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Paper 2

Mark scheme

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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 Assessment Writer.

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.

Information to Examiners

1. General

The mark scheme for each question shows:
- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives, level of demand and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of errors/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols/formulae

If a student writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

'Ignore' is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do <u>not</u> accept

'Do **not** accept' means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

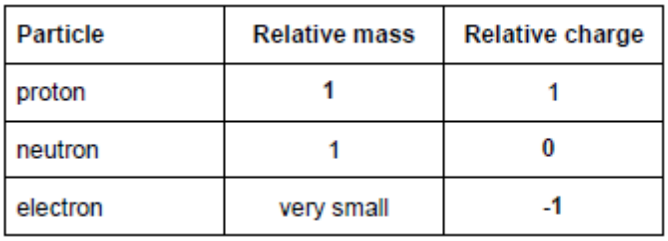
Extended response questions are marked on level of response mark schemes.

- 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 two 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.

Question	Answers	Extra information	Mark	AO/ Spec. Ref.	ID
01.1	the point at which the mass may be thought to be concentrated		1	AO1 3.1.7a	A
01.2	directly below the pin		1	AO2 3.1.7b	A
01.3	gravitational force or weight	allow gravity	1	AO1 3.1.1e	E
01.4	(the centre of mass is located at) the point where the two lines cross		1	AO1 3.1.7a	E
01.5	hang the card from another point and mark the position of the string again		1	AO4 3.1.7a	A
01.6	2 or 3 straight lines drawn connecting opposite corners		1	AO3 3.1.7c	E
01.7	make the stool wider (at the base) lower the centre of mass	allow increase the (effective) surface area of the base allow make the stool lower allow a change in design that would result in a lower centre of mass	1 1	AO2 AO3 3.1.7c	E
01.8	$W = 5.0 \times 9.8$ $W = 49$ (N)	an answer of 49 (N) scores 2 marks	1 1	AO2 3.1.1e	E

Total			**10**

Question	Answers	Extra information	Mark	AO/Spec. Ref.	ID
02.1	it has an equal number of protons and electrons protons and electrons have opposite charge **OR** allow equal number of positive charges and negative charges (1) allow therefore the charge ads up to zero (1)	allow it has 1 proton and 1 electron allow proton is positive and electron is negative allow charge cancels	1 1	AO2 3.7.1d	E
02.2	ions		1	AO1 3.7.1e	E
02.3		3 correct for 2 marks 1 or 2 correct for 1 mark	2	AO1 3.7.1c	E
02.4	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.		3–4	2xAO1 3.7.1cf	E
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.		1–2	2xAO2 3.7.1cf	
	No relevant content		0		
	Indicative content • oxygen has 2 more protons/carbon has 2 fewer protons • oxygen has 2 more neutrons/carbon has 2 fewer neutrons • (neutral) oxygen has 2 more electrons/(neutral) carbon has 2 fewer electrons				

	• oxygen atom has more mass/carbon atom has less mass • oxygen atom is larger/carbon atom is smaller • oxygen has 4 more particles in its nucleus/carbon has 4 fewer particles in its nucleus • oxygen has 16 particles in its nucleus • carbon has 12 particles in its nucleus • oxygen has 8 protons in its nucleus, carbon has 6 protons in its nucleus • oxygen has 8 neutrons in its nucleus, carbon has 6 neutrons in its nucleus • oxygen has 8 electrons, carbon has 6 electrons			

Total			**9**

Question	Answers	Extra information	Mark	AO/ Spec. Ref.	ID
03.1	wavelength		1	AO1 3.3.1d	A
03.2	period		1	AO1 3.3.1d	A
03.3	parallel perpendicular	allow in the same direction as allow at 90° to	1 1	AO1 3.3.1c	E
03.4	 λ = 0.138 m v = 2500 × 0.138 v = 345 (m/s)	an answer of 345 (m/s) scores 3 marks allow a correct substitution using an incorrectly/not converted value of λ allow 350 (m/s) allow a correct calculation using an incorrectly/not converted value of λ	 1 1 1	AO2 3.3.1h	E
03.5			1	AO3	E

	both light and sound travel very fast Or allow the distance between the boy and the TV is small the sound waves and light waves reach the boy at almost the same time.	 allow time taken is almost the same allow time difference is too small to be noticeable	1	3.3.1h	

Total			**9**

Question	Answers	Extra information	Mark	AO/ Spec. Ref.	ID
04.1	electrons		1	AO1 3.5.1a	E
04.2	voltmeter ammeter variable resistor	allow **1** mark for one or two pieces of equipment.	2	AO4 3.5.1	E
04.3	prevents the graphite getting hot which would increase the resistance of the graphite	allow temperature is a control variable	1 1	AO4 3.5.1i	E
04.4	current is directly proportional to potential difference because the line of best fit is a straight line and goes through the origin	allow calculations that demonstrate direct proportionality allow 1 mark for current increases as potential difference increases allow 2 marks for an answer that explains that current is not directly proportional to potential difference because the line of best fit does not quite go through the origin.	1 1	AO3 3.5.1i	E

Question	Answers	Extra information	Mark	AO/Spec. Ref.	ID
04.5	**random errors** correct point(s) identified ie 4.0/5.0 V therefore there are random errors because all points are not on/near the line of best fit **systematic errors** The line of best fit crosses the x-axis at 0.1 so evidence that zero error on voltmeter		 1 1 1 1	2xAO3 2xAO4 3.5.1	E
04.6	 pair of values chosen from the dotted line $9.0 = 0.2 \times R$ $R = \frac{9.0}{0.2}$ $R = 45$ Ω	allow 4 calculation marks for 45 (Ω allow any pair of values read from graph correctly substituted allow correct rearrangement using their correctly substituted values allow correct calculation using their values allow a max of 2 calculation marks if incorrect line is chosen	 1 1 1 1 1	1 x AO1 4 x AO2 3.5.1h	E
Total			**16**		

