Cambridge Assessment International Education
Cambridge Pre-U Certificate

PHYSICS **9792/02**

Paper 2 Written Paper **May/June 2018**

MARK SCHEME

Maximum Mark: 100

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.

Cambridge International is publishing the mark schemes for the May/June 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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:

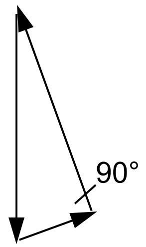
Marks must be awarded **positively**:

- 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.

Question	Answer	Marks
1(a)	 <u>closed</u> triangle **and** 90° clear **and** arrows all in same direction ; weight, contact force and friction labelled **and** weight as the hypotenuse ;	**2**
1(a)(ii)	(μ_s = tan 35.5° =) 0.713	**1**
1(b)(i)	(t =) $\sqrt{(2 \times 0.630 / 0.150)}$ **or** $t^2 = 2 \times 0.630 / 0.150$	**1**
	2.90 (s)	**1**
1(b)(ii)	$mg\sin\theta$ seen	**1**
	($\mu_k N$ =)$m(g\sin\theta - a)$ **or** $m(9.81\sin 35.5° - 0.150)$ **or** $mg\sin\theta - F_f = ma$ or $mg\sin\theta - \mu_k N = ma$	**1**
	(μ_k =)$(g\sin\theta - a) / g\cos\theta$ **or** $(9.81\sin 35.5° - 0.150) / 9.81\cos 35.5°$	**1**
	0.695	**1**
1(b)(iii)	(on way down) gravitational potential energy to kinetic **and** internal energy	**1**
	(on collision / at bottom) kinetic energy to internal energy	**1**

Question	Answer	Marks
2(a)(i)	P marked between 350 MPa and 380 MPa	**1**
2(a)(ii)	Y marked at first maximum	**1**
2(b)	one stress value (from graph) divided by one strain value **and** from straight-line region **or** $1.35 – 1.55 \times 10^{11}$ (Pa)	**1**
	$1.40 – 1.50 \times 10^{11}$ (Pa)	**1**
2(c)	500 < value < 510 (MPa)	**1**
2(d)(i)	(atoms / molecules / particles) separate permanently / permanent deformation / plastic deformation	**1**
2(d)(ii)	atoms / molecules / particles slip down into next gap **or** slide / move past each other **or** dislocations move	**1**
2(e)	area <u>under</u> graph (between the two points considered)	**1**
	multiply by volume of sample	**1**

Question	Answer	Marks
3(a)	(ΔV =) $g\Delta h$ **or** 9.81×82.3	**1**
	807 (J kg^{-1})	**1**
3(b)(i)	(ΔT =) $g\Delta h / c$ **or** mgh **and** $mc\Delta T$ quoted **or** $9.81 \times 82.3 / 4180$	**1**
	0.193 (K)	**1**

Question	Answer	Marks
3(b)(ii)	any **two** from: greater **and** air / rocks warmer / thermal energy transfer from air / rocks greater **and** kinetic energy of water in river not zero / kinetic energy transferred to thermal energy greater **and** Sun heats water in pond smaller **and** water bounces back up (away from pond) / kinetic energy lost to system smaller **and** evaporation removes (latent) heat / requires thermal energy smaller **and** pond fills reducing drop height smaller **and** work done on rock face (by water)	**2**
3(c)	gravitational potential energy change **and** thermal energy required both directly proportional to mass	**1**

Question	Answer	Marks
4(a)(i)	(quantity of chemical / other form of energy) transferred to <u>electrical</u> energy	**1**
	(quantity of chemical / other form of energy transferred to) <u>electrical</u> energy <u>per</u> unit charge (that flows through the cell)	**1**
4(a)(ii)	resistance due to (conducting properties of) material of cell / source **or** lost volts / current	**1**
4(b)(i)	(V =)$E – Ir$ **or** $ER / (r + R)$ **or** 1.52 × 2.55 / (2.55 + 0.450) **or** $I = E / (R + r)$ **or** 2.55 / (2.55 + 0.450) **or** 0.507	**1**
	1.29 (V)	**1**
4(b)(ii)	(P =) I^2R **or** $0.507^2 \times 2.55$	**1**
	0.655 (W)	**1**

Question	Answer	Marks
4(c)(i)	**1** charge can be neither created nor destroyed	**1**
	2 energy can be neither created nor destroyed	**1**
4(c)(ii)	**1** (sum of emfs =) 3.04 (V) **or** 2×1.52 (V)	**1**
	$3.04 = 0.90i + 13.0i + 18.5I$ **or** $3.04 = 13.9i + 18.5I$	**1**
	2 (i =) 0.108 (A) seen **or** 0.0255 (A)	**1**
	0.0255 (A) **and** backwards through cell / B to C	**1**

Question	Answer	Marks
5(a)	$3.00 \times 10^8 / 1.54$ **or** $3.00 \times 10^8 / 1.33$	**1**
	1.95×10^8 (m s^{-1}) **and** 2.26×10^8 (m s^{-1})	**1**
5(b)(i)	$i = \sin^{-1}(\sin(65°) / 1.54)$ **or** $\sin(i) = \sin(65°) / 1.54$	**1**
	36.1(°)	**1**
5(b)(ii)	ray in glass between incident ray (continued) and horizontal **and** ray in water between ray in glass (continued) and line parallel to incident ray	**1**

