Assessment Schedule – 2007

Physics: Demonstrate understanding of heat transfer and nuclear physics (90184)

Evidence Statement

Note: Minor computational errors will not be penalised. A wrong answer will be accepted as correct provided there is sufficient evidence that the mistake is not due to a lack of understanding. Such evidence includes:

- the last written step before the answer is given has no unexpanded brackets or terms and does not require rearranging
- the power of any number that is multiplied by a power of 10 is correct.

Correct units and significant figures are required only in the questions that specifically ask for them.

Question	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)	Fission A large **nucleus** (not atom) is broken into smaller ones.	[1] Correct reaction.	[1] Correct reaction and explanation.	
(b)	$92 + 0 = 42 + 57 + 0 - X$ $X = 7$	[2] Correct answer.		
(c)	Water / CO_2 / graphite. The moderator slows down the neutrons so that they can be absorbed by the uranium atoms.	[1] Correct name.	[1] Correct name and explanation.	
(d)	1. The chain reaction causes continuous fission of uranium atoms which produce heat energy. 2. This heat energy is absorbed by the coolant in the reactor. 3. As the coolant passes through the heat exchanger it transfers its heat energy to the water in the boiler. 4. The water in the boiler boils and the steam generated drives the turbines to generate electricity. 5. The steam from the turbines is condensed back to water and recycled back to the boiler to repeat the process.	[1] Describes that fission produces heat energy, which is transferred to the water in the exchanger and steam is generated.	[1] Explains the process reasonably well but misses explaining one point.	[1] Gives a concise explanation in the correct order.
(e)	${}^{2}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n}$	[2] Correct equation.		
(f)	3.8×10^{26} W ÷ 3.0×10^{16} J $= 1.27 \times 10^{10}$ million tonnes $(= 1.27 \times 10^{16}$ tonnes)	2. Correct working (Incorrect answer).	[2] Correct answer.	
(g)	1. Conduction and convection both need a medium / particles to transfer energy. 2. Space is a vacuum / there are no particles in space, so no heat is lost by convection or conduction.	[1] Identifies the need for a medium	[1] Explains why there is no heat loss by these methods	
TWO (a)	$Q = m \times L = 8.0 \times 139\,000$ $= 1\,112\,000$ J	[2] Correct working answer.		

(b)	1. The air next to the ice is cooled by conduction from the ice surface. 2. The cool air is denser than the warmer air in the rest of the building. So the cool air stays down and the warm air, being less dense than the cooler air, stays above the ice.	[1] Indicates that the layer of air next to the ice is cooled by the ice / conduction OR Warmer air being less dense remains above the cold air	[1] Correct explanation in terms of density differences AND the idea of conduction.	
(c)	$Q = m \times c \times \Delta T$ $= 75 \times 2100 \times (4 - 0)$ $= 630\,000$ J	[2] Correct working answer.		
(d)	$Q = m \times c \times \Delta T$ $= 4200 \times 300 \times (50 - 15)$ $= 44100\,000$ J $P = E / t$ $t = E / P = 44\,100\,000 / 8500$ $= 5188.2$ s (= 5188 s)		[2] Correct working but used 8.5 kW for P and got the answer as 5 188 235 s.	[2] Correct working and answer.
(e)	Energy to cool the water to 0°C $Q1 = m \times c \times \Delta T = 300 \times 4200 \times 50$ $= 63\,000\,000$ (63 000 kJ) Energy to freeze the water to ice $Q = m \times L = 300 \times 340\,000$ $= 102\,000\,000$ J (= 102 000 kJ) Total = 165 000 000 J (165 000 kJ)		[2] Correct procedure followed; one mistake.	[2] Correct working and answer.
THREE (a)	1. The insulating material under the roof reduces the gain of heat by conduction from outside to the inside of the rink. 2. Shiny aluminium (silver surface) is a good reflector of radiation. So the shiny surface facing the roof reflects heat energy back to the roof area, thereby reducing the heat gain from the roof. 3. The shiny surface facing the rink reflects heat energy back to the rink, thereby reducing the heat loss from the rink.	[1] Identifies one of the heat transfer ideas.	[1] Explains reflection by both sides of the foil OR radiation on either side of the foil and reduction of conduction by the insulating material.	[1] Explains reflection of radiation on both sides of the foil and reduction of conduction by the insulating material.
(b)	$E = P \times t$ $= 65 \times 60 \times 60$	[2] Correct formula and working.		
(c)	$Q = 0.12 \times 234\,000 = 28\,080$ J $Q = m \times c \times \Delta T$ $28\,080 = 4.3 \times c \times 14.5$ $c = 450.4 = 450$ J kg^{-1} °C^{-1}	[2] Correct answer for Q.	[2] Correct working answer.	

Judgement Statement

	Achievement	Achievement with Merit	Achievement with Excellence
Criterion One	2 × A1	2 × M1 + 2 × A1	1 × E1 + 2 × M1 + 2 × A1
Criterion Two	2 × A2	2 × M2 + 3 × A2	1 × E2 + 2 × M2 + 3 × A2

Note: At least 1 × A1 and 1 × A2 from each of heat and nuclear.