Day 269 **A Tier 10-a-day: Model Solutions**

1 Substitution

$s = ut + \frac{1}{2}at^2$

Work out the value of s when $u = -3$, $a = 4$ and $t = 2$

$s = (-3) \times 2 + \frac{1}{2} \times (4) \times 2^2$

$= -6 + (8)$

$= 2$

Answer: 2

2 Exchange rates

£1 = $1.12.

(a) Change £160 to dollars.

(b) Change $268.8 to pounds.

(a) $160 \times 1.12 = 179.2$

(b) $268.8 \div 1.12 = 240$

Answer: (a) $179.2 (b) £240

3 Factorising quadratics

Factorise $x^2 - 4x + 3$

Find two numbers that multiply to 3 and add to -4

The numbers are -3 and -1

$(x - 3)(x - 1)$

Answer: $(x - 3)(x - 1)$

4 Circle theorems: angle in a semicircle

XY is a diameter of the circle.

Angle YXZ = 60°.

Work out the size of angle x.

Give a reason for each step of your working.

The angle in a semicircle is 90°, so angle XZY = 90°

Angles in a triangle add up to 180°

$x = 180 - 90 - 60 = 30$

Answer: x = 30°

5 Compound interest

Chloe invests £6,500 in a bank account. (Calculator)

The account pays compound interest at 5% per year.

Work out the value of the investment after 4 years.

Multiplier $= 1 + 5 \div 100 = 1.05$

£6,500 $\times 1.05^4$ = £7,900.79

Answer: £7,900.79

6 Rates of flow

A tank is in the shape of a cuboid measuring 100 cm by 50 cm by 150 cm.

It already contains 20 litres of water.

Water flows in at 10 litres per minute until the tank is full.

Work out how long this takes. Give your answer in minutes.

Volume $= 100 \times 50 \times 150 = 750000$ cm^3 = 750 litres

Water needed $= 750 - 20 = 730$ litres

Time $= 730 \div 10 = 73$ minutes

Answer: 73 minutes

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7 Bounds

A triangle has base 31 cm and perpendicular height 20 cm.
Each measurement is correct to the nearest cm.
Work out the upper bound for the area of the triangle.

Upper bounds: base = 31.5 cm, height = 20.5 cm

Area = ½ × 31.5 × 20.5 = 322.875 cm^2

Answer: 322.875 cm^2

8 Surface area of cones and spheres

A sphere has radius 9 cm.
Work out the surface area of the sphere.
Give your answer in terms of π.

Surface area = $4\pi r^2$

= $4 \times \pi \times 9^2$

= 324π

Answer: 324π cm^2

9 Functions

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

(a) f(2) = 3 × 2 + 2 = 8

(b) fg(x) means f(g(x)), so replace x in f with $x^2 + 2$

$fg(x) = 3(x^2 + 2) + 2$

$= 3x^2 + 8$

Answer: (a) 8 (b) $3x^2 + 8$

10 Bounds and accuracy

A cyclist travels 600 metres in 5.4 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 = 605 ÷ 5.35 = 113.0841
Lower bound = 595 ÷ 5.45 = 109.1743
(b) Both bounds round to 110 to 2 s.f. but not to the same value to 3 s.f.
So the speed is 110 m/s to 2 significant figures.
Answer: (a) 113.0841, 109.1743 (b) 110 m/s (2 s.f.)