Cambridge Assessment International Education

Cambridge Pre-U

PHYSICS **9792/02**

Paper 2 Written Paper **For examination from 2020**

MARK SCHEME

Maximum Mark: 100

Specimen

This specimen paper has been updated for assessments from 2020. The specimen questions and mark schemes remain the same. The layout and wording of the front covers have been updated to reflect the new Cambridge International branding and to make instructions clearer for candidates.

This syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document has **8** pages. Blank pages are indicated.

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.

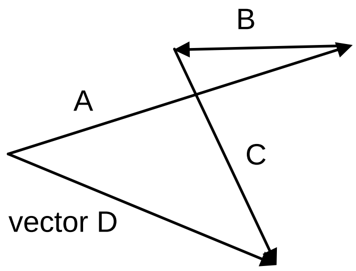
GENERIC MARKING PRINCIPLE 5:

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:

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.

Section 1

Question	Answer	Marks
1(a)(i)	vectors have magnitude and direction but scalars have only magnitude	**1**
1(a)(ii)	pair of correct vectors (1) pair of correct scalars (1)	**2**
1(b)(i)	 three vectors correctly arranged (nose-to-tail) (1) resultant with correct arrow (1)	**2**
1(b)(ii)	(component in *x*-direction = 37cos 25° =) 33.5 (units) (component in y-direction = 37sin 25° =) 15.6 (units)	**2**

Question	Answer	Marks
2(a)	power = $\frac{\mathrm{d}(WD)}{\mathrm{d}t}$ **or** WD = $\int P\mathrm{d}t$ (1) equals $\frac{\mathrm{d}(\boldsymbol{F}.\boldsymbol{x})}{\mathrm{d}t}$ equals $\frac{\boldsymbol{F}.\mathrm{d}\boldsymbol{x}}{\mathrm{d}t}$ equals $\boldsymbol{F}.\boldsymbol{v}$ (1) **OR** work done equals force × distance moved (in the direction of the force) so (1) work done in unit time (second) = force × distance moved in unit time (second) (1) (therefore power = force × velocity) accept sensible symbols	**2**
2(b)(i)	$1800 = F \times 12.0$; $F = \frac{1800}{12.0} = 150$ (N)	**1**
2(b)(ii)	150 (N) **or** candidate's answer to **(b)(i)**	**1**
2(c)(i)	850 × 2.5 (1) 2125 (kg ms^{-2}) (1)	**2**
2(c)(ii)	(driving force =) 2125 + candidate's **(b)(ii)** calculated (expected answer = 2275 (N)) (1)	**1**
2d(i)	($R \propto v^2$) $\frac{R_{slow}}{R_{fast}} = \left(\frac{12.0}{36.0}\right)^2 = \frac{1}{9}$ **or** $k = 1.042$ (1) (resistance at high speed = 9 × 150 =) 1350 (N) (1)	**2**
2d(ii)	(power output = 1350 × 36 =) 48 600 (W)	**1**

Question	Answer	Marks
3(a)(i)	(current $= \frac{V}{R} =$) $\frac{240\,(\text{V})}{20\,(\Omega)}$ **or** 12 (A) (1) power = $V \times I$ **or** 240 × 12 (1) (240 × 12 =) 2880 (W) (1) alternatively $\frac{V^2}{R} = \frac{240^2}{20}$ = 2.88 × 10^3 (W)	**3**
3(a)(ii)	(E =) 2880 × t = $m \times c \times \Delta T$ (1) (t = $\frac{33 \times 4200 \times 40}{2880}$ =) 1925 (s) (1)	**2**
3(b)(i)	the (single) switch will cause three lights A, B and C to come on	**1**
3(b)(ii)	either switch turns lamp D on (by completing circuit) (1) either switch turns lamp D off (by breaking circuit) (1)	**2**
3(b)(iii)	(current =) $\frac{10\,(\text{W})}{240\,(\text{V})}$ **or** $\frac{1}{24}$ (A) **or** $\frac{V^2}{P}$ **or** $\frac{240^2}{10}$ (1) (resistance = $\frac{V}{I}$ = 240 × 24 =) 5760 (Ω) (1)	**2**
3(c)(i)	one correct route from P to Q (1) second correct route from P to Q (1)	**2**
3(c)(ii)	any **two** from: independent switching / if one appliance fails the others work many sockets can be attached to the ring extra sockets can be put in with little difficulty large currents can be supplied by two cables less wiring needed fault on one side will still leave circuit working max 2	**2**

