Day 231 **A Tier 10-a-day: Model Solutions**

1 nth term of a linear sequence

Here are the first four terms of a sequence.
−1, −6, −11, −16
(a) Find an expression for the nth term.
(b) Find the first term in the sequence that is less than −50.

The terms change by −5 each time, so the nth term starts with −5n
−1 − (−5) = 4, so the nth term is −5n + 4
(b) −5n + 4 < −50
−5n < −54

Divide by −5 and reverse the inequality sign: $n > \frac{54}{5}$

The smallest whole number is n = 11, and the term is −51
Answer: (a) −5n + 4 (b) −51

2 Decimal calculations

(a) Work out 0.6 × 0.03
(b) Work out 0.12 ÷ 0.06

(a) 6 × 3 = 18, and there are 3 decimal places in total, so 0.018
(b) Multiply both numbers by 100: 12 ÷ 6 = 2
Answer: (a) 0.018 (b) 2

3 Functions

f(x) = 3x − 3
$g(x) = x^2 - 7$
(a) Find f(−3)
(b) Find fg(x). Give your answer in its simplest form.

(a) f(−3) = 3 × (−3) − 3 = −12
(b) fg(x) means f(g(x)), so replace x in f with $x^2 - 7$
$fg(x) = 3(x^2 - 7) - 3$
$= 3x^2 - 24$
Answer: (a) −12 (b) $3x^2 - 24$

4 Circle theorems: angle at the centre

X, Y and Z are points on a circle with centre O.
Angle XOY = 146°.
Work out the size of angle x.
Give a reason for your answer.

The angle at the centre is twice the angle at the circumference
x = 146 ÷ 2 = 73
Answer: x = 73°

5 Addition and multiplication rules

A spinner can land on red, blue or green.
P(red) = 0.3 and P(blue) = 0.2.
(a) Work out the probability that it lands on red or blue.
(b) Work out the probability that it lands on green.

(a) Mutually exclusive, so add: 0.3 + 0.2 = 0.5
(b) 1 − 0.5 = 0.5
Answer: (a) 0.5 (b) 0.5

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6 Describing transformations

Describe fully the single transformation that maps shape A onto shape B.

The shape has been turned, so this is a rotation
Compare the matching vertices to find the angle and direction: a half turn
The centre is the point that stays fixed: (1, 1)
Answer: Rotation, 180°, centre (1, 1)

7 Laws of indices

Simplify fully

(a) $\frac{18x^7y^5}{3x^4y^3}$

(b) $(2x^4y^4)^4$

(a) Divide the numbers: 18 ÷ 3 = 6
Subtract the powers: $x^7 \div x^4 = x^3$ and $y^5 \div y^3 = y^2$
$= 6x^3y^2$

(b) Raise every part to the power 4: $2^4 = 16$, $(x^4)^4 = x^{16}$, $(y^4)^4 = y^{16}$
$= 16x^{16}y^{16}$

Answer: (a) $6x^3y^2$ (b) $16x^{16}y^{16}$

8 Stratified sampling

A company has 70 employees in Sales, 40 in Admin and 60 in Production.
A stratified sample of 17 employees is to be taken.
Work out how many employees should be chosen from Admin.

Total = 70 + 40 + 60 = 170

Number from Admin = $\frac{40}{170} \times 17$

= 4

Answer: 4

9 Circle theorems: angles in the same segment

A, B, C and D are points on a circle. AC and BD meet at E.
Angle BAC = 60° and angle ACD = 62°.
Work out the size of angle x (angle AEB).
Give reasons for your working.

Angles in the same segment are equal, so angle ABD = angle ACD = 62°
In triangle ABE: angle BAE = 60° and angle ABE = 62°
x = 180 − 60 − 62 = 58
Answer: x = 58°

10 Reverse percentages

A bike costs £396 including VAT at 20%. (Calculator)
Work out the price of the bike before VAT is added.

Price including VAT is 120% of the price before VAT.
120% = £396, so 1% = £396 ÷ 120 = £3.30
100% = £3.30 × 100 = £330
Answer: £330