C. Kirkwood

Government of **Western Australia**
School Curriculum and Standards Authority

EST CODE
MAEGT
FOR OFFICE USE ONLY

Mathematics Essential
General course

Externally set task 2019
Marking key

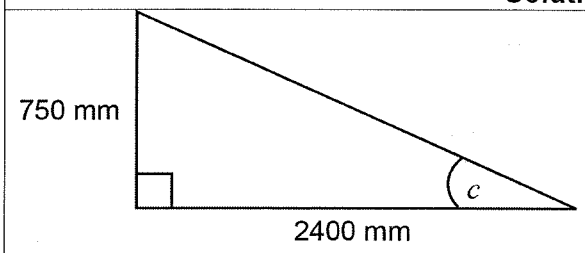
Total marks for this task: 42

Question 1 **(11 marks)**

(a) Determine the difference in the total length of steel required for each of the two A-frame constructions. (6 marks)

Solution	
Design 1 Length of steel = 2 × 2140 + 1500 = 5780 mm **Design 2** Let a be length of side A-frame $a^2 = 2400^2 + 750^2 \Rightarrow a \approx 2514.46$ mm Length of steel ≈ 2 × 2514.5 + 1500 = 6529 mm Therefore, the difference in the length of steel is: 6529 – 5780 = 749 mm more (accept 748 mm and 750 mm)	
Specific behaviours	**Marks**
Correctly finds total steel for Design 1	1
Recognises use of Pythagoras to find the side length of A-frame in Design 2	1
Uses Pythagoras as sum of squares on Design 2	1
Uses square root function to determine a	1
Correctly finds total steel for Design 2	1
Correctly finds difference in length of steel for Designs 1 and 2	1
Total	**6**

(b) Determine the size of the angle at the apex of the A-frame Rob selected. (5 marks)

Solution	
 Tan $\angle c = \frac{750}{2400}$ or sin $\angle c = \frac{750}{2514.46}$ or cos $\angle c = \frac{2400}{2514.46}$ $\angle c \approx 17.35°$ ∴Apex angle is 2 × 17.35° = 34.7° (accept 35°)	
Specific behaviours	**Marks**
Identifies Design 2 as most stable	1
Identifies use of trig ratios	1
Expresses the trig ratio correctly	1
Uses calculator (in degrees) to solve for angle in right triangle	1
Doubles angle value above to deduce angle at apex	1
Total	**5**

Question 2 **(15 marks)**

(a) (i) How long does it take for the competitor to complete the swimming section? (1 mark)

Solution	
40 minutes	
Specific behaviours	**Marks**
Interprets time scale correctly, including units	1
Total	**1**

(ii) What is the average speed for this section of the triathlon? (4 marks)

