $(x - 1)$ is a factor of $f(x)$.
(b) Factorise $f(x)$ completely.

$f(1) = 2 + (-4) + (-10) + 12 = 0$, so $(x - 1)$ is a factor.
$f(x) = (x - 1)(2x^2 - 2x - 12)$
$2x^2 - 2x - 12 = 2(x + 2)(x - 3)$
Answer: (b) $f(x) = 2(x + 2)(x - 1)(x - 3)$

10 Resultant force as vectors and acceleration (AQA, Edexcel, OCR, MEI, Eduqas)

Two forces $(-5\mathbf{i} + 7\mathbf{j})$ N and $(9\mathbf{i} + \mathbf{j})$ N act on a particle of mass 4 kg. No other horizontal forces act. Find the acceleration of the particle as a vector in terms of $\mathbf{i}$ and $\mathbf{j}$.

Resultant $= (-5\mathbf{i} + 7\mathbf{j}) + (9\mathbf{i} + \mathbf{j})$
$= (4\mathbf{i} + 8\mathbf{j})$ N
$F = ma$: $a = \frac{1}{4}(4\mathbf{i} + 8\mathbf{j})$
Answer: $(\mathbf{i} + 2\mathbf{j})$ m s^{-2}