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Cambridge Ordinary Level

MARK SCHEME for the October/November 2014 series

5054 PHYSICS

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

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Section A

1	**(a)**	**(i)**	(a =) $(v-u)$ / t **or** $\Delta v / t$ **or** (55–40) / 2 **or** equivalent values from graph	C1	
			7.5 m / s^2	A1	
		(ii)	(F =) ma **or** 180 × 7.5	C1	
			1300 / 1350 / 1400 N	A1	
	(b)	**(i)**	(acceleration) decreases (to zero)	B1	
		(ii)	air resistance / friction / drag mentioned	B1	
			air resistance / friction / drag increases (with speed) **or** resultant force decreases (with speed)	B1	
			(finally) (air) resistance = driving force **or** resultant is zero	B1	**[8]**
2	**(a)**	**(i)**	$F_1 \times d_1 = F_2 \times d_2$ **or** (0.39 × 0.40) / 0.30	C1	
			0.52 N	A1	
		(ii)	0.052 kg **or** 52 g	B1	
	(b)		(ρ =) m / V **or** 52 / 60 **or** 0.052 / 0.000 060 **or** 0.052 / 60	B1	
			870 / 867 / 866.7 kg / m^3 **or** 0.87 g / cm^3 **or** 8.7×10^{-4} kg / cm^3 etc.	B1	**[5]**
3	**(a)**		(atoms / molecules / particles) move (about) / collide / hit	B1	
			(atoms / molecules / particles) collide / hit the walls / surface (of the cylinder)	M1	
			force on walls (causes pressure)	A1	
	(b)		atoms / molecules / particles closer / more compact / more molecules per unit volume / less space to move	B1	
			more collisions with the wall / surface (of chamber) **not** if speed / KE changes	B1	**[5]**
4	**(a)**		any **two** from: transmission of energy without net movement of medium through vibration of particles	B2	
	(b)	**(i)**	number of (complete) waves / cycles / oscillations per unit time / second	B1	
		(ii)	distance between (neighbouring) waves	C1	
			distance between (neighbouring) wavefronts / points of same phase **or** crest to crest / tough to trough distance	A1	
	(c)		three reflected wavefronts roughly correct direction	M1	
			wavelengths equal to each other and incident wavelength by eye	A1	
			reflected wavefronts joined to incident wavefronts	B1	**[8]**

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5	**(a)**	longitudinal / pressure / sound (wave) **or** compressions **and** rarefactions	B1	
		(frequency) greater than 15 – 25 kHz / above limits of audibility	B1	
	(b)	(x =) vt / 2 **or** 340 × 0.030 / 2 **or** 340 × 0.015 **or** 10.2	C1	
		5.1 m	A1	**[4]**
6	**(a)**	**electrons** repelled by cloud (leaving ground positive) **not** positive charge / protons move	B1	
		like charges repel **or** electrons negative	B1	
	(b)	(region) where (electric) charge experiences a force	B1	
	(c)	(I =) Q / t **or** 180 / 0.0015	C1	
		1.2×10^5 A	A1	**[5]**
7	**(a)**	wire cuts field lines	B1	
		current / e.m.f. / voltage **induced**	B1	
	(b)	larger deflection **and** to the left / opposite direction	B1	
	(c)	no deflection / current	B1	**[4]**
8	**(a)**	neutrons and protons together and alone in the middle	B1	
		5 protons	B1	
		7 neutrons (if protons and neutrons unlabelled 1/2)	B1	
		5 electrons **and** electrons surrounding nucleus	B1	
	(b) **(i)**	6	B1	
	(ii)	12	B1	**[6]**
				[Total: 45]

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Section B

9 (a) any **two** from:
biomass / wood; geothermal power; solar power; tidal power; wave power; wind power — B2 **[2]**

(b) (i) 1. $2.1(4) \times 10^{17}$ J (**allow** $2.1(5) \times 10^{17}$ J if candidate uses 365.24 / 5) — B1
2. any **one** from: not enough water (to maintain maximum flow); rainfall varies (during the year); periods of low demand — B1

