G3 MATHEMATICS HOLIDAY REVISION

Week 3

Graphs and applications

Worked solutions

Upper Secondary - Sec 3 and Sec 4

12 original questions

Attempt the student worksheet first. Then compare each step with the reasoning and checks in this companion.

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WORKED SOLUTIONS

Week 3 · Graphs and applications

WARM-UPS

Q1

[4 marks]

A line passes through (−2,3) and (4,−1). Find its gradient, equation and x-intercept.

WORKED REASONING

1. Gradient m = (−1−3)/(4−(−2)) = −4/6 = −2/3.
2. Using y = mx + c and (−2,3): 3 = 4/3 + c, so c = 5/3. The line is y = −(2/3)x + 5/3.
3. Set y = 0: 0 = −2x + 5 after multiplying by 3, giving x = 5/2. The x-intercept is (5/2,0).

CHECK THIS STEP FIRST

Subtract x-coordinates in the same point order as y-coordinates.

WORKED SOLUTIONS

Week 3 · Graphs and applications

WARM-UPS

Q2

[3 marks]

A price rises by 10% and then falls by 10%. Find the final price if it began at $200, and explain why it does not return to $200.

WORKED REASONING

1. After the rise: $200 × 1.10 = $220.

2. After the fall: $220 × 0.90 = $198, a $2 or 1% decrease from the original.

3. The second 10% is taken from $220, not $200.

CHECK THIS STEP FIRST

The two percentage changes have different bases.

WORKED SOLUTIONS

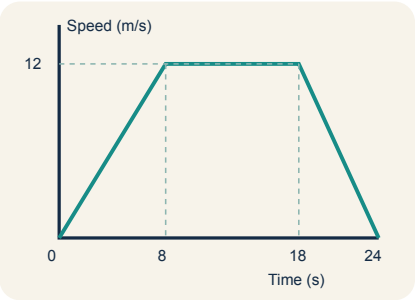
Week 3 · Graphs and applications

CORE APPLICATIONS

Q3

[5 marks]

A speed–time graph joins (0 s,0 m/s), (8 s,12 m/s), (18 s,12 m/s) and (24 s,0 m/s) with straight segments. Find the total distance and average speed over 24 s.



WORKED REASONING

1. Area from 0–8 s is a triangle: (1/2)(8)(12) = 48 m.

2. Area from 8–18 s is a rectangle: (10)(12) = 120 m. Area from 18–24 s is a triangle: (1/2)(6)(12) = 36 m.

3. Total distance = 48 + 120 + 36 = 204 m. Average speed = 204/24 = 8.5 m/s.

CHECK THIS STEP FIRST

Average speed is total distance divided by total time; it is not the mean of the plotted speeds.

WORKED SOLUTIONS

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CORE APPLICATIONS

Q4

[4 marks]

A jacket's price is reduced by 20%, then a 10% surcharge is applied to the reduced price. The final price is $88. Find the original price and check it forward.

WORKED REASONING

1. Let the original price be P dollars. The final price is 0.80 × 1.10 × P = 0.88P.

2. So 0.88P = 88 and P = $100.

3. Check: $100 → $80 after the reduction → $88 after the surcharge.

CHECK THIS STEP FIRST

The surcharge is applied to $80, not to the original $100.

WORKED SOLUTIONS

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CORE APPLICATIONS

Q5

[4 marks]

In a grouped table, masses 0–<10 g, 10–<20 g and 20–<30 g have frequencies 4, 6 and 10. Estimate the mean mass and identify the modal class. Explain why the mean is an estimate.

WORKED REASONING

1. Use class midpoints 5, 15 and 25 g. The estimated total is $4(5)+6(15)+10(25)=360$ g for 20 items.
2. Estimated mean = 360/20 = 18 g. The modal class is 20–<30 g because it has the greatest frequency, 10.
3. Individual masses are not given; replacing each value by its class midpoint makes the mean an estimate.

CHECK THIS STEP FIRST

Do not divide by the number of classes or treat each midpoint as occurring once.

WORKED SOLUTIONS

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CORE APPLICATIONS

Q6

[4 marks]

Two mobile plans have monthly costs A(t) = 8 + 0.20t dollars and B(t) = 20 dollars for t minutes of calls, with t ≥ 0. Find when their costs are equal and when B is cheaper. Interpret the boundary.

WORKED REASONING

1. Set 8 + 0.20t = 20. Then 0.20t = 12 and t = 60 minutes.

2. B is cheaper when 20 < 8 + 0.20t, or t > 60.

3. At exactly 60 minutes the costs are equal; at fewer than 60 minutes A costs less.

CHECK THIS STEP FIRST

The inequality direction should match the plan whose cost is being compared.

