Day 195 **A Tier 10-a-day: Model Solutions**

1 Time

(a) A coach leaves Leeds at 0905. The journey takes 3 hours 17 minutes. Work out the time it ends.
(b) Change 2.7 hours into hours and minutes.

(a) 0905 + 3 hours = 1205, then + 17 minutes = 1222
(b) 0.7 hours = 0.7 × 60 = 42 minutes, so 2.7 hours = 2 hours 42 minutes
Answer: (a) 1222 (b) 2 hours 42 minutes

2 Median from a frequency table

Here are the results for 27 students.
(a) Find the median.
(b) Work out the range.

(a) The median is the 14th value (27 + 1) ÷ 2 = 14
Cumulative frequencies: 6, 8, 15, 19, 27
The 14th value is 7
(b) Range = 9 − 5 = 4
Answer: (a) 7 (b) 4

3 Circles and tangents

The point P(8, 15) lies on a circle with centre O(0, 0).
(a) Work out the equation of the circle, in the form $x^2 + y^2 = r^2$.
(b) Find the equation of the tangent to the circle at P.

(a) The circle is $x^2 + y^2 = r^2$, so $r^2 = 8^2 + 15^2 = 289$

(b) Gradient of the radius OP = $\frac{15}{8}$

The tangent is perpendicular to the radius, so its gradient = $-1 \div \frac{15}{8} = -\frac{8}{15}$

$y = -\frac{8}{15}x + c$ through (8, 15): $15 = -\frac{8}{15} \times 8 + c$, so $c = \frac{289}{15}$

$y = -\frac{8}{15}x + \frac{289}{15}$

Answer: (a) $x^2 + y^2 = 289$ (b) $y = -\frac{8}{15}x + \frac{289}{15}$

4 Finding a missing value from an average

The mean of the five numbers 22, x, 18, 10, 13 is 14.
Work out the value of x.

Total = 5 × 14 = 70
Known numbers add to 63
x = 70 − 63 = 7
Answer: x = 7

5 Income tax

No tax is paid on the first £12,000 of income. Tax of 25% is paid on the next £30,000. Tax of 40% is paid on all income above £42,000. (Calculator)
Chloe earns £68,000 a year.
Work out the income tax paid.

Next £30,000 at 25%: £30,000 × 0.25 = £7,500
Above £42,000: £68,000 − £42,000 = £26,000, taxed at 40%: £26,000 × 0.4 = £10,400
Total tax = £7,500 + £10,400 = £17,900
Answer: £17,900

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6 Circle theorems: isosceles triangles with radii

A, B and C are points on a circle with centre O.
Angle OAB = 41°.
(a) Work out angle AOB.
(b) Work out the size of angle x.
Give reasons for your answers.

(a) OA = OB (radii), so triangle OAB is isosceles and angle OBA = 41°
Angle AOB = 180 − 41 − 41 = 98°
(b) The angle at the centre is twice the angle at the circumference
x = 98 ÷ 2 = 49
Answer: (a) 98° (b) x = 49°

7 Wages and overtime

Kiran is paid £11.20 per hour for a basic week of 35 hours. (Calculator)
Overtime is paid at double time.
Last week Kiran worked 7 hours of overtime.
Work out Kiran's total pay for the week.

Basic pay = 35 × £11.20 = £392.00
Overtime rate = £11.20 × 2 = £22.40 per hour
Overtime pay = 7 × £22.40 = £156.80
Total = £392.00 + £156.80 = £548.80
Answer: £548.80

8 Rearranging formulae (subject twice)

Make x the subject of $y = \frac{5x - 1}{x + 3}$

Multiply both sides by (x + 3): y(x + 3) = 5x − 1
Expand the bracket: xy + 3y = 5x − 1
Collect the x terms on one side: xy − 5x = −3y − 1
Factorise: x(y − 5) = −3y − 1
Divide by (y − 5): $x = \frac{-3y - 1}{y - 5}$
Answer: $\mathbf{x = \frac{-3y - 1}{y - 5}}$

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 = 40° and angle ACD = 26°.
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 = 26°
In triangle ABE: angle BAE = 40° and angle ABE = 26°
x = 180 − 40 − 26 = 114
Answer: x = 114°

10 Equations with algebraic fractions

Solve $\frac{6}{(x + 5)} + \frac{5}{(x - 3)} = 1$

Multiply every term by (x + 5)(x − 3)
6(x − 3) + 5(x + 5) = (x + 5)(x − 3)
$11x + 7 = x^2 + 2x - 15$
$x^2 - 9x - 22 = 0$
(x + 2)(x − 11) = 0
x = −2 or x = 11
Answer: x = −2 or x = 11