Mark scheme – Power and Efficiency (H)

Question			Answer/Indicative content	Marks	Guidance
1			**D** ✓	1 (AO 2.1)	
			Total	**1**	
2			**D** ✓	**1 (AO2.2)**	
			Total	**1**	
3			**B** ✓	**1 (AO2.2)**	**Examiner's Comments** Q10 and Q11 required candidates to rearrange the equations provided to calculate the useful output energy transfer per minute, or the height of the water tank. Almost every candidate wrote out their workings by the side of the question stem and then selected the correct answer. See Exemplar 1 below. **Exemplar 1** 11 A pump lifts 500 kg of water to a water tank at the top of a building. The water gains 240 000 J of gravitational potential energy. The gravitational field strength is 10 N/kg. Use the equation: Potential energy = Mass × Height × Gravitational field strength Calculate the height of the water tank. 240000 / 500 × 10 A 4.8 m B 48 m C 240 m D 480 m Your answer B [1]
			Total	**1**	
4			C	1	
			Total	**1**	
5			D	1	
			Total	**1**	
6	a		28 (1)	1	
	b		(Josh's is only) 50% efficient / AW (1) And any one from: (Kate's) red is 76% efficient (1) Blue is 61% efficient (1) White is 85% efficient (1)	2	

			Total	**3**	
7			Reduce the friction between the car and track / lubrication (1) Make the shape of the car more streamlined to reduce drag (1)	2	
			Total	**2**	
8	a		Half of the (previously) wasted power or energy / 0.5 kW is being used to heat water (1) Less energy needed from other sources to heat water (1) Fire X is (4/5 × 100% =) 80% efficient (1) Fire Y is (4.5/5 × 100% =) 90% efficient (1)	4	**ALLOW** some energy from fire now used to heat water scores (1)
	b		Energy for oil is 672 000 (J) (1) Energy for water is 1 680 000 (J) (1) Recall P=E/t (1) Calculation to show: 672 000 / 400 = 1680 AND 1680000 / 1000 = 1680 (1)	4	
			Total	**8**	
9			Lorry has more KE than a car at the same velocity (1) More absorption of energy by larger brake discs (1) Higher rate of dissipation of energy to surrounding air (1) Brakes less likely to overheat (1)	4	
			Total	**4**	
10		i	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.8 (kW) award 4 marks** (P =) $I^2 \times R$ ✓ 11 x 11 x 23 or 11^2 x 23 or 121 x	**4** (AO1.2) (AO2.1)	**ALLOW** 2.78 kW or 2.783 kW ✓✓✓✓ **ALLOW** equation in any form

			23 ✓ = 2783 ✓ Conversion to kW = 2.8 ✓	(AO2.1) (AO2.1)	**ALLOW ECF** candidates answer to 3rd marking point converted to kW **Examiner's Comments** This question required candidates to recall the equation: *power = current² x resistance* before converting their answers into kW. Out of the candidates who gained credit, most were credited with all four marks. A few candidates were only credited with one mark for converting the power output in W into kW. A significant number of candidates used an incorrect equation for power, most commonly using *current* rather than *current²* **AfL** When a physics question requires candidates to apply their mathematical skills they should always write down how they are answering the question. Using brief notes is and writing down intermediate calculations helps the examiner to see what the candidate is doing. A single finger error will result in many candidates receiving no credit because they only write down their final answer. Marks may be available for each stage of the process, using the correct equation, rearranging the equation, substituting in correct values. Choosing to access these compensatory marks by showing workings is good examination technique.
		ii	Wind speed varies / AW ✓	**1** (AO2.1)	**ALLOW** it depends on the strength of the wind / how windy it is / AW **IGNORE** there might not be any wind / wind changes direction / AW
		iii	(Idea of) not always enough wind / demand may exceed supply / AW ✓	**1** (AO2.1)	**ALLOW** (it) may not generate enough power / energy / AW **Examiner's Comments** Most candidates gained full credit for Q16(d)(ii) and (d)(iii). Those who did not gain credit often provided non-specific generalised reasons about the weather or the wind turbine 'breaking'.
			Total	**6**	
11			**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 38.28 (W) award 3 marks** Recall (Power =) potential difference x current ✓ 12 × 3.19 ✓	3 (AO 1.2) (AO 2.1) (AO 2.1)	**ALLOW** correct equation in any form **ALLOW** 38.3 (W) or 38 (W) **Examiner's Comments** Candidates had to recall the equation: power = potential difference x current and substitute the values provided in the question. Most candidates achieved full marks although some

			(P =) 38.28 (W) ✓		of the less able candidates could not recall the equation and therefore gained no credit. **AfL** Candidates would benefit from writing down the equation and their calculations rather than just their final answer so that compensatory marks may possibly be awarded.
			Total	**3**	
12	a		Thermal conductivity of metal is higher (so rate of cooling is greater) / ORA ✓	1 (AO3.2a)	**ALLOW** metal is a (better thermal) conductor / ORA
	b		Change the thickness of the cardboard (and repeat) ✓ **Any 2 from:** (Control variable) Same volume of water / same starting temperature of water ✓ Measure temperature with thermometer / time with stopwatch ✓ Calculate the rate using change in temperature / time ✓ Repeat results (and calculate the mean) ✓	3 (AO3 × 3.3a)	**ALLOW** use different boxes with different thicknesses / line the box with an insulator **ALLOW** same beaker / both beakers (don't) have a lid / same room temperature **ALLOW** a specified amount of water in the beaker / a specified starting temperature
			Total	**4**	
13	a		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.9 (A) award 2 marks** (Rearrangement: I_p =) $I_s \times V_s / V_p$ ✓ **OR** (I_p =) 12 × 9.0 / 120 ✓ (I_p =) 0.9 (A) ✓	2 (AO1.2) (AO2.1)	
	b	i	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 72 (%) award 5 marks**	5	

			Select from data sheet: change in thermal energy = mass × specific heat capacity × change in temperature (no mark) (change in thermal energy =) 1.2 × 4200 × 75 ✓ (change in thermal energy =) 378 000 (J) ✓ (Recall: efficiency =) useful output energy transfer / input energy transfer **OR** (Efficiency =) 378 000 / 525 000 ✓ (Efficiency =) 0.72 ✓ (Efficiency =) 72 (%) ✓	(AO1.2) (AO2.1) (AO1.2) (AO2.1) (AO1.2)	**ALLOW** ecf for incorrect thermal energy calculated **ALLOW** 4 marks for answer of 0.72 (%)
		ii	some energy is transferred to the (thermal energy store of the) kettle/surroundings/air ✓	1 (AO2.1)	**IGNORE** sound
			Total	**8**	