WORKED SOLUTIONS

Week 3 · Graphs and applications

CHALLENGING REASONING

Q7

[5 marks]

A(0,0), B(6,0) and C(2,5) are vertices of a triangle. Find its area, the midpoint M of BC and the equation of AM.

WORKED REASONING

1. AB is horizontal with length 6; C is 5 units above it. Area = (1/2)(6)(5) = 15 square units.
2. M = ((6+2)/2,(0+5)/2) = (4,5/2).
3. Gradient of AM is (5/2)/4 = 5/8. Since A is the origin, AM has equation y = (5/8)x.

CHECK THIS STEP FIRST

The midpoint's y-coordinate is 5/2, not 5; use both endpoint coordinates.

WORKED SOLUTIONS

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CHALLENGING REASONING

Q8

[5 marks]

A cyclist travels 60 km outward at 30 km/h, rests for 1 hour, then returns 60 km at 60 km/h. Find the total elapsed time, average speed for the whole trip and average speed while moving.

WORKED REASONING

1. Outward time = 60/30 = 2 h. Return time = 60/60 = 1 h. Including the rest, elapsed time = 2+1+1 = 4 h.

2. Total distance = 120 km, so whole-trip average speed = 120/4 = 30 km/h.

3. Moving time is 3 h, so moving-only average speed = 120/3 = 40 km/h.

CHECK THIS STEP FIRST

Do not take the arithmetic mean of 30 and 60; the two legs take different times, and the rest counts in whole-trip time.

WORKED SOLUTIONS

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CHALLENGING REASONING

Q9

[6 marks]

For $y = x^2 - 4x - 5$, find the x-intercepts and turning point. Find where the curve meets the line $y = -5$. State which features can be read exactly from algebra without a scale drawing.

WORKED REASONING

1. Factor $y = (x-5)(x+1)$, so the x-intercepts are $(5,0)$ and $(-1,0)$.
2. Complete the square: $y = (x-2)^2-9$, so the minimum turning point is $(2,-9)$.
3. Set $x^2-4x-5 = -5$. Then $x(x-4)=0$, giving intersections $(0,-5)$ and $(4,-5)$.
4. All these coordinates follow exactly from the equations; a sketch alone is not required for exact values.

CHECK THIS STEP FIRST

Setting $y = -5$ is different from setting $y = 0$ to find the x-intercepts.

WORKED SOLUTIONS

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MISCONCEPTION ANALYSIS

Q10

[4 marks]

Two classes have five-number summaries (minimum, Q1, median, Q3, maximum). Class A: 30, 42, 50, 58, 70. Class B: 25, 48, 52, 56, 80. Compare their medians and the spread of the middle half. Can you conclude which class has the greater mean?

WORKED REASONING

1. Class B's median 52 is 2 higher than Class A's median 50.
2. IQR(A) = 58−42 = 16; IQR(B) = 56−48 = 8. The middle half of B is less spread out by this measure.
3. Five-number summaries do not determine the mean, so the greater mean cannot be concluded from this information alone.

CHECK THIS STEP FIRST

A higher median does not prove a higher mean; the data within quartile ranges are unknown.

WORKED SOLUTIONS

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MISCONCEPTION ANALYSIS

Q11

[4 marks]

On a speed–time graph, a horizontal segment at 12 m/s lasts from t = 8 s to t = 18 s. A student says the object was stopped for 10 s because the graph was horizontal. Explain the error, find the distance during the segment and state what a horizontal distance–time segment would mean.

WORKED REASONING

1. A horizontal speed–time segment above zero means constant speed, here 12 m/s, not a stop.
2. Distance during the 10 s interval is the rectangle area 12 × (18−8) = 120 m.
3. A horizontal distance–time segment has zero gradient, so distance does not change and the object is stopped.

CHECK THIS STEP FIRST

Name the vertical axis before interpreting the shape of a graph.

WORKED SOLUTIONS

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STRETCH

Q12

[6 marks]

On one straight route, cyclist A starts at kilometre 0 and travels at 12 km/h. Cyclist B starts 6 km ahead, travels at 8 km/h for 1 hour, stops for 30 minutes, then resumes at 8 km/h. They start at the same time. Find when and where A first catches B, and who is ahead after 2 hours.

WORKED REASONING

1. After 1 hour, A is at 12 km and B is at 6+8=14 km, so A has not yet caught B.
2. During B's 30-minute stop, B stays at 14 km. A needs 2 km more at 12 km/h: time 2/12 h = 1/6 h = 10 minutes.
3. They first meet 1 hour 10 minutes after starting, at kilometre 14. This occurs during B's stop.
4. After 2 hours, A is at 24 km. B travelled for 1 hour, stopped 0.5 hour, then travelled another 0.5 hour: 6+8(1.5)=18 km. A is 6 km ahead.

CHECK THIS STEP FIRST

A single straight-line equation for B does not apply during the stop; use the correct stage before solving.