Cambridge O Level

**Cambridge Assessment International Education**
Cambridge Ordinary Level

**PHYSICS** **5054/22**

Paper 2 Theory **May/June 2019**

MARK SCHEME

Maximum Mark: 75

**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

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## Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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| GENERIC MARKING PRINCIPLE 5:<br><br>Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen). |
| GENERIC MARKING PRINCIPLE 6:<br><br>Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind. |

| Question | Answer | Marks |
|---|---|---|
| 1(a) | reading / volume with water / liquid alone<br>**or** use displacement can filled (to spout) | **B1** |
| | subtracted from reading (of volume) with object (submerged) in cylinder<br>**or** place rock in displacement can and measure volume of overflow with measuring cylinder | **B1** |
| 1(b) | (d =) M / V algebraic or numerical | **C1** |
| | 7.8 g / $cm^3$ | **A1** |
| 1(c) | 350 × 51 / 39<br>**or** (density of Cu =) 350 / 39 **or** or 9.0 (g / $cm^3$) seen | **C1** |
| | 460 g | **A1** |
| 1(d) | (density) decreases<br>**and** volume increases / object expands<br>**or** molecular explanation of expansion | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 2(a) | force per unit area | **B1** |
| 2(b) | (P=) dgh algebraic or numerical | **C1** |
| | 0.16 × 1.4 × $10^4$ × 10 **or** 22 400 (Pa) seen | **C1** |
| | 7.8 × $10^4$ Pa | **A1** |
| 2(c)(i) | 7.5 – 8.0 cm | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 2(c)(ii) | (molecules) move faster / have more kinetic energy | **B1** |
| | (molecules) hit sides / walls / mercury / container | **B1** |
| | (molecules) hit harder **or** more often / more frequently / more violently / vigourously<br>**or** (molecules) create large(r) pressure / large(r) force<br>**or** eventually (molecules) exert same pressure as air | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 3(a) | middle ray angle of incidence labelled c | **B1** |
| 3(b) | angle of incidence (of right-hand ray only) greater than the critical angle | **B1** |
| 3(c)(i) | (n=) sin i / sinr algebraic or numerical | **C1** |
| | 1.3 | **A1** |
| 3(c)(ii) | sin c = 1 / n algebraic or numerical | **C1** |
| | answer in range 49° to 50.3° | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 4(a) | $1.15–1.25 \times 10^{-6}$ (m) | **B1** |
| 4(b) | infra-red | **B1** |
| 4(c) | ($f = v / \lambda$) algebraic or numerical | **C1** |
| | $3 \times 10^{8} / 1.2 \times 10^{-6}$ | **C1** |
| | $2.5 \times 10^{14}$ Hz | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 5(a) | negative charge / electrons / experience repulsive force (from dome) | **B1** |
| | negative charge / electrons are earthed / move to earth | **B1** |
| 5(b) | D at start or E at end | **C1** |
| | D C B E | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 6(a) | (I= )V / R algebraic or numerical | **C1** |
| | 0.4(0) A | **A1** |
| 6(b) | current in Q is 0.25 (A)<br>**or** (total resistance ) 6 / 0.25 **or** 6 / 0.65 **or** 9.2(3 Ω) seen | **C1** |
| | 24 Ω | **A1** |
| 6(c)(i) | correct circuit with two lamps ammeter and battery in series | **B1** |
| 6(c)(ii) | (total) resistance increases<br>**or** (each) lamp has lower p.d. across it | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 7(a) | current direction in copper wire correct on any part of diagram | **B1** |
| 7(b) | current and magnetic field create a force<br>**or** current (in wire) creates a magnetic field | **B1** |
| | left-hand rule mentioned or used<br>**or** interaction of magnetic fields of magnet and current (catapult effect) | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 7(c) | (electric) motor or any device that contains a motor | **B1** |
| | (loud)speaker or any device that contains a loudspeaker | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 8(a) | filament is heated / hot (emits electrons)<br>**or** thermionic emission occurs at the filament | **B1** |
| | cylinder / anode attracts / accelerates electrons | **B1** |
| 8(b) | connect a battery / p.d. / voltage / power supply across plates | **B1** |
| | electrons deflect / attract towards positive / away from negative<br>**or** field is from positive to negative | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 9(a)(i) | 10.2–10.4 (cm) **or** 50 (km) **or** 15 (km) seen | **C1** |
| | 51–53 km | **A1** |
| | direction (0)72–74° **or** N 72–74 °E etc. | **B1** |
| 9(a)(ii) | (distance) has no direction<br>**or (**distance) is a scalar | **B1** |
| 9(a)(iii) | changes direction **or** goes round a corner | **B1** |
| | velocity changes **or** velocity depends on direction<br>**or** acceleration / force is towards the centre of circle / centripetal | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 9(b)(i) | distance travelled before brakes applied (after seeing emergency) | **B1** |
| 9(b)(ii) | any 2 of<br>• poor tyre surface<br>• poor road conditions, e.g. rain, ice<br>• high speed (of car) **or** good aerodynamic car shape **or** tail wind<br>• large mass / weight of car<br>• driver applies less force to pedal / less braking force | **B1B1** |
| 9(c)(i) | (KE =) ½$mv^2$ algebraic or numerical | **C1** |
| | ½ × 1200 × $30^2$ | **C1** |
| | 540 000 J | **A1** |
| 9(c)(ii) | (a=) F / m algebraic or numerical | **C1** |
| | 1.5 m / $s^2$ | **A1** |
| 9(c)(iii) | friction (produces thermal energy)<br>**or** kinetic energy changes to heat<br>**or** work done against friction | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 10(a) | *metal tip* 1000 °C | **B1** |
| | *solder* 200 °C | **B1** |
| 10(b)(i) | (E= )VIt algebraic or numerical | **C1** |
| | 790 J | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 10(b)(ii) | (Q=) mcT algebraic or numerical | **C1** |
| | $2.3 \times 300 \times 0.39$ | **C1** |
| | 270 J | **A1** |
| 10(c)(i) | electrons move around<br>**or** electrons diffuse through (metal) | **M1** |
| | pass on energy to other parts / hit atoms or other electrons / (transfer energy) in all directions | **A1** |
| 10(c)(ii) | hot air / heated air rises | **B1** |
| | (hot air) less dense (than cold air) | **B1** |
| 10(d)(i) | two different metals | **B1** |
| | complete circuit with meter in series **and** one junction labelled H on hot tip | **B1** |
| 10(d)(ii) | ANY TWO from<br>• can measure rapid temperature changes<br>• can measure high temperatures<br>• is small in size<br>• has a small heat capacity<br>• can give electrical signal / be read by computer | **B1 B1** |

