Day 113 **A Level Maths: C Tier 10-a-day: Model Solutions**

1 Exact trigonometric values (All boards)

Write down the exact value of tan 225°.

tan 225° has the same size as tan 45°, and the sign comes from the quadrant (CAST).
tan 45° = 1, so tan 225° = 1
Answer: 1

2 Constant acceleration: $v^2 = u^2 + 2as$ (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle moves in a straight line with constant acceleration. Its speed increases from 8 m s^{-1} to 21 m s^{-1} as it travels 377 m. Find the acceleration.

$v^2 = u^2 + 2as$
$21^2 = 8^2 + 2 \times a \times 377$
$377 = 754\ a$
Answer: 0.5 m s^{-2}

3 Reciprocal trig functions: exact values (All boards)

Write down the exact values of
(a) cosec 60° (b) cosec 315°

(a) $\text{cosec } 60° = \frac{1}{\sin 60°} = \frac{1}{\frac{\sqrt{3}}{2}} = \frac{2\sqrt{3}}{3}$

(b) $\text{cosec } 315° = \frac{1}{\sin 315°} = \frac{1}{-\frac{\sqrt{2}}{2}} = -\sqrt{2}$

Answer: (a) $\frac{2\sqrt{3}}{3}$ (b) $-\sqrt{2}$

4 Position of a point relative to a circle (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A circle has equation $(x + 1)^2 + (y + 2)^2 = 16$.
Determine whether the point P(2, −4) is inside, outside or on the circle.

Distance^2 from the centre (−1, −2) to P:
$(2 - (-1))^2 + (-4 - (-2))^2 = 9 + 4 = 13$
$r^2 = 16$, and $13 < 16$.
Answer: P is inside the circle

5 Critical region (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

X ~ B(25, p). H_0: p = 0.5, H_1: p > 0.5.
Find the critical region for a test at the 5% significance level.

$P(X \geq 18) = 0.0216 \leq 0.05$
$P(X \geq 17) = 0.0539 > 0.05$
Answer: X ≥ 18

6 Partial fractions: find the constants (All boards)

Express $\frac{2x}{(x + 3)(x + 1)}$ in the form $\frac{A}{x + 3} + \frac{B}{x + 1}$.
Find the values of A and B.

$2x \equiv A(x + 1) + B(x + 3)$
$x = -3$: $-6 = A(-2)$, so $A = 3$
$x = -1$: $-2 = B(2)$, so $B = -1$
Answer: A = 3, B = −1

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7 Algebraic division (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Divide $f(x) = x^3 + 7x^2 + 7x - 27$ by $(x + 4)$.
Find the quotient and the remainder.

Use synthetic division with $a = -4$:
Bottom row: 1, 3, −5, −7
Quotient: $x^2 + 3x - 5$
Remainder: −7
Answer: Quotient $x^2 + 3x - 5$, remainder −7

8 Projectile launched with velocity components (AQA, Edexcel, OCR, MEI)

A golf ball is projected from level ground with velocity $(9\mathbf{i} + 29.4\mathbf{j})$ m s^{-1} ($\mathbf{i}$ horizontal, $\mathbf{j}$ vertically up). Take g = 9.8 m s^{-2}.
(a) Find the time of flight.
(b) Find the greatest height reached.

(a) Vertically: $0 = 29.4\,t - 4.9t^2$
$t = \frac{29.4}{4.9} = 6$
(b) $0 = 29.4^2 - 2 \times 9.8 \times H$
$H = \frac{864.36}{19.6}$
Answer: (a) 6 s (b) 44.1 m

9 Hypothesis test for a normal mean (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A population is $N(\mu, 6^2)$. H_0: $\mu = 190$, H_1: $\mu < 190$.
A sample of 64 has mean $\bar{x} = 189.18$.
Test at the 5% level. Critical value: $z = -1.645$.

$z = (\bar{x} - \mu) \div (\sigma \div \sqrt{n}) = (189.18 - 190) \div (6 \div 8)$
$z = -1.09$
−1.09 is outside the critical region, so do not reject H_0
Answer: $z = -1.09$; do not reject H_0

10 Proof by exhaustion (AQA, Edexcel, OCR, MEI, Eduqas)

Use proof by exhaustion to show that $n(n + 1)(n + 2)$ is divisible by 6 for every integer n with $1 \leq n \leq 5$.

Substitute each value of n:
n = 1: $6 = 6 \times 1$; n = 2: $24 = 6 \times 4$
n = 3: $60 = 6 \times 10$; n = 4: $120 = 6 \times 20$
n = 5: $210 = 6 \times 35$
Every value is a multiple of 6, so the statement is true for $1 \leq n \leq 5$.
Answer: Shown