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PHYSICS

9203/2

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 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.

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 straight forward 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 mark 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.

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	Pyramids have a wide base.		1	AO1 3.1.8c 1–3	
01.2	W = 80 000 × 9.8 784 000 (N)	an answer of 784 000 scores **2** marks	1 1	AO2 3.1.1e 1–3	
01.3	They can act as force multipliers.		1	AO1 3.1.8d 1–3	
01.4	M = 12 000 × 0.40 4800 (Nm)	an answer of 4800 scores **2** marks	1 1	AO2 3.1.8a 1–3	
01.5	Equal to that produced by the weight of the stone block.		1	AO1 3.1.8c 1–3	

Question	Answers	Mark	AO/ Spec. Ref	ID
01.6	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted.	3–4	AO3 3.1.8 2 × 1–3 2 × 4–5	
	Level 1: Relevant features are identified and differences noted.	1–2		
	No relevant content.	0		
	Indicative content **Crane disadvantages** • more expensive (to make the crane) • needs a specialist operator • more complicated • difficult to construct **Crane advantages** • can lift through greater distances • can lift greater weights • decreases time to build • needs fewer people to operate • can lift many blocks at once • reduces overall construction costs **Wooden beam advantages** • easy to operate • easy to construct • easy to replace if it breaks **Wooden beam disadvantages** • can't lift blocks very far • can't lift many blocks at once • takes much longer to lift blocks to a reasonable height			

Total			**11**

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
02.1	Transverse		1	AO1 3.3.2a 1–3	
02.2	Microwaves		1	AO1 3.3.2h 1–3	
02.3	any **one** from: • to increase the power of the emitted waves • so that the signal is transmitted in all directions	allow so that signals are received from all directions.	1	AO3 3.3.2g 1–3	
02.4	any **two** from: • so that trees are not damaged • real trees are not tall enough • real trees may not be strong enough • easier to repair/replace		2	AO3 3.3.2g 1–3	
02.5	wavelength frequency		1 1	AO2 3.3.1g 1–3	
Total			**7**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	any **two** from: • wear safety goggles • place a cushion under the slotted masses • use a g-clamp • stand up	allow any reasonable object for cushion allow position equipment to minimise risk from falling masses	2	AO4 3.1.1 1–3	
03.2	**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 3.1.1 2 × 1–3 2 × 4–5	
	Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.		1–2		
	No relevant content.		0		
	Indicative content • measure the original length of the spring with a ruler • add a known mass • add a slotted mass of 10/100 g • use a top pan balance to measure mass to be added • calculate the weight/force applied to the spring • measure length of spring again • calculate extension • repeat for more masses • continue until spring is permanently deformed • plot graph of force against extension • elastic limit can be found where the graph stops being a straight line • remove the mass • measure length of spring again • compare to original length • repeat by adding more mass • continue until unloaded spring is longer the original length • elastic limit is between/one of the last two forces applied				
03.3	the spring will not go back to its original length because it has gone past its elastic limit	allow no longer behaves elastically allow would not give the same	1 1	AO4 3.3.1f 2 × 4–5	

		result			

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.4		an answer of 50 scores **4** marks		AO2 3.1.1h	
	e = 0.060 (m)		1		
	3.0 = k × 0.060	allow a correct substitution of an incorrectly/not converted value of extension	1		
	$k = \frac{3.0}{0.06}$	allow a correct rearrangement using an incorrectly/not converted value of extension	1		
	50 (N/m)	allow a correct calculation using their value of extension	1		
Total			**12**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	If there is a current greater than 13 amps in the fuse the wire in the fuse melts **or** breaks the circuit	 allow blows	1 1	AO1 3.6.3e 4–5	
04.2	so the fuse can be replaced		1	AO3 3.6.3e 4–5	
04.3	759 = I × 230 $I = \frac{759}{230}$ I = 3.3 A	an answer of 3.3 scores **3** marks allow 3.30	1 1 1	AO2 3.6.5c 4–5	
04.4	E = 2530 × 60 E = 151 800 151 800 = m × 2 300 000 $m = \frac{151800}{2\,300\,000}$ m = 0.066 66 (g)	 allow a correct substitution of an incorrectly/not converted value of Lv allow a correct rearrangement using an incorrectly/not converted value of Lv allow a correct calculation using an incorrectly/not converted value of Lv allow a correct conversion of their calculated value of m	1 1 1 1 1 1	AO2 3.4.1c 6–7	

