UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

5054 PHYSICS

5054/21 Paper 2 (Theory), maximum raw mark 75

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.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

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UNIVERSITY of CAMBRIDGE
International Examinations

Section A

1	(a)	(i)	any **one** time between 1.60 and 2.50 s **or** range of correct values	B1	[1]
		(ii)	any **one** time between 0.75 and 1.65 s **or** range of correct values	B1	[1]
		(iii)	2.5(0) s	B1	[1]
	(b)		area (under graph) **or** ½bh **or** ½gt^2 **or** ½ × 0.75 × (7.3 to 7.5)	C1	
			2.7(375) to 2.8(125) m	A1	[2]
2	(a)		gravitational/centripetal (pull/attraction)	B1	
			of the **Sun**	B1	[2]
	(b)	(i)	arrow touching Venus towards centre/left (must pass through Sun if extended)	B1	[1]
		(ii)	(F =) ma **or** 4.9 × 10^{24} × 9.7 × 10^{-3}	C1	
			4.8(4.753) × 10^{22} N	A1	[2]
	(c)		direction of movement ∩ direction of force	C1	
			force/it is perpendicular/at right angles to distance moved **or** does not move **any** distance in direction of force	A1	[2]
3	(a)		energy cannot be created/destroyed (nb. only one required)	B1	
			energy cannot be destroyed or created (i.e. the other one as well) **or** (merely) transformed **or** total energy in an isolated system is constant	B1	[2]
	(b)	(i)	chemical (potential) **at beginning**	B1	
			to electrical (and heat) **at end** others present: max 1	B1	[2]
		(ii)	light	B1	
			heat/thermal/internal others present: max 1	B1	[2]
	(c)		less heat; same light	B2	
			or less chemical/electrical; less heat	B2	
			or less chemical/electrical; same light	B2	[2]
4	(a)	(i)	e/m waves can travel/satellite in a **vacuum/space**	B1	[1]
		(ii)	microwave/radio wave (region)	B1	[1]
		(iii)	greater coverage/less ground-based infrastructure/less obstruction	B1	[1]
	(b)		(x =) vt **or** 3.0 × 10^8 × 0.24	C1	
			7.2 × 10^7 m **or** 72 000 km	A1	[2]

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5	**(a)**	**(i)**	(*P* =) *VI* **or** 12 × 35	C1	
			420 W **or** J/s	A1	[2]
		(ii)	(*Q* =) *Pt* **or** *VIt* **or** 12 × 35 × 2 **or** 420/ecf **(i)** × 2	C1	
			12 × 35 × 120 **or** 420/ecf **(i)** × 120	C1	
			5.0(4) × 10^4 J	A1	[3]
	(b)	**(i)**	(*m* =) Q/l_f **or** 5.04 × 10^4/330	C1	
			150/153/152.7272) g **or** 152 g from 5.0 × 10^4 J	A1	[2]
		(ii)	heat lost to **glass/air/wires/water/surroundings** (i.e. specified heat loss)	B1	
			ice below 0°C	B1	[2]
6	**(a)**	**(i)**	current in magnetic field **or** motor effect/LH rule **or** coil is magnet	B1	
			(produces) force **or** current **direction** changes **or** coil moves **or** repulsion **and** attraction	B1	
			force changes direction/backwards and forwards	B1	[3]
		(ii)	air (atoms/molecules/particles) (next to cone) vibrates	B1	
			compressions **and** rarefactions **or** high **and** low pressure **or** vibrations passed on **or** longitudinal	B1	[2]
	(b)		the note is louder/has greater intensity (**not** changed frequency)	B1	[1]
7	**(a)**	**(i)**	p.d. rises	B1	
			the capacitor charges/at a decreasing rate/to a maximum value	B1	[2]
		(ii)	it takes a certain time/200 s to reach certain charge/p.d. **or** certain charge/p.d. activates alarm	B1	[1]
	(b)		(*I* =) *Q*/*t* **or** 5.4 × 10^{-7}/200	C1	
			2.7(0) × 10^{-9} A	A1	[2]

