Day 78 **S Tier 10-a-day: Model Solutions**

1 Time zones

A flight leaves London at 18:20 (London time).
It takes 8 hours 35 minutes.
When it is 12:00 in London it is 04:00 in Los Angeles.
At what time, in Los Angeles time, does the flight land? Say if it is on a different day.

Arrival in London time = 18:20 + 8 h 35 min = 02:55 the next day
Los Angeles is 8 hours behind London, so subtract 8 hours
18:55
Answer: 18:55 the same day

2 Angle in a semicircle

AB is a diameter of a circle, centre O. C is a point on the circle. Angle BAC = 52°.
(a) Work out the size of angle ACB.
(b) Work out the size of angle COB.
The diagram is not drawn accurately.

(a) The angle in a semicircle is 90°, so angle ACB = 90°
(b) OA = OC (radii), so triangle OAC is isosceles and angle OCA = 52°
Angle COB is an exterior angle of triangle OAC: 52 + 52 = 104°
(or: the angle at the centre is twice the angle at the circumference)
Answer: (a) 90° (b) 104°

3 Laws of indices with algebra

Simplify fully $\frac{7x^3y^5 \times 8xy^2}{4x^3y^4}$

Give your answer in the form kx^ay^b

Numbers: 7 × 8 ÷ 4 = 14
Powers of x: 3 + 1 − 3 = 1
Powers of y: 5 + 2 − 4 = 3
= $14xy^3$
Answer: $14xy^3$

4 Line of best fit

The scatter graph shows temperature (x) and ice creams sold (y).
The line of best fit passes through (4, 13) and (8, 23).
(a) Find its equation in the form y = mx + c.
(b) Explain what its gradient tells you.

(a) Gradient m = $\frac{23 - 13}{8 - 4} = \frac{10}{4} = 2.5$
y = 2.5x + c: using (4, 13), 13 = 2.5 × 4 + c, so c = 3
y = 2.5x + 3
(b) For each extra degree of temperature, the number of ice creams sold goes up by 2.5
Answer: (a) y = 2.5x + 3 (b) For each extra degree of temperature, the number of ice creams sold goes up by 2.5

5 Compound interest

Uma puts £3,000 in a savings account.
Compound interest is paid at 3% in year 1, 6% in year 2 and 1% in year 3.
Work out the amount in the account at the end of year 3.
Give your answer to the nearest penny. (Calculator)

Multipliers: 1.03, 1.06, 1.01
£3,000 × 1.03 × 1.06 × 1.01
= £3,308.15
Answer: £3,308.15

Day 78 **S Tier 10-a-day: Model Solutions**

6 Trigonometric graphs

The diagram shows the graph of y = a cos bx, where a and b are positive integers.
(a) Write down the value of a and the value of b.
(b) Work out the value of y when x = 330°.

(a) The maximum value is 4 and the minimum is −4, so a = 4
The graph completes 2 full cycles between 0° and 360°, so b = 2
(b) y = 4 cos (2 × 330°) = 4 cos 660°

cos 300° = $\frac{1}{2}$, so y = 2

Answer: (a) a = 4, b = 2 (b) y = 2

7 At least one

The probability that a light bulb in a hallway fails in any month is $\frac{1}{20}$.

Events on different occasions are independent.
Work out the probability that this happens at least once in 3 months.
Give your answer correct to 3 significant figures. (Calculator)

P(never) = $(1 - \frac{1}{20})^3 = \frac{19}{20}^3 = 0.857375$

P(at least once) = 1 − P(never) = 1 − 0.857375
= 0.143

Answer: 0.143

8 Percentages with an unknown rate

A population is increased by x% in one year and then increased by a further x% the next year.
Over the two years the population increases by 44%.
Work out the value of x.

Yearly multiplier = $1 + \frac{x}{100}$

Two years: $(1 + \frac{x}{100})^2 = 1.44$

Take the square root: $1 + \frac{x}{100} = 1.2$

$\frac{x}{100} = 0.2$, so x = 20

Answer: x = 20

9 Cosine rule and area of a triangle

The diagram shows triangle ABC. (Calculator)
(a) Work out the length of AB, marked x, to 1 decimal place.
(b) Work out the area of triangle ABC to 3 significant figures.
The diagram is not drawn accurately.

(a) $x^2 = 6^2 + 9^2 - 2 \times 6 \times 9 \times \cos 55°$
$x^2 = 55.054$
x = 7.4 cm (1 d.p.)

(b) Area = $\frac{1}{2} \times 6 \times 9 \times \sin 55° = 22.1$ cm^2 (3 s.f.)

Answer: (a) 7.4 cm (b) 22.1 cm^2

Day 78 **S Tier 10-a-day: Model Solutions**

10 Composite functions

$f(x) = -2x - 1$ and $g(x) = 5x^2 - 5$

(a) Find $fg(x)$.

(b) Solve $fg(x) = -81$

(a) $fg(x) = f(5x^2 - 5) = -2(5x^2 - 5) - 1$

$= -10x^2 + 9$

(b) $-10x^2 + 9 = -81$, so $-10x^2 = -90$

$x^2 = 9$, so $x = \pm 3$

Answer: (a) $-10x^2 + 9$ (b) $x = \pm 3$