**Day 6** **S Tier 10-a-day: Model Solutions**

## 1 Percentage change

The price of a phone is decreased by 15%.
The new price is then increased by 10%.
Work out the overall percentage change in the price.

Multipliers: 0.85 and 1.1
Overall multiplier = 0.85 × 1.1 = 0.935
0.935 − 1 = −0.065, so an overall decrease of 6.5%
**Answer: 6.5% decrease**

## 2 Equations with fractions

Solve $\frac{x-1}{2} - \frac{x+1}{6} = 2$

Multiply every term by 6: 3(x − 1) − (x + 1) = 12
Expand: 2x − 4 = 12
2x = 16
x = 8
**Answer: x = 8**

## 3 Comparing box plots

The box plots show the times taken by two groups, A and B.
(a) Work out the interquartile range for each.
(b) Compare the distributions of A and B.

(a) IQR of A = 75 − 45 = 30
IQR of B = 80 − 40 = 40
(b) Group B has the lower median (60 compared with 70), so on average Group B was faster
Group A has the smaller interquartile range (30 compared with 40), so its times are more consistent
**Answer: (a) A: 30, B: 40 (b) B has the lower median, A has the smaller IQR**

## 4 Factorising quadratics

Factorise $4x^2 - 29x + 30$

4 × 30 = 120. Two numbers that multiply to 120 and add to −29 are −24 and −5
Split the middle term: $4x^2 - 24x - 5x + 30$
Factorise in pairs: 4x(x − 6) − 5(x − 6)
= (4x − 5)(x − 6)
**Answer: (4x − 5)(x − 6)**

## 5 HCF and LCM

$A = 2 \times 7^3$
$B = 3^4 \times 7^2$
Write down, as a product of prime factors,
(a) the HCF of A and B
(b) the LCM of A and B

HCF: take the lowest power of each prime that appears in both numbers
$= 7^2$
LCM: take the highest power of every prime that appears
$= 2 \times 3^4 \times 7^3$
**Answer: (a) $7^2$ (b) $2 \times 3^4 \times 7^3$**

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## 6 Trigonometric graphs

The diagram shows the graph of $y = a \sin x + c$.
(a) Write down the value of a and the value of c.
(b) Work out the value of y when $x = 150°$.

(a) The maximum value is 5 and the minimum value is $-1$
$a = (5 - (-1)) \div 2 = 3$
$c = (5 + (-1)) \div 2 = 2$

(b) $y = 3 \sin 150° + 2$, and $\sin 150° = \frac{1}{2}$

$y = \frac{7}{2}$

**Answer: (a) a = 3, c = 2 (b) $y = \frac{7}{2}$**

## 7 Ratio and algebra

In a fruit box, the ratio of the number of apples to the number of pears is 5 : 2.
Then 5 more apples are added and 6 pears are removed.
The ratio is now 5 : 1.
How many pears were there at the start?

Let the numbers at the start be 5k and 2k
$(5k + 5) : (2k - 6) = 5 : 1$, so $1(5k + 5) = 5(2k - 6)$
$5k + 5 = 10k - 30$
$-5k = -35$, so $k = 7$
Number of pears at the start: $2 \times 7 = 14$
**Answer: 14**

## 8 Percentage change and proportion

The time for a pendulum to swing is directly proportional to the square root of the length of the pendulum.
The length of the pendulum is increased by 125%.
Work out the percentage change in the time for a pendulum to swing.

The length of the pendulum is multiplied by 2.25
The multiplier for the time for a pendulum to swing is $\sqrt{2.25} = 1.5$
1.5 is an increase of 50%
**Answer: 50% increase**

## 9 Bounds of speed, density and pressure

A force of 355 N acts on a surface, correct to the nearest 5.
The area of the surface is 80 $m^2$, correct to 1 significant figure.
Work out the lower bound of the pressure.
Give your answer correct to 3 significant figures. (Calculator)

$352.5 \leq$ force $< 357.5$; $75 \leq$ area $< 85$
Lower bound of pressure = smallest force ÷ biggest area = 352.5 ÷ 85
= 4.14706... = 4.15 (3 s.f.)
**Answer: 4.15 $N/m^2$**

## 10 Shaded areas: exact answers

The diagram shows a square inside a circle of radius 3 cm.
The four vertices of the square lie on the circle.
Work out the area of the shaded region. Give your answer in terms of $\pi$.

The diagonal of the square is a diameter of the circle: 6 cm
Area of the square = $\frac{1}{2} \times$ diagonal $\times$ diagonal = $\frac{1}{2} \times 6 \times 6 = 18$
Area of circle = $\pi \times 3^2 = 9\pi$
Shaded area = $9\pi - 18$ $cm^2$
**Answer: $(9\pi - 18)$ $cm^2$**