

Assessment Schedule – 2006**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	Merit	Excellence
ONE (a)	$4 + x = 30 + 1$ $x = 27$	² Correct working and answer.		
(b)	Reaction 3 Two lighter/smaller nuclei are combined to form a heavier/larger one.	¹ States Reaction 3.	¹ Mentions combining lighter nuclei to form a heavier one.	
(c)	Mass number / number of protons and neutrons / number of nucleons.	¹ Correct statement.		
(d)	Neutrons = $235 - 92 = 143$	² Correct answer.		
(e)	$E = \frac{1}{3} \times 3.2 \times 10^{-11} \times 2.56 \times 10^{21}$ $= 2.73 \times 10^{10}$		² Correct working and answer.	
(f)	Using control rods. Control rods absorb neutrons. They are lowered into the reactor to absorb more neutrons and reduce the number of nuclear reactions or raised to absorb fewer neutrons and increase the number of nuclear reactions.	¹ Mentions control rods.	¹ Achieved plus mentions raising or lowering of the control rods, change (the number of neutrons or rate of reaction).	¹ Explanation includes either that the control rods can be lowered absorbing more neutrons and reducing the number of nuclear reactions (collisions), or can be raised absorbing fewer neutrons and increasing the number of nuclear reactions (collisions).

TWO (a)	$c = \frac{Q}{m\Delta T} = \frac{19400}{0.240 \times 88}$ $= 919 \text{ J kg}^{-1}(\text{°C})^{-1}$	² Correct working/substitution but wrong answer.	² Correct working and answer.	
(b)	$p = \frac{E}{t} = \frac{19\,400}{0.50 \times 60} = 646.7$ $= 647 \text{ W}$	² Correct answer using $t = 0.50$ (38 800 W).	² Correct working and answer.	
(c)	Property: Insulator / poor conductor. It prevents heat conduction from the metal body (to Michelle's hand).	¹ Mentions the property.	¹ Correct explanation and property are given.	
(d)	291 000 J of energy is required to melt one kg of the solid material to liquid (without rise in temperature).		¹ Correct explanation.	
(e)	$Q = mL = 0.015 \times 291\,000 = 4365 \text{ J}$	² Correct working and answer		
(f)	$Q_1 = mc\Delta T = 0.20 \times 4200 \times (100 - 18)$ $= 68880 \text{ J}$ $Q_2 = mL = 0.20 \times 2\,260\,000$ $= 452\,000 \text{ J}$ $\text{Total} = Q_1 + Q_2 = 520\,880 \text{ J}$	² Correct working and answer either Q_1 or Q_2 .	² Correct working and answer for both Q_1 and Q_2 .	² Correct working and answer.
THREE (a)	Conduction causes water surrounding the element to heat up. This heated water becomes less dense and rises to the top. The denser cooler water sinks to the element and the process is repeated.	¹ Mentions concepts of conduction or convection.	¹ Mentions the concepts of both conduction and convection.	¹ Merit plus correct explanation of convection using the idea of density difference.
(b)	$Q = mc\Delta T = 180 \times 4200 \times (55 - 52)$ $= 2268\,000 \text{ J}$ $t = \frac{E}{P} = \frac{2268\,000}{3000} = 756\text{s}$ $(= 12.6 \text{ min})$	² Correct working and answer for Q .	² Correct working and answer for Q and correct methods but used P as 3. (756 000)	² Correct working and answer.
(c)	Radiation	¹ Correct answer.		
(d)	$E = P \times t$ $= 250 \times (5.0 \times 60)$ $= 75\,000 \text{ J} (= 75 \text{ kJ})$	² Correct working but wrong answer using t as 5 min. (1250)	² Correct working and answer.	
Total opportunities		criterion 1: 6 criterion 2: 8	criterion 1: 5 criterion 2: 6	criterion 1: 2 criterion 2: 2
		3 × A1	2 × M1 + 2 × A1	1 × E1 + 2 × M1 + 2 × A1
		4 × A2	3 × M2 + 2 × A2	1 × E2 + 2 × M2 + 2 × A2

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

The grade awarded is the highest one that has been demonstrated in all achievement criteria up to and including that grade.

The following is a guide to the standard required for each grade in the two criteria.

Criterion One

Achievement	Achievement with Merit	Achievement with Excellence
Total of THREE opportunities answered at Achievement level or higher. $3 \times A1$	Total of FOUR opportunities answered with TWO at Merit level or higher. $2 \times M1 + 2 \times A1$	Total of FIVE opportunities answered with at least ONE at Excellence level and TWO at Merit level. $1 \times E1 + 2 \times M1 + 2 \times A1$

Criterion Two

Achievement	Achievement with Merit	Achievement with Excellence
Total of FOUR opportunities answered at Achievement level or higher. $4 \times A2$	Total of FIVE opportunities answered with THREE at Merit level or higher. $3 \times M2 + 2 \times A2$	Total of FIVE opportunities answered with at least ONE at Excellence level and TWO at Merit level. $1 \times E2 + 2 \times M2 + 2 \times A2$

Overall Judgement Statement

Note: For Achievement, at least $1 \times A1$ and $1 \times A2$ must be from each of heat and nuclear.

Achievement Criteria		
Achievement	Achievement with Merit	Achievement with Excellence
$3 \times A1$	$2 \times M1 + 2 \times A1$	$1 \times E1 + 2 \times M1 + 2 \times A1$
$4 \times A2$	$3 \times M2 + 2 \times A2$	$1 \times E2 + 2 \times M2 + 2 \times A2$