# A-LEVEL
# Physics
## Paper 2
## Mark scheme

7408/2
Specimen Paper (set 2)

Version: 1.0

**Keep secure**

Please be aware that centres may want to use these specimen papers as mock exams for their students. Help us to maintain the security of these papers by ensuring they are not distributed on social media or other platforms.

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 aqa.org.uk

**Important - please note**

This mark scheme has not been through the full standardisation process. As such, many of the phases described above have not been completed.  The Instructions for examiners are also included as a guide to how the mark scheme will function as an operational document. The layout has been kept consistent so that future operational mark schemes do not appear different to the specimen materials.

# Physics - Mark scheme instructions 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 and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

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

**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.

## 3. Marking points

### 3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates 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 (often prefaced by 'Ignore' in the mark scheme) are not penalised.

### 3.2 Marking procedure for calculations

Full marks can usually be given for a correct numerical answer without working shown unless the question states 'Show your working'. However, if a correct numerical answer can be evaluated from incorrect physics then working will be required. The mark scheme will indicate both this and the credit (if any) that can be allowed for the incorrect approach.

However, if the answer is incorrect, mark(s) can usually be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

A calculation must be followed through to answer in decimal form. An answer in surd form is never acceptable for the final (evaluation) mark in a calculation and will therefore generally be denied one mark.

## 3.3 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.

## 3.4 Errors carried forward, consequential marking and arithmetic errors

Allowances for errors carried forward are likely to be restricted to calculation questions and should be shown by the abbreviation ECF or *conseq* in the marking scheme.

An arithmetic error should be penalised for one mark only unless otherwise amplified in the marking scheme. Arithmetic errors may arise from a slip in a calculation or from an incorrect transfer of a numerical value from data given in a question.

## 3.5 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited (eg fizix) **unless** there is a possible confusion (eg defraction/refraction) with another technical term.

## 3.6 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.

## 3.7 Ignore / Insufficient / Do <u>not</u> allow

'Ignore' or 'insufficient' 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.

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

## 3.8 Significant figure penalties

Answers to questions in the practical sections (7407/2 – Section A and 7408/3A) should display an appropriate number of significant figures. For non-practical sections, an A-level paper may contain up to 2 marks (1 mark for AS) that are contingent on the candidate quoting the **final** answer in a calculation to a specified number of significant figures (sf). This will generally be assessed to be the number of sf of the datum with the least number of sf from which the answer is determined. The mark scheme will give the range of sf that are acceptable but this will normally be the sf of the datum (or this sf -1).

An answer in surd form cannot gain the sf mark. An incorrect calculation **following some working** can gain the sf mark. For a question beginning with the command word 'Show that…', the answer should be quoted to **one more** sf than the sf quoted in the question eg 'Show that X is equal to about 2.1 cm' – answer should be quoted to 3 sf. An answer to 1 sf will not normally be acceptable, unless the answer is an integer eg a number of objects. In non-practical sections, the need for a consideration will be indicated in the question by the use of 'Give your answer to an appropriate number of significant figures'.

## 3.9 Unit penalties

An A-level paper may contain up to 2 marks (1 mark for AS) that are contingent on the candidate quoting the correct unit for the answer to a calculation. The need for a unit to be quoted will be indicated in the question by the use of 'State an appropriate SI unit for your answer '. Unit answers will be expected to appear in the most commonly agreed form for the calculation concerned; strings of fundamental (base) units would not. For example, 1 tesla and 1 weber/metre$^2$ would both be acceptable units for magnetic flux density but 1 kg m$^2$ s$^{-2}$ A$^{-1}$ would not.

## 3.10 Level of response marking instructions.

Level of response mark schemes are broken down into three 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.

### Determining 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. i.e. if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2.

The exemplar materials used during standardisation will help you to determine the appropriate level. 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 | Answers | Additional Comments/Guidance | Mark |
|---|---|---|---|
| 01.1 | the capacitor stores 120 μC of charge for each one volt of pd between the plates ✓ | | 1 |
| 01.2 | $Q = C\,\Delta V = 120 \times 10^{-6} \times 4.2 = 5.0 \times 10^{-4}$ C ✓ | | 1 |
| 01.3 | $I = \frac{V}{R}$ so maximum current = $\frac{9.6}{1300}$ = 7.4 ± 0.2 × $10^{-3}$ (A)✓ | Allow ecf for incorrect read off in 01.2 | 1 |
| 01.4 | use of $E = ½ CV^2$ using $V$ = 9.6V, 5.4V or 4.2V✓<br>Correct value of $E$ at 9.6V or 5.4V ( 5.5 (3) × $10^{-3}$ J or 1.7(5) × $10^{-3}$ J✓<br>Both correct and subtraction 3.7(8) x $10^{-3}$ J ✓ | Condone incorrect powers of 10<br>Allow 3.7 x $10^{-3}$J | 3 |
| 01.5 | Graph same shape up to point where capacitor stops discharging✓<br>current falls to zero at time when capacitor stops discharging✓<br>Scale on current axis with Initial and final currents correct<br>7.4 mA and 4.2 mA at the instant when foil breaks<br>(Allow ±0.1 mA) ✓ | must show curvature during discharge time | 3 |
| 01.6 | use of $V = V_0\, e^{-t/RC}$ Allow substitution of manipulation to *(discharge time)* $t = RC \ln(V_0/V)$✓<br>$t$ = 0.156(0.16 ) × ln (9.6/5.4) ✓<br>= 0.090 or 0.092 s ✓<br>$v = s/t$ = 0.12/their time ( 1.3 m $s^{-1}$)✓ | correct substitutions for $V$, condone incorrect powers of 10 in substitution<br>Allow ecf for incorrect readoff for $V$ in in Question 1.2 | 4 |
| 01.7 | There are resistive forces on the ball/the ball will decelerate ✓<br>The foil is unlikely to break at the instant the ball reaches it✓ | | 2 |

