Day 274 **A Level Maths: C Tier 10-a-day: Model Solutions**

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

Write $\sqrt{98}$ in the form $p\sqrt{q}$, where q is an integer as small as possible.

$\sqrt{98} = \sqrt{49 \times 2} = \sqrt{49} \times \sqrt{2}$

$= 7\sqrt{2}$

Answer: $7\sqrt{2}$

2 Interpreting the PMCC (AQA, Edexcel, OCR, MEI, Eduqas)

The product moment correlation coefficient between age of a car and its value is $r = -0.9$.
Interpret this value.

r is close to -1, so there is strong negative linear correlation.
As age of a car increases, its value tends to decrease.
Answer: strong negative linear correlation

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

$f(x) = x^3 - 6x^2 - 7x + 60$
(a) Show that $(x - 5)$ is a factor of f(x).
(b) Factorise f(x) completely.

$f(5) = 125 + (-150) + (-35) + 60 = 0$, so $(x - 5)$ is a factor.

$f(x) = (x - 5)(x^2 - x - 12)$

$x^2 - x - 12 = (x + 3)(x - 4)$

Answer: (b) $f(x) = (x + 3)(x - 4)(x - 5)$

4 Solve trig equation in radians (calculator) (All boards)

Solve $3 \cos x = 2$ for $0 \leq x \leq 2\pi$.
Give your answers to 3 significant figures.

$\cos x = \frac{2}{3}$

Reference angle $= \cos^{-1}(0.6667) = 0.8411$ radians
cos is positive in the first and fourth quadrants.
$x = 0.841, 5.44$
Answer: $x = 0.841, 5.44$

5 Normal distribution: inverse (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

$X \sim N(25, 6^2)$. Given that $P(X < a) = 0.7$, find a to 3 s.f.

$P(Z < z) = 0.7$, so $z = 0.5244$ (from the inverse normal function)
$a = 25 + 0.5244 \times 6$
Answer: 28.1

6 Identity then solve (sin² to cos) (All boards)

Solve $-3\cos^2 x - 3\sin x + 3 = 0$
for $0° \leq x \leq 360°$.

Use $\cos^2 x = 1 - \sin^2 x$: $3\sin^2 x - 3\sin x = 0$
Factorise and solve: $\sin x = 0$ or $\sin x = 1$
$x = 0°, 90°, 180°, 360°$
Answer: $x = 0°, 90°, 180°, 360°$

7 Equilibrium of a particle under three forces (diagram) (All boards)

A particle is in equilibrium under the three forces shown. $\cos \alpha = \frac{5}{13}$. Find P and Q.

Horizontally: $P = 52 \cos \alpha = 52 \times \frac{5}{13}$

Vertically: $Q = 52 \sin \alpha = 52 \times \frac{12}{13}$

Answer: $P = 20$, $Q = 48$

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8 Integrate using partial fractions (All boards)

$\frac{4x + 7}{(x + 2)(x + 1)} \equiv \frac{A}{x + 2} + \frac{B}{x + 1}$.

Find A and B, and hence find $\int \frac{4x + 7}{(x + 2)(x + 1)}\,dx$.

$4x + 7 \equiv A(x + 1) + B(x + 2)$

$x = -2$ gives $A = 1$; $x = -1$ gives $B = 3$

$\int \left(\frac{1}{x + 2} + \frac{3}{x + 1}\right) dx = 1 \ln|x + 2| + 3 \ln|x + 1| + c$

Answer: $A = 1$, $B = 3$; $\ln|x + 2| + 3 \ln|x + 1| + c$

9 Work done and kinetic energy (CIE)

A constant force of 80 N pulls a crate 8 m along rough horizontal ground against a constant frictional force of 5 N. Find (a) the work done by the pulling force, (b) the work done against friction.

(a) Work done = force × distance = 80 × 8

(b) Work done against friction = 5 × 8

Answer: (a) 640 J (b) 40 J

10 Rationalising the denominator (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Rationalise the denominator of $\frac{5}{1 - \sqrt{6}}$.

Write your answer in the form $p + q\sqrt{6}$.

Multiply top and bottom by $1 + \sqrt{6}$:

$\frac{5(1 + \sqrt{6})}{(1)^2 - (\sqrt{6})^2} = \frac{5(1 + \sqrt{6})}{-5}$

Answer: $-1 - \sqrt{6}$