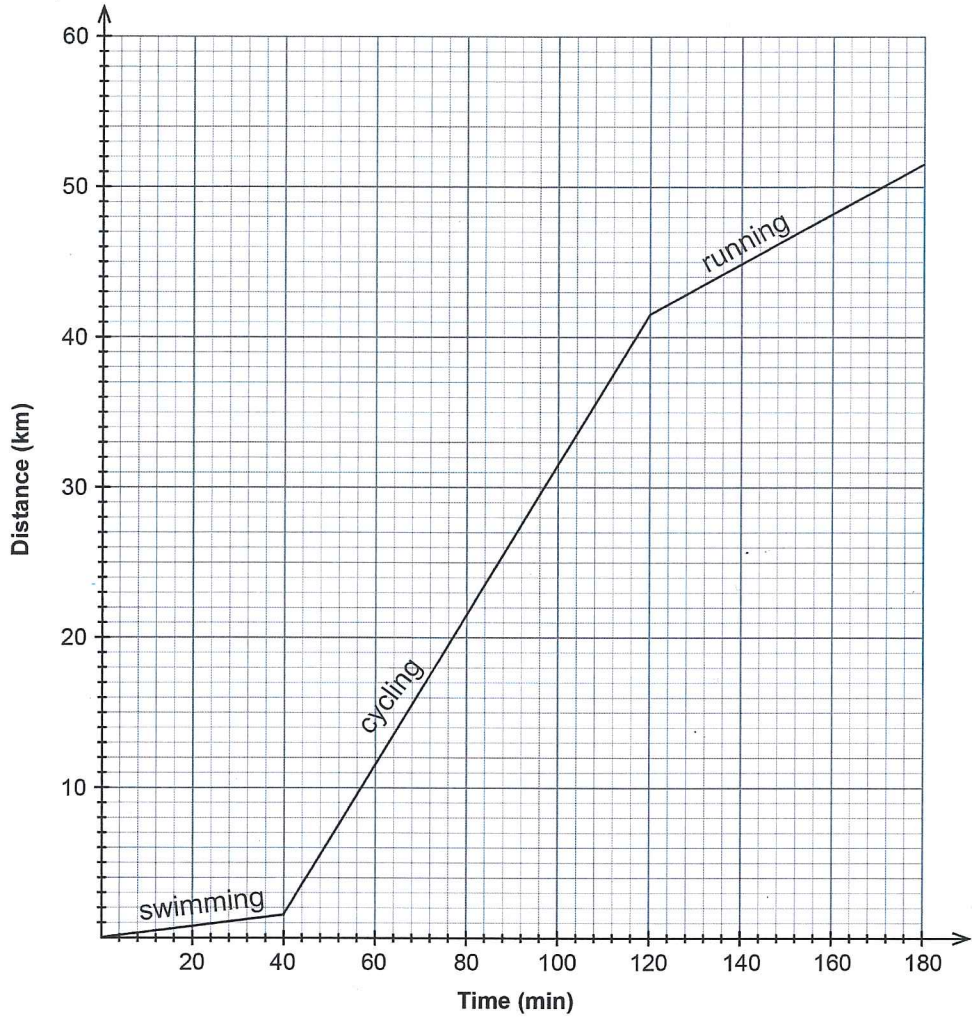
Solution	
$\frac{1500}{40}$ = 37.5 m/min (or $\frac{1.5}{40} \times 60$ = 2.25 km/hour or 2250 m/hour)	
Specific behaviours	**Marks**
Interprets distance scale correctly	1
Chooses the correct operation to determine rate of change (speed)	1
Determines the correct average speed	1
Includes the correct units for speed	1
Total	**4**

(b) Plot on **Graph 2**:

- the cycling section, which follows the swimming section
- the running section, which follows the cycling section to show all sections of the triathlon. (6 marks)

Solution

Graph 2



Specific behaviours	Marks
Draws line joining cycling to swimming section	1
Allows a time duration of 80 minutes	1
Allows a distance cycled of 40 km	1
Subtotal	**3**
Draws line joining running section to cycling section	1
Increases time by a further 60 minutes	1
Increases distance by a further 10 km	1
Subtotal	**3**
Total	**6**

Question 2 (continued)

(c) Compare the three sections of the triathlon to determine which section is completed at the fastest rate by the competitor. Justify your conclusion. (4 marks)

Solution	
From (a)(ii) (Swimming $\frac{1500}{40}$ = 37.5 m/min or 2.25 km/hour) Cycling $\frac{40\,000}{80}$ = 500 m/min or 30 km/hour Running $\frac{10\,000}{60} \approx$ 166.7 m/min or 10 km/hour $\therefore$ Fastest section is cycling.	
Specific behaviours	**Marks**
Correctly calculates the rate of change (speed) for cycling	1
Correctly calculates the rate of change (speed) for running	1
Compares the three speeds for swimming, cycling and running to justify conclusion	1
States that cycling is completed at the fastest rate (its rate of change is the fastest)	1
Total	**4**

Question 3 **(7 marks)**

(a) Determine the quantity of shampoo: (1 mark)

(i) pumped out per action.

Solution	
20 mL	
Specific behaviours	**Marks**
Determines usage of 20 mL per complete pump	1
Total	**1**

(ii) remaining in the bottle after four complete pump actions. (1 mark)

Solution	
1940 − 20 = 1920 mL	
Specific behaviours	**Marks**
Applies rate from (a)(i) to determine quantity remaining after four pumps	1
Total	**1**

(iii) that would have been in the bottle when it was full. (1 mark)

Solution	
1980 + 20 = 2000 mL	
Specific behaviours	**Marks**
Applies rate from (a)(i) to determine quantity when bottle was full	1
Total	**1**

(b) Determine the linear relationship to be used to represent the quantity of shampoo (q_s), expressed in millilitres, remaining in the bottle after n complete pumps from the bottle. (4 marks)

