Measurement & Geometry

Question 1 **(6 marks)**

A flagpole is held upright by several support wires attached to the top of the pole and anchored to the ground. Each wire, together with the pole and the ground, forms a right-angled triangle.

(a) One wire is anchored 6 m from the base of the pole, and the pole is 8 m tall at the point where the wire is attached. Find the length of this wire. (2 marks)

Solution
$c^2 = a^2 + b^2$
$c^2 = 6^2 + 8^2 = 36 + 64 = 100$
$c = 10$ m

Specific behaviours
✓ correctly substitutes into Pythagoras' theorem
✓ correct final answer, 10 m

(b) A second wire is 13 m long and is anchored 12 m from the base of the pole. Find the height at which this wire is attached to the pole. (2 marks)

Solution
$a^2 = c^2 - b^2$
$a^2 = 13^2 - 12^2 = 169 - 144 = 25$
$a = 5$ m

Specific behaviours
✓ correctly rearranges Pythagoras' theorem to find the shorter side
✓ correct final answer, 5 m

(c) A third wire is 20 m long and makes an angle of 30° with the ground. Find the height at which this wire is attached to the pole. (2 marks)

Solution
$\sin 30° = \text{opposite} \div \text{hypotenuse}$
$\text{height} = 20 \times \sin 30° = 20 \times 0.5$
$\text{height} = 10$ m

Specific behaviours
✓ correctly sets up $\sin 30° = \text{opposite} \div \text{hypotenuse}$
✓ correct final answer, 10 m

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Question 2 **(7 marks)**

A cylindrical plastic container has a radius of 7 cm and a height of 10 cm. Use $\pi \approx \frac{22}{7}$ throughout this question.

(a) Find the volume of the container. (2 marks)

Solution

$V = \pi r^2 h$

$$V = \frac{22}{7} \times 7^2 \times 10 = \frac{22}{7} \times 49 \times 10$$

$V = 1540 \text{ cm}^3$

Specific behaviours

✓ correctly substitutes into $V = \pi r^2 h$

✓ correct final answer, 1540 cm^3

(b) Find the total surface area of the container, including both circular ends. (2 marks)

Solution

$SA = 2\pi r^2 + 2\pi rh$

$$SA = (2 \times \frac{22}{7} \times 7^2) + (2 \times \frac{22}{7} \times 7 \times 10) = 308 + 440$$

$SA = 748 \text{ cm}^2$

Specific behaviours

✓ correctly substitutes into $SA = 2\pi r^2 + 2\pi rh$

✓ correct final answer, 748 cm^2

(c) The container is packaged inside a rectangular box measuring 20 cm × 20 cm × 10 cm. Find the volume of empty space inside the box surrounding the container. (3 marks)

Solution

Volume of box = $20 \times 20 \times 10 = 4000 \text{ cm}^3$

Volume of container (from part (a)) = 1540 cm^3

Empty space = $4000 - 1540 = 2460 \text{ cm}^3$

Specific behaviours

✓ correct volume of the box, 4000 cm^3

✓ correctly uses the container volume from part (a)

✓ correct final answer, 2460 cm^3

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Number & Algebra

Question 3 **(6 marks)**

(a) Expand and simplify $(x + 4)(x - 3)$. (2 marks)

Solution
$x^2 - 3x + 4x - 12$
$= x^2 + x - 12$

Specific behaviours
✓ correctly expands the brackets
✓ correct simplified answer, $x^2 + x - 12$

(b) Factorise $x^2 + 7x + 12$. (2 marks)

Solution
Need two numbers that multiply to 12 and add to 7: 3 and 4
$x^2 + 7x + 12 = (x + 3)(x + 4)$

Specific behaviours
✓ identifies the correct factor pair, 3 and 4
✓ correct factorised answer, $(x + 3)(x + 4)$

(c) Factorise $6x^2 - 9x$ by taking out the highest common factor. (2 marks)

Solution
The highest common factor of $6x^2$ and $9x$ is $3x$
$6x^2 - 9x = 3x(2x - 3)$

Specific behaviours
✓ identifies the highest common factor, $3x$
✓ correct factorised answer, $3x(2x - 3)$