Question	Answers	Extra information	Mark	AO/ Spec. Ref.	ID
05.1	current continually changes direction		1	AO1 3.6.3b	E
05.2	330	allow 320–340	1	AO2 3.6.3b	E
05.3	$f = \frac{1}{0.020}$ $f = 50$ (Hz)	an answer of 50 (Hz) scores 2 marks	1 1	AO2 3.6.3b	E
05.4	efficiency $= \frac{750}{1200}$ **or** efficiency $= \frac{875}{1400}$ efficiency $= 0.625$	an answer of 0625 or 62.5% scores 2 marks allow 62.5 %	1 1	AO2 3.2.2f	E
05.5	(a fault could cause) the casing to become live earthing prevents electrocution	 allow if case wasn't earth contact could cause an electric shock allow the current is harmlessly conducted away	1 1	AO1 AO3 3.6.3d	E

Question	Answers	Mark	AO/ Spec. Ref.	ID
05.6	**Level 2:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	3–4	2xAO1 3.6.3ef 2xAO3 3.6.3ef	E
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2		
	No relevant content	0		
	Indicative content • Fuses melt when there is too much current • Fuses and circuit breakers both break the circuit to prevent overheating • Both are designed to prevent further damage/fire breaking out if something goes wrong • Fuses need replacing circuit breakers does not need replacing • Fuses require some expertise to replace • Circuit breakers are easy to reset • Fuses are cheaper than circuit breakers • Circuit breaker breaks the circuit when there is a fault • Circuit breakers can be reset but fuses can't • Circuit breakers act faster than fuses • Fuses have different fixed values • Fuses are too slow to protect the user from a shock, circuit breakers are fast enough.			

Total			12

Question	Answers	Extra information	Mark	AO/ Spec. Ref.	ID
06.1	$m = 0.450$ kg $E_k = \frac{1}{2} \times 0.450 \times 20^2$ $E_k = 90$ (J)	an answer of 90 (J) scores 3 marks allow a correct substitution using an incorrectly/not converted value of m allow a correct calculation using an incorrectly/not converted value of m	1 1 1	AO2 3.5.1c	E
06.2	$20 = \frac{11.4}{t}$ $t = \frac{11.4}{20}$ $t = 0.57$ (seconds) 0.57 is less than 0.65 so the goalkeeper cannot save the ball OR 20 = s / 0.65 (1) s = 20 × 0.65 (1) s = 13 (1) 13 is greater than 11.4 so the goalkeeper cannot save the ball (1)	a calculation of minimum speed of ball and 20 > 17.5 scores 4 marks	1 1 1 1	AO3 3.1.2c	E
06.3	the momentum of the ball changes when it strikes a young player's head	allow momentum is conserved	1	AO3 3.1.4c	E

	change in momentum changes over a short time which causes a large force to be exerted on the head which could cause injury	allow correct use of Newton's second or third law can cause injury is insufficient	1 1		

Total			**10**		

Question	Answers	Mark	AO/ Spec. Ref	ID
07.1	**Level 2:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	3–4	AO4 3.1.1h	E
	Level 1: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	1–2		
	No relevant content	0		
	Indicative content • use wires of known diameter • measure diameter of wire using a micrometer • hang a wire from a clamp • secure clamp stand to desk with a G-clamp • use 10 g slotted masses • attach mass holder to bottom of the wire • increase the mass by 10 g each time • place sponge/soft material below the slotted masses so they land safely when the wire breaks • determine the weight of the masses when the wire breaks using $W = mg$ or newton meter • record force • repeat with other diameter • keep the length of each wire the same • ensure each wire is made from the same material • wear goggles			

Question	Answers	Extra information	Mark	AO/ Spec. Ref.	ID
07.2	curved line of best fit drawn correct value read off ie 2.0 (N)	 allow correct value read off a correctly extrapolated curve	1 1	AO3 3.1.1h	E
07.3	$2.25 \times 10^{-3} = \frac{1}{2} \times 2000 \times e^2$ $e = \sqrt{\frac{2.25 \times 10^{-3}}{\frac{1}{2} \times 2000}}$ $e = 0.0015$ m $e = 1.5$ (mm)	an answer of 1.5 (mm) scores 4 marks	1 1 1 1	AO2 3.2.1c	E
Total			**10**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
08.1	temperature at the surface increases so the mean (kinetic) energy of the particles increases therefore the particles are more likely leave the surface		1 1 1	AO2 3.4.1a 3.4.2b	E
08.2	heated water expands becomes less dense so water at the surface will be less dense than water below convection currents don't form	allow particles have more (kinetic) energy allow it is already at the top allow in cannot rise allow hot water cannot fall to form convection current allow colder water stays at the bottom	1 1 1 1	2xAO2 2xAO3 3.4.2a	E
08.3	P = 315 000 000 (W) (E = 315 000 000 J each second) 315 000 000 = m × 4200 × (12-7) $m = \frac{315\,000\,000}{4200 \times 5}$ m = 15 000 (kg)	 allow a correct substitution using an incorrectly/not converted value of P/E allow a correct rearrangement using an incorrectly/not converted value of P/E allow a correct calculation using an incorrectly/not converted value of P/E	1 1 1 1	AO2 3.4.1b 3.2.1f	E
08.4	graph levels off after 1700 m so little temperature change		1	AO3 3.2.1ad	E

	takes more energy to pump from a greater depth not worth the extra cost		1 1		

Total			**14**