Question	Answer	Marks
4(a)(i)	transverse wave with <u>oscillation</u> / <u>vibration</u> at right angles to direction of travel (1) longitudinal wave with <u>oscillation</u> / <u>vibration</u> in the direction of travel (1) accept answers in terms of a diagram	**2**
4(a)(ii)	polarised with all the oscillation in one plane / direction / angle (1) non-polarised with a variety of planes / directions / angles (1) a diagram here must have at least <u>three</u> doubled headed arrows	**2**
4(a)(iii)	any **three** from: standing wave as two waves (of the same type and frequency) travelling in opposite directions forming nodes and antinodes (can be from diagram) that do not change their position (can be from diagram) crests and troughs of progressive waves move forwards (can be from diagram) progressive waves transfer energy **or** standing waves do not transfer energy compares amplitudes (progressive constant; standing varies) compares phases (progressive varies; standing constant) max 3	**3**

Question	Answer	Marks
4(b)(i)	($n\lambda = d\sin\theta$) $d = \frac{1}{500}$ (mm) $= 2 \times 10^{-6}$ (m) (1) $\lambda = \frac{\sin 36.09 \times 2 \times 10^{-6}}{2}$ (1) $= 5.891 \times 10^{-7}$ (m) (1)	**3**
4(b)(ii)	$\lambda = \sin 36.13 \times 10^{-6} = 5.896 \times 10^{-7}$ (m)	**1**
4(b)(iii)	θ in radians **or** $\frac{0.04 \times 2\pi}{360}$ (1) ($\theta = 0.04° = \frac{0.04 \times 2\pi}{360}$ (rad) =) 6.98×10^{-4} (rad) **or** $b = \frac{\lambda}{0.04}$ **or** $b = \frac{\lambda}{\text{candidate's value}}$ (1) 8.4×10^{-4} (m) (1)	**3**

Question	Answer	Marks
5(a)(i)	P = 236 **cao and** Q = 92 **cao** (1) R = 143 **cao** (1)	**2**
5(a)(ii)	more neutrons are produced than are required to cause the reaction	**1**
5(b)(i)	${}^{90}_{38}Sr \rightarrow {}^{90}_{39}Y + {}^{0}_{-1}\beta^{(-)}$ allow if candidate writes ${}_{x}Sr$ and ${}_{x+1}Y$ correct yttrium numbers (1) correct beta numbers (1)	**2**
5(b)(ii)	39	**1**
5(b)(iii)	half life is 28 years so 112 years is 4 half lives (1) number present after this time is $\frac{1}{16}$ of original (1) number present $= \frac{2.36 \times 10^{13}}{16} = 1.475 \times 10^{12}$ (1)	**3**

Question	Answer	Marks
6(a)	when photons / em radiation / light is incident on surfaces / electrons / material / atom (1) electrons are emitted (1) <u>photons</u> must have sufficiently high energy / frequency (1) hf is the energy of a photon / em radiation / light / wave (1) Φ is the work function / (minimum) energy required to liberate an electron (1) $\frac{1}{2}mv^2$ is the (maximum) kinetic energy of a liberated electron (1)	**6**
6(b)	<u>use</u> of a stopping potential (1) arrangement with correct polarity and (sensitive) galvanometer / ammeter (1) measure / adjust p.d. to a situation where current ceases (1) this gives energy per unit charge so to get v_{max} charge per unit mass of electron needs to be used or $eV_S = \frac{1}{2}mv^2_{max}$ (1)	**4**