Question	Answer	Marks
5(b)(iii)	**1** (c =)sin^{-1}(1 / n) **or** sin(c) = 1 / n **or** ($_an_g$) = 1.54 / 1.33 **or** ($_an_g$) = 1.16	**1**
	(c =)sin^{-1}(1.33 / 1.54) **or** (c =)sin^{-1}(1 / 1.16)	**1**
	59.7(°)	**1**
	2 critical angle is always greater than maximum angle of incidence at second surface ; maximum angle of incidence from n / 1 **and** critical angle from n / n_w ; **or** imagine air gap between wall and water **and** ray in gap parallel to original ray in air ; light is effectively passing from air to water / (optically) rarer to (optically) denser medium ;	**2**

Question	Answer	Marks
6(a)	sin(θ) = 6.33 × 10^{-7} / 8.0 × 10^{-5} **or** (θ =)0.453(°)	**1**
	(w =) (2) × 5.12 × tan(θ) **or** (2) × 5.12 × tan(0.145(°)) **or** 0.0405	**1**
	0.0810 (m)	**1**
6(b)(i)	crests / light from second slit cancel troughs / light from first slit **or** destructive interference **and** reference to second slit **or** owtte	**1**
6(b)(ii)	(x =) 6.33 × 10^{-7} × 5.12 / 2.40 × 10^{-4}	**1**
	0.0135 (m)	**1**
6(b)(iii)	at these places are single slit diffraction minimums	**1**
	no light to interfere **or** factor of 3 recognised	**1**

Question	Answer	Marks
7(a)	$({}^{63}_{28}\text{Ni}) \longrightarrow {}^{63}_{29}(\text{Cu}) + {}^{0}_{-1}(\beta + {}^{0}_{0}\overline{\nu})$ 63 **and** 0 ; 29 a**nd** –1 ;	**2**
7(b)(i)	number of decays per unit time **or** rate (w.r.t. time) of decays	**1**
7(b)(ii)	number of atoms / activity is decreasing	**1**
	direct proportionality (to number of atoms) described	**1**
	(decreasing activity leads to) number of atoms / activity decreasing at decreasing rate **or** constant decay probability	**1**
7(c)	no effect **and** radioactivity is a spontaneous occurrence / nucleus deep within atom (or equivalent statement)	**1**

Question	Answer	Marks
8(a)	(light of) only one / a single frequency	**1**
8(b)(i)	any **seven** from: all frequencies calculated axes with quantities, units **and** sensible scale middle five points plotted ±1 mm **and** best-fit straight line 4.85×10^{14} Hz < threshold frequency < 5.05×10^{14} Hz **or** threshold frequency from *x*-axis intercept 3.25×10^{-19} J < work function < 3.40×10^{-19} J **or** 2.00×10^{-19} eV < work function < 2.15 eV **or** work function from *h* **and** *x*-axis intercept / f_{th} **or** from *y*-axis intercept **and** *e* Planck constant from gradient **and** *e* 6.60×10^{-34} (V s) < Planck constant < 6.75×10^{-34} (V s) **or** Planck constant from gradient × *e* there exists a maximum velocity / kinetic energy (for the electrons emitted) the maximum velocity / stopping potential depends on the frequency (of illumination) wave theory not a complete explanation **or** light / e.m. radiation is quantised	**7**
8(b)(ii)	**1** photon / quantum energy is less than the work function / is too low	**1**
	2 ultraviolet radiation does not pass through the glass	**1**

Question	Answer	Marks
9(a)	energy gained by an electron / particle with charge 1.6×10^{-19} C	**1**
	when accelerated / moved through a p.d. of one volt.	**1**
9(b)(i)	correct antilog values subtracted	**1**
	conversion to joules	**1**
	uses $\Delta E = hf$ **and** $c = f\lambda$ **or** $\Delta E = hc / \lambda$ **or** (λ =) $(6.63 \times 10^{-34} \times 3.0 \times 10^{8}) / (57\,701 \times 1.6 \times 10^{-19})$	**1**
	2.15×10^{-11} (m)	**1**
9(b)(ii)	**1** any **two** from: energy is transferred from incident to tungsten electron electron falls from higher to lower energy level emitting a photon of specific energy / frequency / wavelength i.e. that for K_β	**2**
	2 energy of K_β photon / ray / wave is greater than energy of K_α photon.	**1**
	energy drop is greater	**1**
	3 a similarly shaped graph with peak wavelengths in the same places	**1**
	a similarly shaped graph above the given graph	**1**
	a shorter minimum wavelength	**1**

Question	Answer	Marks
9(b)(iii)	**1** plot a graph of ($1/\lambda$) or E vs Z^2 **or** $\sqrt{1/\lambda}$ or $\sqrt{E}$ vs Z **or** calculate E/Z^2 or $\sqrt{E}/Z$ or λZ^2 or $Z\sqrt{\lambda}$	**1**
	best line fit (through origin) **or** constant value calculated confirms relationship	**1**
	2 tungsten has a high melting point (so will not melt) ; energy is produced as heat in the target ; **or** tungsten has a high proton number / Z ; greater probability of collisions between electrons and the large nucleus **or** large energy gaps ;	**2**
9(c)(i)	I/I_0 **or** $0.40 = e^{-0.528x}$	**1**
	1.74 (cm)	**1**
9(c)(ii)	(I/I_0 **or** $0.40 = e^{-\mu 3.87}$ gives) 0.237 (cm^{-1})	**1**
9(c)(iii)	it / attenuation (coefficient) affects brightness of image / absorption or transmission of X-rays	**1**
	absorption / transmission / intensity of X-rays / brightness (correctly) related to type of material / part of body	**1**
9(d)	example clearly identified	**1**
	evidence from CT scan	**1**
	conclusion drawn	**1**