FOR RANKED STUDENTS

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Question 4 **(6 marks)**

(a) Solve the following simultaneous equations using substitution: $y = x + 2$ and $2x + y = 11$. (3 marks)

Solution
$2x + (x + 2) = 11$
$3x + 2 = 11$, so $3x = 9$ and $x = 3$
$y = x + 2 = 3 + 2 = 5$, so $x = 3$, $y = 5$

Specific behaviours
✓ correctly substitutes to form an equation in one variable
✓ correctly solves for x, $x = 3$
✓ correctly finds y, $y = 5$

(b) Simplify $x^5 \times x^{-2}$, giving your answer with a positive index. (1 mark)

Solution
$x^5 \times x^{-2} = x^{5 + (-2)}$
$= x^3$

Specific behaviours
✓ correct simplified answer, x^3

(c) Simplify $(2x^3)^2 \div x^4$, giving your answer with a positive index. (2 marks)

Solution
$(2x^3)^2 = 4x^6$
$4x^6 \div x^4 = 4x^2$

Specific behaviours
✓ correctly expands $(2x^3)^2$ to $4x^6$
✓ correct simplified answer, $4x^2$

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Statistics & Probability

Question 5 **(5 marks)**

Ten Year 9 students in Group A sat a 20-mark quiz. Their scores were: 12, 14, 15, 15, 17, 18, 18, 19, 20, 20.

(a) Construct an ordered stem-and-leaf plot for Group A's scores, using the tens digit as the stem. (2 marks)

Solution
Stem | Leaf 1 | 2 4 5 5 7 8 8 9 2 | 0 0 Key: 1 | 2 = 12

Specific behaviours
✓ correctly splits each score into a tens-digit stem and units-digit leaf
✓ leaves in each row correctly ordered from smallest to largest, with a key shown

(b) Group B's ten scores had a median of 14 and a range of 9. Using your stem-and-leaf plot, find the median and the range of Group A's scores, then state which group's scores were more consistent, giving a reason. (3 marks)

Solution
Median = (17 + 18) ÷ 2 = 17.5 Range = 20 − 12 = 8 Group A's range (8) is smaller than Group B's range (9), so Group A's scores were more consistent.

Specific behaviours
✓ correct median, 17.5
✓ correct range, 8
✓ correctly identifies Group A as more consistent, with a valid reason based on range

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Question 6 **(6 marks)**

A bag contains 3 red counters and 2 blue counters. Two counters are drawn at random from the bag, one after the other.

(a) Suppose the first counter is replaced before the second counter is drawn. Draw a probability tree diagram showing all possible outcomes and their probabilities. (3 marks)

Solution

First draw: $P(\text{Red}) = \frac{3}{5}$, $P(\text{Blue}) = \frac{2}{5}$

Second draw (with replacement): $P(\text{Red}) = \frac{3}{5}$, $P(\text{Blue}) = \frac{2}{5}$ on every branch, since the counter is replaced

Four branches: $RR = \frac{3}{5} \times \frac{3}{5}$, $RB = \frac{3}{5} \times \frac{2}{5}$, $BR = \frac{2}{5} \times \frac{3}{5}$, $BB = \frac{2}{5} \times \frac{2}{5}$

Specific behaviours

✓ correct first-draw probabilities shown, 3/5 red and 2/5 blue

✓ correct second-draw probabilities shown as unchanged, 3/5 and 2/5, on every branch

✓ all four outcome branches (RR, RB, BR, BB) correctly labelled with multiplied probabilities

(b) Using your tree from part (a), find the probability that both counters drawn are red. (1 mark)

Solution

$$P(RR) = \frac{3}{5} \times \frac{3}{5} = \frac{9}{25}$$

Specific behaviours

✓ correct probability, 9/25

(c) Suppose instead the first counter is NOT replaced before the second counter is drawn. Find the probability that both counters drawn are red. (2 marks)

Solution

After drawing one red counter without replacement, 2 red and 2 blue counters remain (4 total)

$$P(RR) = \frac{3}{5} \times \frac{2}{4} = \frac{6}{20} = \frac{3}{10}$$

Specific behaviours

✓ correctly adjusts the second probability for no replacement, 2/4

✓ correct final answer, 3/10

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