OXFORD
INTERNATIONAL AQA EXAMINATIONS

INTERNATIONAL A-LEVEL

PHYSICS

PH04

Unit 4 Energy and Energy resources

Mark scheme

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201XPH04/MS

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from oxfordaqaexams.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Marking guidance	Additional comments/guidelines	Mark
01.1	Multiplies mass (either 2.40 kg or 2.98 kg) by 9.81 OR subtracts weight from upthrust ✓ 0.066(2) (N) ✓	Use of 9.8 for g gets 1 max Both marks can be given if working is clear but correct answer is rounded to 2sf or 1sf	2
01.2	MAX 2 Upthrust will change as balloon expands or the density of the atmosphere decreases ✓ air resistance which will change as the diameter of balloon changes ✓ air resistance will change as speed of balloon changes ✓	Allow references to wind applying a force (to change speed) condone upthrust explained e.g. “force provided by helium” Ignore references to temperature Allow ‘air resistance will change as air density changes’ owtte	2
01.3	Use of 75 for ΔT✓ n = 145 mol ✓ Uses $\frac{3}{2}nRT$ or equivalent to get -1.35×10^5 (J) ✓	Evidence may for MP1 may be seen in equation Condone lack of negative sign	3
01.4	Helium does work in expanding ✓ heat transfer is from balloon to surrounding because balloon is at a higher temperature ✓ Both Q and W are negative/ reference to $\Delta U = \Delta Q + \Delta W$ so internal energy falls ✓		3

Question	Marking guidance	Additional comments/guidelines	Mark
01.5	Refers to rate of energy transfer = $\frac{kA\Delta\theta}{L}$ ✓ Leading to ... Surface area increases (as balloon ascends) OR Thickness (of latex skin) decreases (as balloon ascends) ✓	Condone reference of UA$\Delta\Theta$ for MP1 unless thickness argument used. Accept increase in temperature difference between inside and outside of the balloon for MP2	2
Total			**12**

Question	Marking guidance	Additional comments/guidelines	Mark
02.1	Mentions latent heat of vaporisation (of working substance) ✓ Temperature (of working substance) falls OR is lower than the temperature of the contents ✓ Heat transfer because there is a temperature difference ✓		3
02.2	Uses average temperature difference of between 8 K and 12 K ✓ area (3.0) m^2 ✓ Uses rate of heat transfer = $UA\Delta\theta$ to give an answer between 16 (W) and 24 (W) ✓	Expect to see 3.0 m^2	3
02.3	Uses $Q = mc\Delta\theta$ ✓ Divides by 4 × 3600 to give 28(.2)(W) ✓	Expect to see 4.06×10^5 (J)	2
02.4	Adds candidate's 02.3 + candidate's 02.2 + 60 ✓ Answer between 105 (W) and 111 (W) ✓		2
02.5	Energy transfer (to interior of house) is work done by pump plus energy extracted from ground ✓ Correct because more useful energy for same energy input ✓		2
Total			**12**

Question	Marking guidance	Additional comments/guidelines	Mark
03.1	Mass to energy in fusion ✓ Electromagnetic through space ✓ Plus any 2 from: Heating / evaporation of seawater ✓ Mention of E_p ✓ E_p or E_k converted to electrical by turbine generator ✓		4
03.2	MAX 3 Hydroelectric – destruction of habitats owtte ✓ HEP can be used for flood / water management ✓ Fission – problem of radioactive waste OR risk of catastrophic release OR radiation danger associated with uranium mining ✓ No (direct) CO_2 or atmospheric pollution from either ✓	For full credit, relevant comment must be made about fission and HEP Condone reference to greenhouse gasses for CO_2	3
Total			**7**

Question	Marking guidance	Additional comments/guidelines	Mark
04.1	Uses $T = I \propto$ ✓ Uses $\omega = \alpha t$ ✓ Both of the above used 10.6 (rad s^{-1}) to at least 3 sf ✓	Look for (α=) 55/37 or 1.49	3
04.2	390 or 392 ✓ kg m^2 s^{-1} ✓	Use of ω = 11 gives 410 or 407 Accept kg m^2 rad s^{-1}	2
04.3	Angular speed will increase ✓ Moment of inertia (of system) decreases ✓ Reference to principle of conservation of angular momentum ✓	Do not credit answers that lead to angular speed stays the same/decreases	3
Total			**8**

Question	Marking guidance	Additional comments/guidelines	Mark
05.1	Top line: 236 and 90 ✓ Bottom line: 92 and 37 ✓	First MP = both proton numbers correct Second MP = both nucleon numbers correct	2
05.2	Attempts to find a mass defect OR attempts to use $E = mc^2$ ✓ 0.31337×10^{-27} (kg) ✓ $2.8(2) \times 10^{-11}$ (J) ✓	Mass defect must be to at least 2 sf to get mark Correct to 2 sf	3
05.3	Converts to J eg 3.2×10^{-13} seen OR use of $E_k = \frac{1}{2}mv^2$ ✓ 1.95×10^7 (m s^{-1}) ✓	Seen to at least 3 sf Accept 1.96 for 1.951	2
05.4	Recognisable conservation of momentum equation seen ✓ Speed of neutron = 6.6×10^6 (m s^{-1}) ✓	Accept calculations using mass of hydrogen = 1 and mass of deuterium = 2	2
05.5	MAX 2 Most / all collisions (between neutron and deuteron) will not be head on (so less momentum will be lost by the neutron) ✓ There will be a range of initial speeds ✓ Deuterium (nucleus) may not be stationary ✓		2
Total			**11**

Question	Key
6	B
7	B
8	B
9	C
10	A
11	D
12	D
13	B
14	B
15	D
16	A
17	B
18	D
19	B
20	B

Question	Key
21	D
22	B
23	D
24	C
25	C
26	C
27	C
28	D
29	C
30	A
31	B
32	B
33	C
34	B
35	C