Day 221 **S Tier 10-a-day: Model Solutions**

1 Time zones

A flight leaves London at 15:45 (London time).
It takes 12 hours 35 minutes.
When it is 12:00 in London it is 19:00 in Singapore.
At what time, in Singapore time, does the flight land? Say if it is on a different day.

Arrival in London time = 15:45 + 12 h 35 min = 04:20 the next day
Singapore is 7 hours ahead of London, so add 7 hours
11:20 the next day
Answer: 11:20 the next day

2 Area of a segment

The circle has centre O and radius 7 cm. A and B are points on the circle and angle AOB = 100°. (Calculator)
Work out the area of the shaded segment. Give your answer correct to 3 significant figures.
The diagram is not drawn accurately.

Area of sector OAB = $\frac{100}{360} \times \pi \times 7^2 = 42.761$ cm^2

Area of triangle OAB = $\frac{1}{2} \times 7 \times 7 \times \sin 100° = 24.128$ cm^2

Segment = sector − triangle = 42.761 − 24.128 = 18.633
= 18.6 cm^2 (3 s.f.)
Answer: 18.6 cm^2

3 Distance-time graphs

The graph shows Nadia's cycle ride to a café and back.
(a) Work out Nadia's speed on the way back.
(b) Work out Nadia's average speed for the whole ride, including the stop.

(a) Return: 30 km in 1 hours, so speed = 30 ÷ 1 = 30 km/h
(b) Total distance = 2 × 30 = 60 km, total time = 4 hours
Average speed = 60 ÷ 4 = 15 km/h
Answer: (a) 30 km/h (b) 15 km/h

4 Laws of indices with algebra

Simplify $(49x^6y^{-4})^{\frac{1}{2}}$

Raise each part to the power $\frac{1}{2}$

$49^{\frac{1}{2}} = \sqrt{49} = 7$

$(x^6)^{\frac{1}{2}} = x^3$ and $(y^{-4})^{\frac{1}{2}} = y^{-2}$
$= 7x^3y^{-2}$
Answer: $7x^3y^{-2}$

5 Standard form

Work out $(8.4 \times 10^2) - (1.1 \times 10^1)$
Give your answer in standard form.

Write the first number as a multiple of 10^1: $8.4 \times 10^2 = 84 \times 10^1$
$(84 - 1.1) \times 10^1 = 82.9 \times 10^1$
$= 8.29 \times 10^2$
Answer: 8.29×10^2

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6 Sine rule

The diagram shows triangle ABC. (Calculator)
Work out the length of AC. Give your answer correct to 1 decimal place.
The diagram is not drawn accurately.

Use the sine rule: $\frac{AC}{\sin B} = \frac{BC}{\sin A}$

$\frac{x}{\sin 57°} = \frac{17}{\sin 68°}$

$x = \frac{17 \times \sin 57°}{\sin 68°} = 15.377$

x = 15.4 cm (1 d.p.)

Answer: AC = 15.4 cm

7 Fractional indices

Given that x > 0, solve $x^{\frac{3}{2}} = 729$

Raise both sides to the power $\frac{2}{3}$

$x = (729)^{\frac{2}{3}}$

x = 81

Answer: x = 81

8 Shaded areas: exact answers

The diagram shows a circle inside a square of side 10 cm.
The circle touches all four sides of the square.
Work out the area of the shaded region. Give your answer in terms of π.

Area of square = 10 × 10 = 100
Radius of circle = 10 ÷ 2 = 5 cm
Area of circle = $\pi \times 5^2 = 25\pi$
Shaded area = $100 - 25\pi$ cm^2

Answer: $(100 - 25\pi)$ cm^2

9 Functions that are their own inverse

$f(x) = \frac{-4x - 1}{2x + 4}$ where $x \neq -2$

(a) Show that ff(x) = x.
(b) Write down $f^{-1}(x)$.

(a) Replace x in f(x) by f(x), then multiply the top and the bottom by (2x + 4)

$ff(x) = \frac{(-4)(-4x - 1) + (-1)(2x + 4)}{2(-4x - 1) - (-4)(2x + 4)}$

Top = 16x + 4 − 2x − 4 = 14x
Bottom = −8x − 2 + 8x + 16 = 14

$ff(x) = \frac{14x}{14} = x$

(b) ff(x) = x, so f is its own inverse: $f^{-1}(x) = \frac{-4x - 1}{2x + 4}$

Answer: (b) $f^{-1}(x) = \frac{-4x - 1}{2x + 4}$

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10 Ratio and expressions

x : y = 5 : 6
Work out the ratio (4x + 1y) : (4y − 1x)
Give your answer in its simplest form.

x : y = 5 : 6, so let x = 5t and y = 6t
4(5t) + 1(6t) = 26t
4(6t) − 1(5t) = 19t
26t : 19t = 26 : 19
Answer: 26 : 19