Solution	
$q_s = 2000 - 20n$ or $-20n + 2000$	
Specific behaviours	**Marks**
Recognises the usage as the rate of change with respect to n	1
Writes co-efficient as negative to show decrease	1
Uses the full value as the vertical intercept	1
Writes the rule in correct format	1
Total	**4**

Question 4 **(9 marks)**

(a) (i) Determine the rate at which the conditioner is pumped out of the bottle with each complete pump. Show working to support your answer. (3 marks)

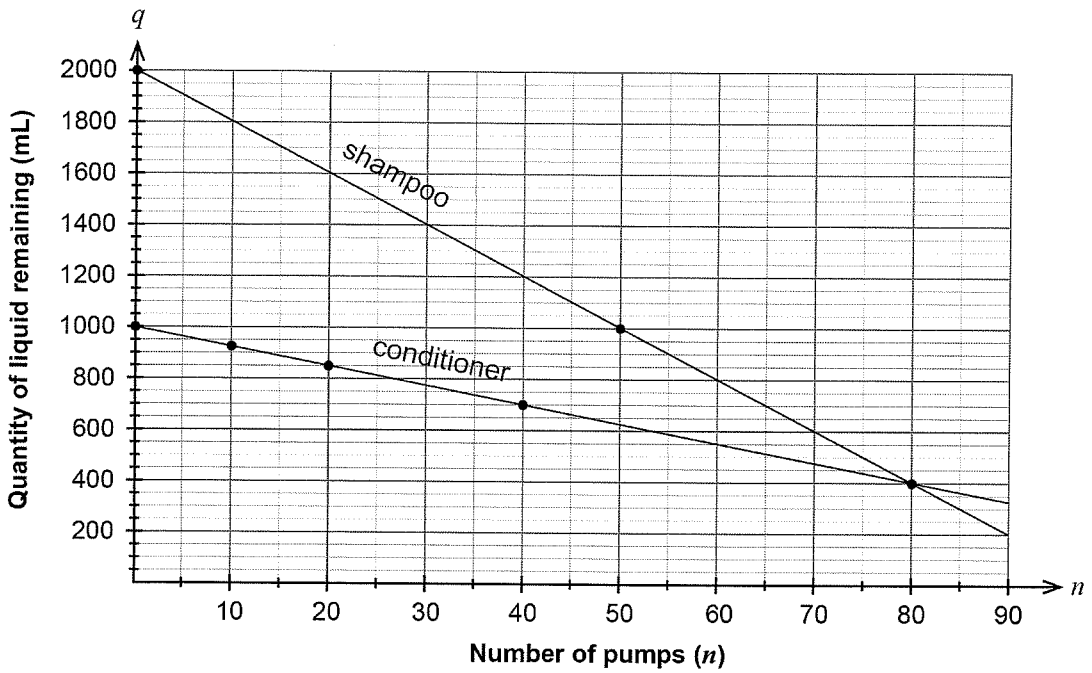
Solution	
Uses 300 mL in 40 pumps or 150 mL in 20 pumps $\frac{300}{40}$ or $\frac{150}{20}$ $= 7.5$ Thus 7.5 mL per pump	
Specific behaviours	**Marks**
Determines correct usage in the correct number of pumps	1
Recognises rate as division of usage by number of pumps	1
Correctly evaluates and writes with correct units	1
Total	**3**

(ii) Determine the linear relationship to represent the quantity of conditioner (q_c), expressed in millilitres, remaining in the bottle after n complete pumps from the bottle. (2 marks)

Solution	
$q_c = 1000 - 7.5n$	
Specific behaviours	**Marks**
Writes the rate of change as the coefficient of n	1
Uses the full value as the vertical intercept	1
Total	**2**

(b) Use graphical techniques on **Graph 3** to determine when the amount of conditioner remaining in the bottle is the same as the amount of shampoo remaining in the bottle from Question 2. State this amount. (4 marks)

Solution



Number of pumps ≈ 80 Quantity liquid remaining ≈ 400 mL

Specific behaviours	Marks
Draws line to show shampoo remaining in bottle	1
Extends both linear graphs to intersect and identifies the point of intersection	1
Writes value of n correctly from graph	1
Writes value of q correctly from graph, with units	1
Total	**4**