| Question | Answer | Marks |
|---|---|---|
| 11(a)(i) | gravity **or** gravitational attraction | **B1** |
| 11(a)(ii) | Any 2 from:<br>• high pressure<br>• (very) high temperature<br>• high particle density | **B1 B1** |

| Question | Answer | Marks |
|---|---|---|
| 11(b)(i) | proton **and** 92 | **B1** |
| | neutron **and** 143 | **B1** |
| 11(b)(ii) | same number of protons | **B1** |
| 11(b)(iii) | neutron hits / absorbed by uranium / nucleus | **B1** |
| | nucleus splits **or** smaller nuclei formed<br>**and** emits more neutrons | **B1** |
| 11(b)(iv) | fusion – coming together **and** fission splitting up<br>**or** fission involves large particles / nuclei **and** fusion small nuclei<br>**or** in fusion nuclear waste / products are less radioactive / dangerous<br>**or** no / few neutrons produced in fusion | **B1** |
| 11(b)(v) | 90 proton number of Th | **B1** |
| | 231 **and** 4 nucleon numbers | **B1** |
| 11(c)(i) | P marked where beam of alpha-particles hits screen | **B1** |
| 11(c)(ii) | fewer flashes (as one moves from centre)<br>**or** very few / only some flashes on same side as source / on left | **B1** |
| 11(c)(iii) | Any 2 bullet points from<br>• nucleus is small<br>**or** atom (mostly empty) space<br>• most mass of atom in nucleus or mass is concentrated in small point / region<br>**or** nucleus is dense **or** nucleus is massive<br>• charge concentrated in small region<br>**or** (positive) charge found in nucleus<br>**or** nucleus has all the (positive) charge of the atom | **B1 B1** |