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 must be read in conjunction with the question papers and the report on the examination.

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1 (a) allow 0.05 mm → 0.15 mm  

(b) allow 0.25 s → 0.5 s  

(c) allow 8 N → 12 N  

ignore number of significant figures

2 crystalline: atoms / ions / particles in a regular arrangement / lattice  
long range order / orderly pattern  
(lattice) repeats itself (1)  

polymer: long chain molecules / chains of monomers  
some cross-linking between chains / tangled chains (1)  
amorphous: disordered arrangement of molecules / atoms / particles  
any ordering is short-range (1)  
(three 'B' marks plus any other 2 marks)  

3 connect microphone / (terminals of) loudspeaker to Y-plates of c.r.o.  
adjust c.r.o. to produce steady wave of 1 (or 2) cycles / wavelengths on screen  
measure length of cycle / wavelength λ and note time-base b  
frequency  =  1 / λb  
(assume b is measured as s cm⁻¹, unless otherwise stated)  
(if statement is 'measure T, f = 1/T' then last two marks are lost)

4 (a) acceptable straight line drawn (touching every point)  

(b) the distance fallen is not d  
   d is the distance fallen plus the diameter of the ball  
   ('d is not measured to the bottom of the ball' scores 2/2)

(c) (i) diameter: allow 1.5 ± 0.5 cm (accept one SF)  
       no ecf from (a)  

   (ii) gradient = 4.76, ± 0.1 with evidence that origin has not been used  
       gradient = g / 2  
       g = 9.5 m s⁻²  

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5. (a) (i) Fig. 5.2 B1 [1]
(ii) Fig. 5.3 B1 [1]

(b) kinetic energy increases from zero then decreases to zero B1 [1]

(c) (i) \[ \Delta E_p = \frac{mg\Delta h}{mgh} \]
\[ = 94 \times 10^{-3} \times 9.8 \times 2.6 \times 10^{-2} \] using \( g = 10 \) then \(-1\)
\[ = 0.024 \text{ J} \] A1 [2]

(ii) \[ \text{either} \quad 0.024 = \frac{\frac{1}{2} k (2.6 \times 10^{-2})^2}{k d^2} = \frac{\frac{1}{2} k (2.6 \times 10^{-2})^2}{0.012} \]
\[ d = 0.018 \text{ m} \]
\[ = 0.018 \text{ cm} \] A1 [3]

6. (a) when two (or more) waves meet (at a point) B1
(resultant) displacement is (vector) sum of individual displacements B1 [2]

(b) (i) \( \lambda = \frac{ax}{D} \) (if no formula given and substitution is incorrect then 0/3) C1
\[ 590 \times 10^{-9} = \frac{(1.4 \times 10^{-3} \times x)}{2.6} \]
\[ x = 1.1 \text{ mm} \] A1 [3]

(ii) 1. \( 180^\circ \) (allow \( \pi \) if rad stated) A1 [1]
2. at maximum, amplitude is 3.4 units and at minimum, 0.6 units C1
\[ \text{intensity} \sim \text{amplitude}^2 \] allow \( I \sim a^2 \)
\[ \text{ratio} = \frac{3.4^2}{0.6^2} \]
\[ = 32 \] A1 [3]

7. (a) (i) path: reasonable curve upwards between plates B1
straight and at a tangent to the curve beyond the plates B1 [2]

(ii) 1. \( (F =) E.g \) B1 [1]
2. \( (t =) L/v \) B1 [1]

(b) (i) total momentum of a system remains constant or total momentum of a system before a collision equals total momentum after collision provided no external force acts on the system (do not accept 'conserved' but otherwise correct statement gets 1/2) M1
\[ \Delta p \] on plates / so law applies A1 [2]

(ii) \( (\Delta p =) EqL/v \) allow ecf from (a)(ii) B1 [1]

(iii) either charged particle is not an isolated system so law does not apply M1
\[ \text{(M1) } \]
\[ \text{(A1) } \] (A1)
8 (a) (i) either \( P = \frac{V^2}{R} \) or \( I = \frac{1200}{230} \) or 5.22
\[
R = \frac{230^2}{1200} \quad \text{or} \quad R = \frac{230}{5.22}.
\]
\[
= 44.1\Omega \quad \text{or} \quad = 44.1\Omega.
\]

(ii) \( R = \frac{\rho L}{A} \)
\[
= \frac{(1.7 \times 10^{-8} \times 9.2 \times 2)}{(\pi \times \{0.45 \times 10^{-3}\}^2)}
\]
\[
= 0.492\Omega.
\]

(b) current = \( \frac{230}{44.6} \) C1

power = \( (230 / 44.6)^2 \times 44.1 \) C1

= 1170 W A1 [3]

(allow full credit for solution based on potential divider)

(c) e.g. less power dissipated in the heater / smaller p.d. across heater / more power loss in cable / current lower cable becomes heated / melts B1

(any two sensible suggestions, 1 each, max 2)

9 (a) nucleus emits \( \alpha \)-particles or \( \beta \)-particles and/or \( \gamma \)-radiation to form a different / more stable nucleus B1

(b) (i) fluctuations in count rate (not 'count rate is not constant') B1 [1]

(ii) no effect B1 [1]

(iii) if the source is an \( \alpha \)-emitter either \( \alpha \)-particles stopped within source (and gain electrons) or \( \alpha \)-particles are helium nuclei B1 [2]

allow 1/2 for 'parent nucleus gives off radiation to form daughter nucleus'