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.5	not all the energy transferred by the iron changes the state of the water because any **one** from: • heats the parts of the iron • increases the temperature of the water • heats the surrounding air		1 1	AO3 3.6.5a 4–5 6–7	

Total			**14**

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	$1.14 = \frac{22.8}{t}$ $t = \frac{22.8}{1.14}$ t = 20.0 (s)	an answer of 20.0 scores **3** marks ignore minus signs	1 1 1	AO2 3.1.3d 4–5	
05.2	912 000 = mass × 1.14 $mass = \frac{912\ 000}{1.14}$ mass = 800 000 (kg)	an answer of 800 000 scores **3** marks allow 9.12×10^5	1 1 1	AO2 3.1.3h 4–5	
05.3	the gradient of the line		1	AO1 3.1.3e 4–5	
05.4	(increasing the braking force) increases the deceleration decreases the time to stop (which decreases the distance)		1 1	AO1 3.1.5b 4–5 6–7	
05.5	values from graph 22.8 **and** 15 $area = \frac{1}{2} \times 15 \times 22.8$ 171 (m)	allow 22–23 allow a correct substitution using their values of v and t read from the graph allow a correct calculation using their values of v and t read from the graph	1 1 1	AO2 3.1.3f 6–7	

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.6	increased friction on brakes increases the wear on the brakes **OR** to avoid greater declaration (of passengers) (1) therefore avoiding increased force on passengers (1)	 allow to prevent injury of passengers	1 1	AO3 3.5.1b 3.1.3h 6–7	
Total			**14**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	radiation (from the rocks in the cave) would affect the results		1	AO2 3.7.2d 6–7	
06.2	**Advantage** less damage is done to the painting **Disadvantage** the amount of radiation emitted will be small so it is more difficult to measure		1 1	AO3 3.7.2 4–5 6–7	
06.3	during beta decay a neutron changes into a proton this increases/changes the number of protons in the nucleus (so a new element is formed)	 allow atomic number increases/changes	1 1	AO1 3.7.2e 4–5 6–7	
06.4	240 and 30 nBq read from the graph 240 ⟶ 120 120 ⟶ 60 60 ⟶ 30 3 half-lives **OR** fraction remaining = $3.0 \times 10^{-8} / 2.4 \times 10^{-7}$ (1) fraction remaining = $1/8 = (1/2)^3$ (1) 3 half-lives (1)	an answer of 3 scores **3** marks	 1 1 1	1 × AO2 2 × AO3 3.7.2h 6–7 8–9	

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.5	at 35 000 the activity of the sample is almost zero	allow change in activity is very small allow very low do not accept activity is zero	1	AO3 3.7.2j 6–7 8–9	
	data gathered would be too similar to background	allow too low to measure	1		
06.6	nuclear power stations	allow nuclear weapons testing nuclear accidents	1	AO3 3.7.2d 6–7	
	medical X-rays	allow other medical uses	1		
Total			**12**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
07.1	pupils become more dilated to let in more light		1 1	AO3 3.3.6h 6–7	
07.2	convex lens in the sunglasses increase the total amount of refraction so light from a closer object can be focused on the retina	allow description of converging rays allow decreases the overall focal length a labelled diagram can score **3** marks	1 1 1	AO1 3.3.6j 8–9	
07.3	angle of refraction, r in degrees sin(i) **and** sin(r)		1 1	AO1 3.3.5e 6–7	
07.4	Plot sin (i) against sin (r) gradient = refractive index	 allow 1 mark for dividing the sines of a corresponding pair of i and r	1 1	AO4 3.3.5e 8–9	
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
08.1	4 to 5 (m/s)		1	AO2 3.2.2f 4–5	
08.2	power output = 2700 **and** efficiency = 0.540 $0.540 = \frac{2700}{\text{input power}}$ $\text{input power} = \frac{2700}{0.540}$ input power = 5000 (kW)		1 1 1 1	AO2 3.2.2f 6–7	
08.3	wind causes blades to rotate rotating blades causes the permanent magnet to move (relative to the coil) coil experiences a changing magnetic field therefore a potential difference is induced (across the ends of the coil) every half rotation the polarity of the permanent magnet changes/reverses so direction of induced p.d. changes	allow coil cuts the magnetic field	1 1 1 1 1 1	3 × AO1 3 × AO2 3.6.1a,b,d 1 × 4–5 3 × 6–7 2 × 8–9	
Total			**11**		