**Day 358** **A Level Maths: C Tier 10-a-day: Model Solutions**

## 1 F = ma: find the acceleration (All boards)

A horizontal force of 15 N acts on a trolley of mass 2 kg on a smooth horizontal surface.
Find the acceleration.

$F = ma$
$15 = 2\ a$
**Answer: 7.5 m s$^{-2}$**

## 2 Find the angle of a sector (All boards)

A sector has radius 6 cm and area 13.5 cm$^2$.
Find the angle of the sector in radians and the arc length.

$\frac{1}{2} \times 6^2 \times \theta = 13.5$, so $\theta = 0.75$
Arc length $= r\theta = 6 \times 0.75 = 4.50$ cm
**Answer: $\theta$ = 0.75 radians; arc length 4.50 cm**

## 3 Equation of a transformed curve (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The curve C has equation $y = x^3 + 2x + 1$.
C is reflected in the x-axis. Find the equation of the image, in the form y = ...

Reflection in the x-axis: y becomes $-y$.
$-y = x^3 + 2x + 1$
$y = -x^3 - 2x - 1$
**Answer: $y = -x^3 - 2x - 1$**

## 4 Conditional probability: two-way tables (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

Of 60 people, 33 are girls. 17 of the girls and 11 of the boys own a bike.
One person is chosen at random.
Given that the person is a girl, find the probability that they own a bike.

There are 33 girls
$P = 17 \div 33$
**Answer: $\frac{17}{33}$**

## 5 Constant acceleration: finding the initial speed (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

A particle moving in a straight line with constant acceleration 0.5 m s$^{-2}$ travels 27 m in 6 s.
Find its initial speed.

$s = ut + \frac{1}{2}at^2$

$27 = 6\ u + \frac{1}{2} \times 0.5 \times 6^2$

$6\ u = 18$
**Answer: 3 m s$^{-1}$**

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

A population is N($\mu$, $5^2$). $H_0$: $\mu = 165$, $H_1$: $\mu > 165$.
A sample of 25 has mean $\bar{x} = 168.4$.
Test at the 5% level. Critical value: $z = 1.645$.

$z = (\bar{x} - \mu) \div (\sigma \div \sqrt{n}) = (168.4 - 165) \div (5 \div 5)$
$z = 3.40$
3.40 is inside the critical region, so reject $H_0$
**Answer: z = 3.40; reject $H_0$**

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## 7 Exponential growth and decay model (All boards)

A car is worth £$V = 15000 \times 0.75^t$ after t years.
Find (a) its value after 5 years, (b) when it is worth £7500.
Give answers to 3 s.f.

(a) $V = 15000 \times 0.75^5 = 3560$
(b) $0.75^t = 0.5$, so $t \log 0.75 = \log 0.5$
$t = \frac{\log 0.5}{\log 0.75} = 2.41$
**Answer: (a) £3560 (b) 2.41 years**

## 8 Finding a quadratic from its turning point (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The diagram shows a sketch of a quadratic curve.
Find its equation in the form $y = a(x - p)^2 + q$.

The turning point is $(-2, 2)$, so $y = a(x + 2)^2 + 2$.
The curve passes through $(0, -6)$:
$-6 = a(2)^2 + 2$, so $-8 = 4a$
$a = -2$
**Answer: $y = -2(x + 2)^2 + 2$**

## 9 Maximum value from R form (All boards)

$f(x) = 8 \sin x + 6 \cos x + 4$.
Write f(x) in the form $R \sin(x + \alpha) + 4$, with $\alpha$ in degrees to 1 d.p., and state the maximum value of f(x).

$R = \sqrt{8^2 + 6^2} = 10$, $\tan \alpha = \frac{6}{8}$ so $\alpha = 36.9°$
$f(x) = 10 \sin(x + 36.9°) + 4$
$\sin(x + \alpha)$ has maximum value 1, so f(max) = 10 + 4
**Answer: f(x) = 10 sin(x + 36.9°) + 4; maximum 14**

## 10 Tangent condition for a line and a curve (AQA, Edexcel, OCR, MEI, Eduqas, CIE)

The line $y = 3x + k$ is a tangent to the curve
$y = x^2 + 5x - 2$.
Find the value of k.

$x^2 + 5x - 2 = 3x + k$
$x^2 + 2x + (-2 - k) = 0$
A tangent touches once: discriminant = 0
$(2)^2 - 4(-2 - k) = 0$
**Answer: $k = -3$**