Assessment Schedule – 2016

Physics: Demonstrate understanding of aspects of heat (90939)

Evidence Statement

Question	Evidence	Achievement	Merit	Excellence
ONE (a)	The heat energy lost was transferred from the warmer bottles to the colder freezer.	Correct statement about transfer of heat to surroundings (freezer).		
(b)	Heat is being transferred from the bottle to the colder surroundings of the freezer, as the bottle is at a higher temperature than the freezer. The main methods are by radiation to the air space of the freezer and by conduction between the bottle and the cooler bottom of the freezer. The tissue paper acts as an insulator, slowing down the rate of heat transfer.	Description of the energy being transferred by radiation or by conduction and the tissue paper being an insulator.	Full explanation of heat transfer, including direction, methods, and tissue paper acting as an insulator that slows the rate of heat transfer.	
(c)	$Q = mL \quad m = 0.60$ kg $Q = 0.60 \times 3.3 \times 10^5$ $= 198\,000$ J $t = \frac{Q}{P} \quad P = 200$ W $= \frac{198\,000}{200} = 990$ s $t = \frac{990}{60} = 17$ min	Any calculation correct except for one mistake in conversion of units.	Correctly finds Q and time but does not convert final time into minutes.	All steps correct.
(d)	The amount of energy being transferred to the freezer by the water is constant, so by increasing the power rating of the freezer, the time to freeze will decrease. This doubling of the power, will act to decrease the time by a half (8.25 min).	States that the time taken to freeze the water will reduce.	Explains that the energy transfer is constant and therefore the time will reduce by a **half**.	

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No relevant evidence.	Very little evidence at Achievement level. Most evidence is at the Not Achieved level.	Some evidence at Achievement level; partial explanations.	Most evidence provided is at Achievement level, while some is at the Not Achieved level.	Nearly all evidence provided is at the Achievement level.	Some evidence is at the Merit level with some at the Achievement level.	Most evidence is at the Merit level, with some at the Achievement level.	Evidence is provided for most tasks, with evidence at the Excellence level weak or with minor errors / omissions.	Evidence provided for all tasks. Evidence at the Excellence level accurate and full.
0	1A	2A	3A	4A	1A + 2M	2A + 2M	2M + 1E	1A + 2M + 1E

Question	Evidence	Achievement	Merit	Excellence
TWO (a)(i) (ii)	See Appendix.	Four of the five labels correct.		
(b)(i) (ii)	Latent heat is the amount of heat energy released (accept absorbed even though graph is cooling) when (one kilogram of) a substance changes its state while the temperature remains constant. At a particle level, making a substance change state requires energy. Thus releasing energy during the section D is not going to lower the temperature further but the now slower particles can come closer together and form a solid, releasing energy.	Correct definition of latent heat. OR Describes the process of energy being released as it changes state but does not refer to particle motion.	Definition and explanation of phase change complete. AND Explains process of phase change with reference to particle motion during freezing (not melting).	
(c)	Heat energy is being transferred from the water to the ice, as the water is warmer. This heat energy from the water is required by the ice to increase in temperature AND undergo a phase change, which requires latent heat. This acts to lower the temperature of the water.	The water is cooled down as the ice takes heat energy from the water.	Explanation of ice requiring energy for a temperature change and phase change, which comes from the heat energy in the water.	
(d)	$Q_{ice} = mc\Delta T$ $m = 0.065$ kg $Q_{ice} = 0.065 \times 2100 \times 5$ $Q_{ice} = 682.5$ J $Q_{melting} = mL = 0.065 \times 330\,000$ $Q_{melting} = 21\,450$ J $Q_{water} = mc\Delta T$ $Q_{water} = 0.065 \times 4200 \times 8$ $Q_{water} = 2\,184$ J Total energy required: $Q = 682.5 + 21\,450 + 2184 = 24\,316$ J $Q = 24\,000$ J	Any energy correctly calculated.	Total energy attempted with calculations that include the latent heat of the ice.	Correct calculations showing the three energy processes adding together for the total energy required.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No relevant evidence.	Very little evidence at the Achievement level. Most evidence is at the Not Achieved level.	Some evidence at the Achievement level; partial explanations.	Most evidence provided is at the Achievement level, while some is at the Not Achieved level.	Nearly all evidence provided is at the Achievement level.	Some evidence is at the Merit level with some at the Achievement level.	Most evidence is at the Merit level, with some at the Achievement level.	Evidence is provided for most tasks, with evidence at the Excellence level weak or with minor errors / omissions.	Evidence provided for all tasks. Evidence at the Excellence level accurate and full.
0	1A	2A	3A	4A	1A + 2M	2A + 2M	2M + 1E	1A + 2M + 1E

Question	Evidence	Achievement	Merit	Excellence
THREE (a)	The foam and the trapped air bubbles are both poor conductors of heat / good insulators.	Correct statement of either foam material or trapped air bubbles.		
(b)	Modifications could include: • extend the foam higher around the drink • outside white • thicker foam • double layer with air space in between. Explanation of modifications: • More foam as it will increase the air bubbles, and since air is an insulator it will reduce heat energy gained by conduction. • Outside white to reflect any of the solar energy transferred by radiation.	Any reasonable statement that relates to a valid modification.	Explains the modification and includes a **named** heat transfer method.	
(c)	$Q = mL \quad m = \frac{Q}{L}$ $m = \frac{12\,000}{2\,300\,000}$ $= 5.2 \times 10^{-3}$ kg $= 5.2$ g	Correct calculation but does not convert final answer.	Correct calculation and conversion.	
(d) (i) (ii)	Drinking the hot drink can stimulate the person to start sweating. This sweat / water then evaporates. For the water to evaporate it requires latent heat energy to undergo a phase change of liquid to gas. This requires a large amount of heat energy (2.3×10^6 J kg^{-1}). This energy mainly comes from the body of the person and results in a cooling effect. Humidity is a measure of how much water vapour is in the air. As humidity increases, the rate of evaporation decreases.	Describes an increase in the person sweating and describes the idea of evaporation that causes a person to feel cooler.	When a person sweats, the water will evaporate off their skin. This evaporation takes energy; thus leaving the skin cooler. AND In humid conditions there is more water vapour in the air and evaporation rates are slower.	When a person sweats, the water / sweat evaporates and the required (latent) heat energy is taken from the body, thus leaving the skin cooler. AND Humid conditions slow down the rate of evaporation.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No relevant evidence.	Very little evidence at the Achievement level. Most evidence is at the Not Achieved level.	Some evidence at the Achievement level; partial explanations.	Most evidence provided is at the Achievement level, while some is at the Not Achieved level.	Nearly all evidence provided is at the Achievement level.	Some evidence is at the Merit level with some at the Achievement level.	Most evidence is at the Merit level, with some at the Achievement level.	Evidence is provided for most tasks, with evidence at the Excellence level weak or with minor errors / omissions.	Evidence provided for all tasks. Evidence at the Excellence level accurate and full.
0	1A	2A	3A	4A	1A + 2M	2A + 2M	2M + 1E	1A + 2M + 1E

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 12	13 – 18	19 – 24

Appendix of Diagrams

Question Two (a)