OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL PHYSICS

(9630)

PAPER 2
Mark scheme

Specimen 2018

V1.1

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.

Question	Marking guidance	Mark	Comments
01.1	<u>cladding</u>	1	
01.2	Sin θ_c = 1.41/1.46 ✓ Θ_c = 75 (degrees) (74.96) ✓	1 1	
01.3	65 (degrees)	1	

Question	Marking guidance	Mark	Comments
02.1	$R = \frac{\rho L}{A}$ ✓ $= \frac{1.7 \times 10^{-8} \times 1.4}{7.8 \times 10^{-7}}$ = 0.031(Ω) ✓	1 1	
02.2	Constant volume gives $l_1A_1 = l_2A_2$ (Or $l_2 = 2l_1$ $A_2 = A_1/2$ ✓ $R = \frac{\rho 2l}{A/2}$ (= 4R) ✓ (or by calculation with $l_2 = 2.8$ m $A_2 = 3.9$ m^2 gives R = 0.124 Ω)	1 1	

Question	Marking guidance	Mark	Comments
03	absorbs enough energy (from the incident) electron (by collision) OR incident electron loses energy (to orbital electron) ✓ exact energy / 10.1((eV) needed to make the transition / move up to level 2 ✓	1 1	For second mark must imply exact energy

Question	Marking guidance	Mark	Comments
04	Use of ε = W/Q W = 14.8 × 15.5 × 10^3 ✓ 2.29 × 10^5 J ✓	1 1	

Question	Marking guidance	Mark	Comments
05	Spring stiffness constant in figure 2 = k/2 ✓ Use of $T = 2\pi\sqrt{\frac{m}{k/2}}$ $T = \sqrt{2} \times 2\pi\sqrt{\frac{m}{k}}$ = 2.1 s ✓	1 1	

Question	Marking guidance	Mark	Comments
06	wavelength (= 2 × **PQ** = 2 × 1.20 m) = 2.4 m ✓ speed (= wavelength × frequency = 2.4 × 150) = 360 ($m\ s^{-1}$) ✓	1 1	 Answer only gets both marks

Question	Marking guidance	Mark	Comments
07.1	same wavelength / frequency ✓ constant phase relationship ✓	1 1	 Allow 'constant phase difference' but not 'in phase'
07.2	($\lambda = \frac{c}{f}$) $3.00 \times 10^8 = 9.4\ (10^9)\ \lambda$ OR $\frac{3.00\times10^8}{9.4\times(10^9)}$ ✓ $= 3.2 \times 10^{-2}$ (3.19×10^{-2} m) ✓	 1 1	 Use of speed of sound gets zero Allow 0.03
07.3	3.2×10^{-2} ✓(m) ecf from 7.2	1	Don't allow 1 wavelength,1λ etc Do not accept zero, 2π, 360

07.4	maximum (at position shown) ✓ constructive interference / reinforcement ✓ (the waves meet) 'in step' / peak meets peak / trough meets trough / path difference is (n) λ / in phase ✓	1 1 1	Allow 'constructive superposition' ecf for 'minimum' or for reference to wrong maximum

07.5	$s = \frac{\lambda D}{w}$ $= \frac{0.0319 \times 0.42}{0.11}$ ✓ ecf 7.3 = 0.12 (0.1218 m) ✓ Correct answer gains first 2 marks = **any <u>2sf</u>** number ✓ *Independent mark for any 2 SF number*	 1 1 1	Don't allow use of the diagram shown as a scale diagram Do not penalise s and w symbols wrong way round in working if answer is correct

07.6	a maximum (no mark) (f × 2 results in) $\lambda/2$ ✓ path difference is an even number of multiples of the new wavelength ($2n\lambda_{new}$) ✓	 1 1	Students stating 'minimum 'can get second mark only. Allow 'path difference is nλ' / any even number of multiples of the new λ quoted eg 'path difference is now 2 λ'

