



Cambridge International Examinations
Cambridge Pre-U Certificate

PHYSICS (PRINCIPAL)

9792/02

Paper 2 Written Paper

For Examination from 2016

SPECIMEN MARK SCHEME

2 hours

MAXIMUM MARK: 100

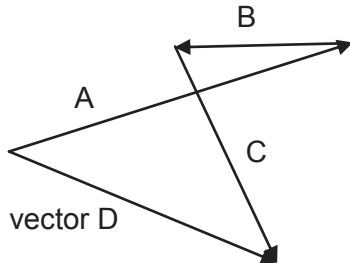
The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document consists of **6** printed pages.

Section 1

- 1 (a) (i) vectors have magnitude and direction but scalars have only magnitude (1) [1]
 (ii) pair of correct vectors (1)
 pair of correct scalars (1) [2]

(b) (i)



three vectors correctly arranged (nose-to-tail) (1)
 resultant with correct arrow (1) [2]

- (ii) (component in x -direction = $37\cos 25^\circ \Rightarrow 33.5$ (units) (2)
 (component in y -direction = $37\sin 25^\circ \Rightarrow 15.6$ (units) [2]

[Total: 7]

- 2 (a) power = $\frac{d(WD)}{dt}$ or $WD = \int Pdt$ (1)
 equals $\frac{d(F \cdot x)}{dt}$ equals $\frac{F \cdot dx}{dt}$ equals $F \cdot v$ (1)

OR

work done equals force \times distance moved (in the direction of the force) so (1)
 work done in unit time (second) = force \times distance moved in unit time (second) (1)
 (therefore power = force \times velocity) accept sensible symbols [2]

- (b) (i) $1800 = F \times 12.0$; $F = \frac{1800}{12.0} = 150$ (N) (1) [1]

(ii) 150 (N) or candidate's answer to (b)(i) (1) [1]

- (c) (i) 850×2.5 (1)
 2125 (kg ms^{-2}) (1) [2]

(ii) (driving force \Rightarrow) 2125 + candidate's (b)(ii) calculated (expected answer = 2275 (N)) (1) [1]

- (d) (i) ($R \propto v^2$)
 $\frac{R_{\text{slow}}}{R_{\text{fast}}} = \left(\frac{12.0}{36.0}\right)^2 = \frac{1}{9}$ or $k = 1.042$ (1)
 (resistance at high speed = $9 \times 150 \Rightarrow$) 1350 (N) (1) [2]

(ii) (power output = $1350 \times 36 \Rightarrow$) 48600 (W) (1) [1]

[Total: 10]

- 3 (a) (i) (current = $\frac{V}{R} = \frac{240(V)}{20}$ (Ω) or 12 (A) (1)
 power = $V \times I$ or 240×12 (1)
 $(240 \times 12 =) 2880$ (W) (1) [3]
 alternatively $\frac{V^2}{R} = \frac{240^2}{20} = 2.88 \times 10^3$ (W)
- (ii) ($E =$) $2880 \times t = m \times c \times \Delta T$ (1)
 $(t = \frac{(33 \times 4200 \times 40)}{2880} =) 1925$ (s) (1) [2]
- (b) (i) the (single) switch will cause three lights A, B and C to come on (1) [1]
 (ii) either switch turns lamp D on (by completing circuit) (1)
 either switch turns lamp D off (by breaking circuit) (1) [2]
- (iii) (current =) $\frac{10(W)}{240(V)}$ or $\frac{1}{24}$ (A) or $\frac{V^2}{P}$ or $\frac{240^2}{10}$ (1)
 (resistance = $\frac{V}{I} = 240 \times 24 =$) 5760 (Ω) (1) [2]
- (c) (i) one correct route from P to Q (1)
 second correct route from P to Q (1) [2]
 (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 (2) [2]
- [Total: 14]**
- 4 (a) (i) transverse wave with oscillation/vibration at right angles to direction of travel (1)
 longitudinal wave with oscillation/vibration in the direction of travel (1) [2]
 accept answers in terms of a diagram
- (ii) polarised with all the oscillation in one plane/direction/angle (1)
 non-polarised with a variety of planes/directions/angles (1) [2]
 a diagram here must have at least three doubled headed arrows
- (iii) any **three** from:
 standing wave as two waves (of the same type and frequency) travelling in
 opposite directions (1)
 forming nodes and antinodes (can be from diagram) (1)
 that do not change their position (can be from diagram) (1)
 crests and troughs of progressive waves move forwards (can be from diagram) (1)
 progressive waves transfer energy or standing waves do not transfer energy (1)
 compares amplitudes (progressive constant; standing varies) (1)
 compares phases (progressive varies; standing constant) (1) [3]