Question	Answer	Marks
6(c)(i)	any **one** from very low intensity still produces immediate emission kinetic energy of electons does not depend on the intensity emission is affected by frequency (e.g. there is a threshold frequency)	**1**
6(c)(ii)	any **one** from classical wave requires a wait the more energy incident on the material, the greater will be the maximum kinetic energy frequency does not affect emission (provided the energy is the same)	**1**
6(c)(iii)	any **one** from some electrons will absorb the few photons each electron absorbs one photon (of constant energy) energy of photon depends on frequency **or** $E = hf$	**1**

Question	Answer	Marks
7	**Limiting angle for toppling** Calculation of angle at which this occurs (geometric method expected) $\tan\theta = \frac{10}{15} = 0.67$ (1) hence $\theta = 33.7°$ (1) **Condition to slide** component of weight down slope = $mg\sin\theta$ (1) friction force acting up slope = $\mu_s\, mg\cos\theta$ (1) leading to $\tan\theta = \mu_s = 0.60$ (1) hence $\theta = 31.0°$ (1) **Prediction / conclusion** 31.0°(slide) < 33.7°(topple) therefore it slides (before toppling). (2) accept conclusion based on direct comparison of values for tangents accept conclusion based on the requirement for the coefficient of static friction to be greater than 0.600	**8**

Section 2

Question	Answer	Marks
8(a)(i)	**1.** 800 (A) (1) **2.** 350 000 **or** 3.5×10^5 (V) (1)	**2**
8(a)(ii)	(P =) VI seen **or** implied (in **1.** or **2.**) (1) 2.8×10^8 (W) **and** 0 (1)	**2**
8(a)(iii)	up and down graph – e.g. sawtooth, triangular wave – **and** number on axis (1) decent $\sin^2$ graph with correct curvature at bottom (1) time period of bumps = 0.010 s (1)	**3**
8(a)(iv)	horizontal line (1) horizontal line at 2.8×10^8 W **or** candidate's value (1)	**2**
8(a)(v)	reference to area under the graph (1) area under the graph is greater (1)	**2**
8(b)(i)	0.0107 (m) **or** 1.07 cm **or** 10.7 mm	**1**
8(b)(ii)	$\pi(r_1^2 - r_2^2)$ **or** $\pi(1.50^2 - 0.43^2)$ **or** $\pi(0.0150^2 - 0.0043^2)$ (1) 6.49×10^{-4} (m^2) (1)	**2**
8(b)(iii)	$R = \frac{\rho l}{A}$ **or** $\frac{1.72 \times 10^n \times 5.8 \times 10^n}{6.49 \times 10^n}$ (1) $\frac{1.72 \times 10^{-8} \times 580\,000}{6.49 \times 10^{-4}}$ **or** 15.3 **or** 15.4 (Ω) (1)	**2**
8(b)(iv)	(P =) I^2R **or** $800^2 \times 15.3$ (1) 9.79 (MW) accept 9.86 (from R = 15.4 Ω) (1)	**2**
8(c)(i)	(Q_t) $CV_0 \sin(2\pi ft)$ **or** CV_t **not** CV	**1**
8(c)(ii)	the charge on the plates charges and charge flows on and off the plates	**1**
8(c)(iii)	**1.** the *more* quickly the charge charges <u>and</u> the *more* quickly the charge flows (1) **2.** (capacitive reactance =) $\frac{1}{2\pi fC}$ and ohm / Ω / VA^{-1} (1) **3.** (I_0 =) $2 \times \pi \times 50.0 \times 200 \times 7.00 \times 10^{-7} \times 350\,000$ (1) 1.54×10^4 (A) (1)	**4**
8(c)(iv)	there is an extra current (not present with d.c.) which generates greater energy losses	**1**

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