Day 314 **A Tier 10-a-day: Model Solutions**

1 Area of shaded regions with circles

4 identical circles of radius 9 cm fit exactly inside a rectangle.
The circles touch each other and the sides of the rectangle. (Calculator)
Work out the area of the shaded region.
Give your answer to 3 significant figures.

Rectangle: $72 \times 18 = 1296$ cm^2
4 circles: $4 \times \pi \times 9^2 = 324\pi$
Shaded area = $1296 - 324\pi = 278$
Answer: 278 cm^2

2 Stem and leaf diagrams

The stem and leaf diagram shows the ages of 15 people.
Key: 2 | 1 represents 21 years
(a) Work out the median age.
(b) Work out the interquartile range.

(a) 15 values, so the median is the 8th value
Counting along the leaves gives 39
(b) LQ is the middle of the lower 7 values = 27
UQ is the middle of the upper 7 values = 51
IQR = $51 - 27 = 24$
Answer: (a) 39 years (b) 24 years

3 Fractions of an amount

Hassan has £528.
Hassan spends $\frac{1}{6}$ of the money on a bike and $\frac{1}{2}$ of the money that is left on a helmet.
How much money does Hassan have left?

$\frac{1}{6}$ of £528 = £88, so after buying a bike, £440 is left.
$\frac{1}{2}$ of £440 = £220
£440 − £220 = £220
Answer: £220

4 Congruent triangles

Triangle STU: angle S = 55°, angle T = 35°, ST = 5 cm.
Triangle UVW: angle U = 55°, angle V = 35°, UV = 10 cm.
Are the two triangles congruent?
Give a reason for your answer.

The angles are the same, so the triangles are similar
But ST = 5 cm and UV = 10 cm, so the matching sides are different
The triangles are not congruent
Answer: No, not congruent

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5 Parallel and perpendicular lines

The line L has equation $y = \frac{2}{3}x + 7$

Find the equation of the line that is perpendicular to L and passes through the point $(6, -13)$.

The gradient of L is $\frac{2}{3}$

Perpendicular gradient = $-1 \div \frac{2}{3} = -\frac{3}{2}$

$y = -\frac{3}{2}x + c$, so $-13 = -\frac{3}{2} \times 6 + c$

$c = -4$

$y = -\frac{3}{2}x - 4$

Answer: $y = -\frac{3}{2}x - 4$

6 Arc length and perimeter of a sector

The diagram shows a sector of a circle of radius 8 cm.
Work out the perimeter of the sector.
Give your answer in terms of π.
The diagram is not drawn accurately.

Arc length = $\frac{270}{360} \times 2 \times \pi \times 8 = 12\pi$

Perimeter = arc + two radii
$= 12\pi + 16$
Answer: $12\pi + 16$ cm

7 Probability with three selections

A bag contains 5 red counters and 5 blue counters.
Three counters are taken at random without replacement.
Work out the probability that at least one of the three counters is blue.

P(none is blue) = P(all red) = $\frac{5}{10} \times \frac{4}{9} \times \frac{3}{8} = \frac{1}{12}$

P(at least one blue) = $1 - \frac{1}{12} = \frac{11}{12}$

Answer: $\frac{11}{12}$

8 Quadratic inequalities

Solve $x^2 + 8x + 12 > 0$

Solve $x^2 + 8x + 12 = 0$: $(x + 6)(x + 2) = 0$
$x = -6$ or $x = -2$
Sketch the U-shaped curve $y = x^2 + 8x + 12$, crossing the x-axis at -6 and -2
The curve is above the x-axis outside the roots
$x < -6$ or $x > -2$
Answer: $x < -6$ or $x > -2$

9 Algebraic formulae in context

A gym charges a joining fee of £20 and then £18 each month.
(a) Write a formula for the total cost, £C, after n months.
(b) Chloe pays £236 in total. Work out the number of months.

(a) $C = 20 + 18n$
(b) $20 + 18n = 236$
$18n = 216$
$n = 12$
Answer: (a) $C = 20 + 18n$ (b) 12

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10 Bounds and accuracy

A cyclist travels 560 metres in 16.5 seconds. The distance is correct to the nearest 10 metres and the time to the nearest 0.1 second.

(a) Work out the upper bound and the lower bound of the speed in m/s.

(b) Write the speed to a suitable degree of accuracy. Give a reason for your answer.

(a) Upper bound = 565 ÷ 16.45 = 34.3465

Lower bound = 555 ÷ 16.55 = 33.5347

(b) Both bounds round to 34 to 2 s.f. but not to the same value to 3 s.f.

So the speed is 34 m/s to 2 significant figures.

Answer: (a) 34.3465, 33.5347 (b) 34 m/s (2 s.f.)