Question	Marking Guidance	Mark	Comments
08.1	**$1/R_{total}$ = 1/(40)** +1/(10 + 5) ✓= 0.09167 R_{total} = 10.9 (kΩ) ✓	1 1	
08.2	I = 12 / 10.9 k = 1.1 (mA) ✓	1	
08.3	<table><tr><th>position</th><th>pd/V</th></tr><tr><td>AC</td><td>6.0 ✓</td></tr><tr><td>DF</td><td>4.0 ✓</td></tr><tr><td>CD</td><td>2.0 ✓</td></tr></table> CE for CD	1 1 1 1	
08.4	AC: no change ✓ constant pd across resistors / parallel branches(AE) ✓ DF: decreases ✓ as greater proportion of voltage across fixed / 10 k Ω resistor ✓	1 1 1 1	 No ecf from first mark No ecf from first mark

Question	Marking guidance	Mark	Comments
09.1	(light travels as photons) energy of a photon depends on frequency ✓ below threshold frequency (photon) does not have enough **energy** to liberate an electron ✓ **or** reference to work function eg a photon does not have enough **energy** (to allow the electron) to overcome the work function	1 1	
09.2	(use of $E = hc/\lambda$) $E = 6.63 \times 10^{-34} \times 3.00 \times 10^{8}/5.40 \times 10^{-7}$ ✓ $E = 3.68 \times 10^{-19}$ (J) ✓	1 1	
09.3	(use of $hf = E_k + \phi$) $3.68 \times 10^{-19} = E_k + 1.40 \times 10^{-19}$ $E_k = 2.28 \times 10^{-19}$ (J) ✓	1	
09.4	(use of $E_k = mv^2/2$) $2.28 \times 10^{-19} = 1/2 \times 9.11 \times 10^{-31} \times v^2$ ✓ $v^2 = 2 \times 2.28 \times 10^{-19}/9.11 \times 10^{-31} = 5.0 \times 10^{11}$ $v = 7.1 \times 10^{5}$ (m s^{-1}) ✓	1 1	
09.5	(use of $\lambda = h/mv$) $\lambda = 6.63 \times 10^{-34}(9.11 \times 10^{-31} \times 7.1 \times 10^{5}$ ✓ $\lambda = 1.03 \times 10^{-9}$ (m) ✓	1 1	
09.6	Increase in number of emitted electrons (per second) Because more photons per second hit the metal	1 1	

Question	Marking guidance	Mark	Comments
10.1	*y* – *intercept* 1.52 (V) (± 0.01 V) ✓	1	
10.2	identifies gradient as *r* **or** use of equation ✓ substitution to find gradient **or** substitution in equation ✓ r = 0.45 ± 0.02 Ω ✓	1 1 1	
10.3	EMF reading lower ✓ Current will flow from the cell through the voltmeter so the voltmeter is reading the terminal pd rather than the emf ✓	1 1	

Question	Marking guidance	Mark	Comments
11.1	Suitable expt eg diffraction through a door/out of a pipe	1	
11.2	Using $c = d/t$ $t = 2\,500/480 = 5.2$ (s) ✓	1	
11.3	(Measured time is difference between time taken by light and time taken by sound) Calculation assumes that light takes no time to reach observer, ie speed is infinite ✓	1	Do not allow "could not know speed of light"
11.4	Sound from gun is a mixture of frequencies. ✓ All the sound reaches observer at the same time ✓	1 1	Alternative for 1st mark '(so speed is independent of frequency) the sound of the gun is similar when close and far away
11.5	More accurate, as it is closer to the accepted value ✓	1	
11.6	When $\theta = 0$ °C $c = 331.29$ m s^{-1} Therefore $331.29 = k\sqrt{273.15}$ ✓ $k = 20.045$ (m s^{-1} K$^{-½}$) ✓	 1 1	
11.7	The method and value are published ✓ other scientists repeat the experiment using the same method ✓	1 1	

Section C

In this section, each correct answer is awarded 1 mark.

Question	Key
12	D
13	C
14	C
15	C
16	C
17	D
18	C
19	C
20	D
21	D
22	A
23	D
24	B
25	D