(ii) 1. (GPE =) mgh **or** $1.6 \times 10^{10} \times 10 \times 170$ — C1
$2.7(2) \times 10^{13}$ J — A1
2. $2.7(2) \times 10^{13} / 3600$ **or** $6.8 \times 10^{9} \times 3600$ **or** $6.8 \times 10^{9} / 7.5(55) \times 10^{9}$ **or** $2.4(48) \times 10^{13} / 2.7(2) \times 10^{13}$ — C1
0.90 **or** 90% — A1
3. any **two** from:
friction (of water) with pipe / turbine /; viscosity of water; friction at bearings; resistance / heat in the wires; KE of water leaving turbine — B2 **[8]**

(c) (i) less energy lost / wasted **or** more efficient — B1
(for a given power) a high voltage results in a small(er) current — B1
less heat generated in wires **or** I^2R **or** less resistive losses (**not** if <u>changed</u> resistance mentioned) — B1

(ii) transformer — B1

(iii) transformers only work with an a.c. supply — B1 **[5]**

[Total: 15]

10 (a) (i) **heated / hot water** expands **or** density of **heated / hot water** decreases — B1
(heated / hot water) rises — B1
convection (current) / circulation set up **or** (heated / hot water) rises **and** cold water sinks — B1

(ii) convection transfers heat upwards **or** less dense / heated / hot water (already) at top — B1 **[4]**

(b) (i) (Q =) VIt **or** $230 \times 9.6 \times 3.5$ **or** $230 \times 9.6 \times 3.5 \times 60$ **or** 7728 — C1
$4.6(368) \times 10^{5}$ J — A1

(ii) (ΔT =) Q / mc **or** $4.6(3680) \times 10^{5} / 1.6 \times 4200$ — C1
69 (°C) — C1
91 °C — A1

(iii) evaporation **or** thermal energy / heat in **plastic casing / element / surroundings** (i.e. air or environment) — B1 **[6]**

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(c) (i) poor conductor (heat or electricity) **or** less heat lost / cooler to touch **or** less risk of shock — B1

(ii) poor emitter **and** less heat lost / of radiation / IR (**not** poor absorber) — B1 **[2]**

(d) (i) **temperature** where liquid and vapour/gas coexist **or** where liquid (**not** substance) boils
(at atmospheric pressure)(**allow** becomes vapour/gas) — B1

(ii) (work done) against / overcoming forces between molecules **or** molecules gain P.E. (**ignore** K.E. increases) — B1
changes to P.E. / molecules separate — B1 **[3]**

[Total: 15]

11 (a) (i) energy to drive charge around a circuit **or** terminal p.d. on open circuit — B1
energy to drive **unit** charge around a circuit **or** energy / charge — B1

(ii) lasts longer **or** lower internal resistance **or** can replace a cell without switching off **or** continues to work if one cell is flat **ignore** more current (**not** greater e.m.f. / voltage) — B1 **[3]**

(b) (i) 4.0 Ω — B1

(ii) $(1/R_{tot} =) 1/R_1 + 1/R_2$ **or** $1/3 + 1/X$ **or** product / sum **or** $(3 \times X)/(3 + X)$ **or** $\frac{1}{X} = \frac{1}{2} - \frac{1}{3}$ — C1
6.0 Ω — A1 **[3]**

(c) (i) $(I =) V/R$ **or** 2.0 / 4.0 — C1
0.50 A — A1

(ii) (from) 0 **and** (to) 0.50 to 5.0 A — B1 **[3]**

(d) $I_2 = I_3 + I_X$ — B1 **[1]**

(e) (i) 1.0 V — B1

(ii) 1.0 V — B1 **[2]**

(f) (i) temperature decreases — B1
resistance decreases — B1

(ii) greater than 0.75 A (e.c.f. resistance increases in **(f)(i)**) — B1 **[3]**

[Total: 15]

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