- (b) (i) $(n\lambda = d\sin\theta)$
 $d = \frac{1}{500} \text{ (mm)} = 2 \times 10^{-6} \text{ (m)}$ (1)
 $\lambda = \frac{\sin 36.09 \times 2.0 \times 10^{-6}}{2}$ (1)
 $= 5.891 \times 10^{-7} \text{ (m)}$ (1) [3]
- (ii) $\lambda = \sin 36.13 \times 10^{-6} = 5.896 \times 10^{-7} \text{ (m)}$ (1) [1]
- (iii) θ in radians **or** $\frac{0.04 \times 2\pi}{360}$ (1)
 $(\theta = 0.04^\circ = \frac{0.04 \times 2\pi}{360} \text{ (rad)} =) 6.98 \times 10^{-4} \text{ (rad)}$ **or** $b = \frac{\lambda}{0.04}$
or $b = \frac{\lambda}{\text{candidate's value}}$ (1)
 $8.4 \times 10^{-4} \text{ (m)}$ (1) [3]

[Total: 14]

- 5 (a) (i) P = 236 **cao** and Q = 92 **cao** (1)
R = 143 **cao** (1) [2]
- (ii) more neutrons are produced than are required to cause the reaction (1) [1]
- (b) (i) ${}_{38}^{90}\text{Sr} \rightarrow {}_{39}^{90}\text{Y} + {}_{-1}^0\beta^{(-)}$ allow if candidate writes ${}_x\text{Sr}$ and ${}_{x+1}\text{Y}$
correct yttrium numbers (1)
correct beta numbers (1) [2]
- (ii) 39 (1) [1]
- (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]

[Total: 9]

- 6 (a) when photons/em radiation/light is incident on surfaces/electrons/material/atom (1)
electrons are emitted (1)
photons 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]

- (b) use 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 $eV_S = \frac{1}{2}mv_{\max}^2$ (1) [4]
- (c) (i) any **one** from
 very low intensity still produces immediate emission
 kinetic energy of electrons does not depend on the intensity
 emission is affected by frequency (e.g. there is a threshold frequency)
- (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)
- (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** $E = hf$

[3]

[Total: 13]

7 Limiting angle for toppling

Calculation of angle at which this occurs (geometric method expected)

$$\tan \theta = \frac{10}{15} = 0.67 \quad (1)$$

$$\text{hence } \theta = 33.7^\circ \quad (1)$$

Condition to slide

$$\text{component of weight down slope} = mg \sin \theta \quad (1)$$

$$\text{friction force acting up slope} = \mu_s mg \cos \theta \quad (1)$$

$$\text{leading to } \tan \theta = \mu_s = 0.60 \quad (1)$$

$$\text{hence } \theta = 31.0^\circ \quad (1)$$

Prediction/conclusion

31.0° (slide) < 33.7° (topple) therefore it slides (before toppling). (2) [8]

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

[Total: 8]

Section 2

- 8 (a) (i) 1. 800 (A) (1)
 2. 350 000 or 3.5×10^5 (V) (1)
- (ii) ($P =$) $V I$ seen or implied (in 1. or 2.) (1)
 2.8×10^8 (W) and 0 (1)
- (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)
- (iv) horizontal line (1)
 horizontal line at $\frac{2.8 \times 10^8 \text{ W}}{\text{candidate's value}}$ (1)
- (v) reference to area under the graph (1)
 area under the graph is greater (1) [11]
- (b) (i) 0.0107 (m) or 1.07 cm or 10.7 mm (1)
- (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} (m²) (1)
- (iii) $R = \frac{\rho l}{A}$ or $\frac{1.72 \times 10^{-8} \times 5.8 \times 10^3}{6.49 \times 10^{-4}}$
 and
 $\frac{1.72 \times 10^{-8} \times 580\,000}{6.49 \times 10^{-4}}$ or 15.3 or 15.4 (Ω) (1)
 (1)
- (iv) ($P =$) $I^2 R$ or $800^2 \times 15.3$ (1)
 9.79 (MW) accept 9.86 (from $R = 15.4 \Omega$) (1) [7]
- (c) (i) (Q_t) $CV_0 \sin(2\pi ft)$ or CV_t not CV (1)
- (ii) the charge on the plates changes and charge flows on and off the plates (1)
- (iii) 1. the *more* quickly the charge charges and 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)
- (iv) there is an extra current (not present with d.c.) which generates greater energy losses (1) [7]

[Total: 25]