COMPONENT 2 – Applications in Physics

HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (except for the extended response questions).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

SECTION A

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			Different shape surfaces cause a difference in air pressure (1) So a resultant force is created (1)		2		2		
	(b)	(i)		Identification that radius = 40 m (1) Swept area = 5 027.2 [m^2] Accept 5 027 (1)	1	1		2	1	
		(ii)		Selection of air density value 1.173 (1) Substitution: ½ × 1.173 × 5 027 (allow **ecf**) × 1 300 (1) Mean KE / second = 3 832 836 [J/s] (1)	1	1 1		3	2	
	(c)	(i)	I	Wind speed increases with altitude			1	1		
			II	Power output of a wind turbine depends on wind speed or air density (1) Both wind speed and density vary with altitude (1)			2	2		
		(ii)		Power output varies with air density (1) Which depends on temperature (1)			2	2		
	(d)			**Benefits** Include references to no fuel costs, renewable resource, no air pollution, no effect on climate **Drawbacks** Include references to variable wind speed, low power outputs, noise / visual pollution **Award a maximum of 2 marks for benefits or for drawbacks**	3			3		
				Question 1 total	**5**	**5**	**5**	**15**	**3**	**0**

SECTION B

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			Speed of molecules is increased (1) More frequent collisions with walls of container / more momentum change in the collisions (1) Increased force (1)	3			3		3
	(b)			Density equation stated i.e. $\text{density} = \frac{\text{mass}}{\text{volume}}$ (1) Neither the mass or volume change (1)	2			2		2
	(c)			A further fall of 11×10^4 N/m^2 (1) Requires a temperature fall of $\left(\frac{11}{4}\right) \times$ 100 = 275 (1) (Accept -275)			2	2	2	2
	(d)			Increase the time between taking readings (1) To allow the air to come into thermal equilibrium with the water in the water bath (1)			2	2		2
				Question 2 total	**5**	**0**	**4**	**9**	**2**	**9**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Use a pointer / place ruler immediately behind the spring (to eliminate parallax errors)			1	1		1
	(b)	(i)		Substitution of an appropriate pair into $k = \frac{F}{x}$ e.g. $\frac{1}{2.0}$ (1) Spring constant = 0.5 (1) Unit = N/cm (1) **Alternative response: (with extension in metres)** Substitution of an appropriate pair into $k = \frac{F}{x}$ e.g. $\frac{1}{2.0 \times 10^{-2}}$ (1) Spring constant = 50 (1) Unit = N/m (1)	1 1	1		3	2	3
		(ii)		The spring becomes permanently stretched when the load is removed / extension larger than 2 cm for every unit of load beyond 500 g	1			1		1
	(c)	(i)		For 1 spring: Conversion of 50 cm to 0.5 m (1) Substitution: 400×0.5 into $F = kx$ (1) Force = 200 [N] (1) For 5 springs in parallel, F = 5×200 = 1 000 [N] (1)	1	1 1 1		4	3	
		(ii)		Remove a spring / use springs which have a smaller spring constant value	1			1		
		(iii)		Energy stored at 30 cm = $5 \times (0.5 \times 400 \times 0.3^2)$ = 90 [J] (1) Energy stored at 50 cm = $5 \times (0.5 \times 400 \times 0.5^2)$ = 250 [J] (1) Increase in energy = 160 [J] (1)		3		3	3	
				Question 3 total	**5**	**7**	**1**	**13**	**8**	**5**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			Specific heat capacity is the [heat] energy required to raise the temperature of 1 kg of the substance by 1 °C	1			1		
	(b)			30 (1) 60 (1) 5 (1) 22.5 (1)		4		4	1 1	
				Question 4 total	**1**	**4**	**0**	**5**	**2**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			**Indicative content:** A variable resistor and an ammeter need to be connected in series with the thermistor and a voltmeter connected in parallel with the thermistor. Readings of current and voltage should be taken before the variable resistor setting is altered and readings taken again. By altering the variable resistor settings again and again, a number of pairs of readings can be taken. Finally a graph of current against voltage should be drawn to establish ohmic behaviour or not. Only if the line is straight is the thermistor ohmic. **5 – 6 marks** Detailed description of how a workable experiment is carried out. Explains how results are to be analysed. Explains how ohmic behaviour can be recognised from graph. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The information included in the response is relevant to the argument.* **3 – 4 marks** Description of how the experiment is carried out which would work with little adjustment/elaboration. Some explanation of how results are analysed. *There is a line of reasoning which is partially coherent, supported by some evidence and with some structure. Mainly relevant information is included in the response but there may be some minor errors or the inclusion of some information not relevant to the argument.* **1-2 marks** Basic description of how the experiment is carried out. The experiment would need some modification before it could be carried out. *There is a basic line of reasoning which is not coherent, supported by limited evidence and with very little structure. There may be significant errors or the inclusion of information not relevant to the argument.* **0 marks** *No attempt made or no response worthy of credit.*	6			6		6

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		Axis and labelling (1) All 6 points plotted correctly ± ½ small square division and appropriate scale (1) Smooth curve of best fit (1) Anomalous point at (40,6) identified (1)		4		4	4	4
		(ii)		Resistance decreases as the temperature increases (1) The rate of decrease of resistance decreases as temperature increases (1)		2		2		2
		(iii)		5.5 [Ω] (**ecf** value to be taken from their graph ± 0.2) Recall of: $V = IR$ (1) Substitution: 0.5 × 5.5 (**ecf**) (1) Potential difference = 2.75 [V] (1)	 1 1	1 1		4	2	4
		(iv)		The products of resistance and Celsius temperature are not constant (1) So they are not inversely proportional (1) **Alternative response:** Pair of temperatures which are double each other (i.e. 20 °C and 40 °C **or** 30 °C and 60 °C) selected and conclusion the resistance does not halve (1) So they are not inversely proportional (1)			2	2	1	2
				Question 5 total	**8**	**8**	**2**	**18**	**7**	**18**