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Section B

8	(a)	(i)	(*W* =) *mg* **or** 70 × 10 **or** 70 × 9.8(1) etc.	C1	
			700(.0) N	A1	[2]
		(ii)	(*P* =) *F*/*A* **or** 700/35	C1	
			700/(35 × 4) **or** 700/0.0035 **or** 700/(0.0035 × 4)	C1	
			50 000 Pa **or** 50.0 kPa **or** 5.0 N/cm^2	A1	[3]
	(b)	(i)	molecules/atoms/particles move **or** collide	B1	
			molecules/atoms/particles collide with cylinder/walls	M1	
			exert force on walls (as they collide)	A1	
			spread out effect (of forces) is pressure **or** (force)/m^2 **or** similar	B1	[4]
		(ii)	molecules/atoms/particles closer/denser/more in given volume	C1	
			more collisions per (unit) area/m^2 **or** per (unit) time/s (**not** faster)	A1	[2]
	(c)	(i)	speed (of molecules/atoms/particles) increases/k.e. increases	B1	[1]
		(ii)	car (body) higher (off the ground)	B1	
			collisions more violent **or** gas in cylinder expanded	B1	
			fewer collisions of molecules/atoms/particles needed **or** pressure rises **initially**	B1	[3]
9	(a)	(i)	horizontal ray from Q to pool edge **and** on to P from corner	B1	
			critical angle marked *C* **or** obvious	B1	[2]
		(ii)	for *i* = 90° **or** horizontal ray	B1	
			angle(in water) equals/cannot be less than critical/*C*	B1	[2]
		(iii)	(*n* =) sin *i*/sin *r* **or** 1/sin *C* **or** 1/*n* = sin *C* **or** sin 90°/sin 49° **or** 1/sin 49°	B1	
			1.3(2501)	B1	[2]
		(iv)	decreases	B1	[1]
	(b)	(i)	any **two** of: real less bright further from lens beyond 2*f*	B2	[2]
		(ii)	straight ray from R to **top** of image	B1	[1]
		(iii)	where ray crosses principal axis, vertical line (L **or** drawn lens)	B1	[1]
		(iv)	paraxial ray from R to lens refracted to top of image **or** paraxial ray from lens to top of image, traced back to R	M1	
			F marked	A1	[2]
		(v)	1.6 – 1.9 cm **or** attempt to use 1/*u* + 1/*v*	C1	
			19 – 23 cm (2 sig. fig. only)	A1	[2]

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10	**(a)**	**(i)**	15	B1	[1]
		(ii)	32	B1	[1]
	(b)	**(i)**	$^{32}_{15}P$ ($\rightarrow$)	B1	
			superscripts: 32 on S **and** 0 on beta (allow e)	B1	
			subscripts: 16 on S **and** -1 on beta (allow e) (just $^{32}_{16}S$ 1/2)	B1	[3]
		(ii)	electron	M1	
			high speed **or** from nucleus **or** causes ionisation	A1	[2]
		(iii)	record/measure background reading/count/radiation	B1	
			sample near **named** detector	B1	
			interpose paper/card/less than 5 cm air **and** no change in reading	B1	
			interpose 2 mm – 20 mm of aluminium **and** reading = background		
			n.b. points may be made on a diagram,		
			other methods marked analogously	B1	[4]
	(c)	**(i)**	time for some measurable quantity to halve	M1	
			number of atoms/no. of nuclei/activity/count rate	A1	[2]
		(ii)	350÷1400 **or** ¼ **or** 2 (half-lives)	C1	
			28.6 days	A1	[2]

MARKING SCHEME CODE:

B1 Independent Mark
C1 Compensation Mark:
awarded automatically if the answer is correct. i.e. the working need not be seen if the answer is correct; also given if the answer is wrong but the point is seen in the working.
M1 (Compulsory) Method Mark:
if not awarded subsequent A marks are lost (up to next B, M or C mark).
A1 Answer Mark.
c.a.o. correct answer only (including unit)
e.e.o.o. each error or omission
e.c.f. error carried forward:
it is usually awarded even where not specifically indicated.
i.e. subsequent working including a previous error is credited, if otherwise correct.

Incorrect units, errors in powers of 10 (except where the power of 10 comes from g = 10 N/kg) and unit multipliers are to be treated as arithmetical errors.

Correct numerical answers with incorrect units will normally gain preceding C marks even when the working is not shown.

Do not penalise a sig. fig. fraction or a unit error more than once in the same question.

Sig. Fig. Answers must given to 2 or more sig. fig. except where the answer is exactly 0.6, 2 etc.
Answers given to 2 or 3 sig. fig. must be correctly rounded – but a 5 can produce a rounding up or down.

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