| Question | Answers | Additional Comments/Guidance | Mark |
|---|---|---|---|
| 02.1 | Ionisation is when an atom/molecule loses (or gains) one (or more) electrons ✓ | | 1 |
| 02.2 | Potential energy of ion is transferred to kinetic energy of ion✓<br>Power supply transfers energy to the ion✓<br>Decrease in energy stored in supply =increase in (kinetic) energy stored by the ion✓ | | 3 |
| 02.3 | electric force is constant✓<br>magnetic force increases with speed✓<br>(magnetic force dominates) direction of force predicted by any consistent named force rule✓ | | 3 |
| 02.4 | Path curves upwards between the plates✓ | | 1 |
| 02.5 | The magnetic force is the same (Bqv) ✓<br>So *r* increases/less curvature✓<br>**OR**<br>$Bqv = \frac{mv^2}{r}$ so $r = \frac{mv}{Bq}$✓<br>$v, B, q$ constant so $r \propto m$ and $r$ increases✓ | | 2 |
| 02.6 | Same path in velocity separator ✓<br>since Bqv=Eq so v independent of q ✓<br>In mass selector radius is decreased ✓<br>since $r = \frac{mv}{Bq}$ so $r \propto \frac{1}{q}$ ✓ | Both correct with one correct justification would get 3 marks | MAX 3 |

| Question | Answers | Additional Comments/Guidance | Mark |
|---|---|---|---|
| 03.1 | 1eV = $1.6 \times 10^{-19}$ J<br>kinetic energy = $1.6 \times 10^{-19} \times 4.9 \times 10^{6} = 7.8(4) \times 10^{-13}$ J ✓<br>ke lost = pe gained = $7.8(4) \times 10^{-13}$ J ✓ | | 2 |
| 03.2 | using $V = Q / 4\pi\varepsilon_0 r$ and $E_p = qV$<br>$r = qQ/4\pi\varepsilon_0 E_p$ ✓<br>$= (2 \times 1.6 \times 10^{-19})(79 \times 1.6 \times 10^{-19})/4\pi \times 8.85 \times 10^{-12} \times 7.84 \times 10^{-13}$ ✓<br>$r = 4.67(4.64) \times 10^{-14}$ m ✓ | | 3 |
| 03.3 | $A = (R/R_0)^3$ ✓<br>$= (7.16 \times 10^{-15} / 1.23 \times 10^{-15}\text{ m})^3$ ✓<br>= 197 placed on the dotted line ✓ | | 3 |
| 03.4 | *r* gets smaller ✓<br>less force so needs to travel further to lose same initial ke ✓ | Fewer protons means that *r* will be smaller when alpha particle has the same electrostatic potential energy (as initial kinetic energy) | 2 |

| Question | Answers | Additional Comments/Guidance | Mark |
|---|---|---|---|
| 04.1 | the work done per unit mass ✓<br>in moving from infinity to the point ✓ | | 2 |
| 04.2 | Gravitational potential is defined as zero at $\infty$ ✓<br>(Forces attractive) so work must be done (on a mass) to reach $\infty$ (hence negative) ✓ | | 2 |
| 04.3 | $V = -GM/r = 6.67 \times 10^{-11} \times 5.97 \times 10^{24} / 6.37 \times 10^{6}$ ✓<br>$= -6.25 \times 10^{7}$ J kg$^{-1}$ ✓ | | 2 |
| 04.4 | in the plane of the equator<br>always above the same location on the earth<br>having the same period as the earth/24 hours<br>✓✓any two lines | | 2 |
| 04.5 | $V = -GM/r = 6.67 \times 10^{-11} \times 5.97 \times 10^{24} / 4.23 \times 10^{7} = -9.41 \times 10^{6}$ J kg$^{-1}$ ✓<br>$E_P = \Delta V \times m = = (6.26 - 0.94) \times 10^{7} \times 1200$ ✓<br>$= 6.38 \times 10^{10}$ J ✓ | | 3 |
| 04.6 | radius must increase ✓<br>velocity gets smaller ✓<br>reference to $R^3$ is proportional to $T^2$ ✓<br>reference (from circular motion) $v^2$ is proportional to $1/r$ ✓ | | 4 |

| Question | Answers | Additional Comments/Guidance | Mark |
|---|---|---|---|
| 05.1 | the core focuses/directs the magnetic field round to the secondary ✓ | Ensures more of the flux from the primary coil links with the secondary coil | 1 |
| 05.2 | made from soft iron to allow easy magnetization and demagnetization / reduce hysteresis loss ✓<br>laminated (structure) to reduce eddy currents ✓<br>made from high resistivity metal to reduce eddy currents ✓ | Do not allow “reduce energy loss” as this is implicit in question. | MAX 2 |
| 05.3 | To produce a continually changing (magnetic) flux in the core✓ | | 1 |
| 05.4 | $N_P = N_S V_P / V_S = 300 \times 230 / 20 = 3500$ (3450) turns ✓ | | 1 |
| 05.5 | efficiency = power out / power in = 65 / (230 x 0.30) ✓<br>= 0.94 ✓ or 94% | | 2 |

**Keys to Multiple Choice Questions**
**(each correct answer is worth 1 mark)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
| B | C | A | D | C | D | B | A | B | B |
| **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** |
| C | C | D | B | A | B | D | A | B | D |
| **26** | **27** | **28** | **29** | **30** | | | | | |
| B | D | C | C | B | | | | | |