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**PHYSICS****5054/22**

Paper 2 Theory

**May/June 2016**

MARK SCHEME

Maximum Mark: 75

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**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.

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Page 2	Mark Scheme	Syllabus	Paper
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- 1 (a) mark at a time between 4.0 and 7.5 seconds B1
- (b) (a =)  $(v - u)/t$  numerical or algebraic C1  
**or** (a =) gradient of graph stated  
 $2.5 \text{ m/s}^2$  A1
- (c) forward force and backward force clear B1  
equal forces (in horizontal direction) B1  
**or** no resultant force  
**or** forces cancel/balance/in equilibrium
- 2 (a) (PE =)  $mgh$  **or**  $Fd$  **or**  $5 \times 3.5$  C1  
 $17.5 \text{ J}$  **or**  $17 \text{ J}$  **or**  $18 \text{ J}$  A1
- (b) (i) (efficiency = useful) energy output/energy input B1  
in any form but all three quantities must be mentioned  
if efficiency is not the subject of the equation
- (ii)  $17.5/0.65$  **or**  $17.5/65$  C1  
**or**  $0.65/65 = (\text{a})/\text{energy input}$   
 $26.9 \text{ J}$  **or**  $27 \text{ J}$  A1
- (c) due to friction (in bearings of motor) B1  
**or** due to (electrical) resistance (in motor)  
**or** air resistance acts  
**or** thermal energy/heat produced/lost (in resistance of motor/due to friction)
- 3 (a) (i) C M1
- (ii) **data** quoted to prove stretches more at end A1  
**or** extensions/changes in length increase/are not the same (at higher loads)
- (iii) 4.5 cm B1
- (b) (tie rock to spring A) B1
- find weight/force/newtons using length or extension **and** graph **or** match readings (in table)
  - find known weight/mass/force/N that gives same extension of spring
  - use of proportionality with length or extension
  - extension (in cm)/1.6
- (mass =) weight/g B1  
**or** weight/gravitational field (strength)

Page 3	Mark Scheme	Syllabus	Paper
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4	(a)	steam or (water) vapour or water in gaseous form	B1
	(b)	(E =) mL numerical or algebraic or 52 000–6000 or 46 000 (J) seen	C1
		(52 000–6000)/20 or 46 000/20 2300 J/g or $2.3 \times 10^6$ J/kg	C1 A1
	(c)	fast moving/energetic molecules escape/evaporate/break bonds/become gas leaving slow(er) molecules/less energetic molecules or reducing <b>average</b> (kinetic) energy (of molecules or liquid)	B1 B1
5	(a)	(i) long-sight or far-sight or hypermetropia	B1
		(ii) rays do not come together (on back of eye) or rays do not converge (on retina) or it/the image is not formed on retina/back of eye or it/the image is formed behind retina/back of eye	B1
	(b)	(i) lens between rays and eyeball <b>and</b> a converging lens shown	B1
		(ii) converging or convex	B1
6	(a)	(i) red	B1
		(ii) blue	B1
	(b)	ANY 2 from (the use must agree with the type)	B4
		Microwaves	B1
		<b>use</b> – satellite television, telephone, mobile/cell phones; cooking, heating in a microwave oven, television remote, radar, communication	B1
		X(-rays)	B1
		<b>use</b> – hospital use in medical imaging or security imaging, killing cancerous cells, and engineering applications such as detecting cracks in metal, crystallography	B1
		gamma (rays)	B1
		<b>use</b> – medical treatment in killing cancerous cells, and engineering applications such as detecting cracks in metal, sterilisation, tracer applications, radiotherapy	B1

Page 4	Mark Scheme	Syllabus	Paper
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- 7 (a) any insulator, e.g. perspex, plastic, nylon, rubber B1
- (b) top of P shows a net negative charge with some negative charges under rod B1  
bottom of P has equal number of positive charges B1
- (c) (i) clear net negative charge on P B1  
**and** (net) negative charges above or at middle line
- (ii) 1 negative (charges)/electrons flow to earth B1  
**or** (P) becomes neutral
- 2 charges spread over P B1
- 8 (a) current/a.c (in primary coil) creates magnetic field B1  
**or** current/a.c magnetises iron B1  
changing magnetic field (in secondary)
- (b) it/secondary has less turns (than primary) B1  
**or** primary has more turns (than secondary)  
**or** (some) flux escapes
- (c) (steel is) a permanent magnet B1  
**or** weaker fields produced  
**or** (steel) difficult to magnetise/demagnetise  
**or** (steel) is a hard magnetic material
- (d) passes current/charge in one direction B1  
**or** has high resistance/is an insulator when current in  
one direction/reverse biased
- 9 (a) (amount of) energy/work (dissipated by source) M1  
by unit charge (around a circuit) A1
- (b) (i) 1 they are the same B1  
**or**  $I_B = I_1 = I_2$
- 2  $E = V_1 + V_2$  B1
- (ii) ( $I =$ )  $V/R$  in any form algebraic or numerical C1  
0.25A A1
- (iii) 4.5V B1
- (iv) ( $P =$ )  $VI$  **or** ( $P =$ )  $I^2R$  **or** ( $P =$ )  $V^2/R$  C1  
in any form algebraic or numerical  
1.1(25)W A1

Page 5	Mark Scheme	Syllabus	Paper
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- (c) current is (directly) proportional to voltage B1  
**or** voltage/current is a constant  
law holds for constant physical conditions/ B1  
constant temperature/constant pressure/for metals
- (d) (i) (directly) proportional B1  
**or**  $(R) \propto 1$
- (ii) inversely proportional B1  
**or**  $(R) \propto 1/A$
- (e) 1<sup>st</sup> band orange B1  
2<sup>nd</sup> and 3<sup>rd</sup> bands both black B1
- 10 (a) (i) B – anode B1  
D – filament **or** heater B1  
E and F–Y plates or X plates in either order B1
- (ii) 1 attract electrons **or** gives electrons speed/K.E. B1
- 2 heats up cathode B1  
**or** gives electrons energy to escape (metal/cathode)  
**or** causes/allows thermionic emission
- (iii) kinetic energy to light B1  
**or** electrical energy to light
- (iv) voltage/charge is applied to the X-plates/vertical plates B1  
**or** turn on time base  
(steadily) increasing voltage/charge applied to plate(s) B1  
**or** saw tooth voltage applied  
**or** electrons attracted/repelled by plate(s) or by the electric field between them
- (b) (i) 1 1(.0)V B1
- 2 one wave 1.3–1.4 squares **or** 3 waves in 4 squares C1  
2.6–2.8 ms A1
- 3  $(f =) 1/T$  numerical or algebraic C1  
345–400 Hz A1
- (ii) smaller amplitude shown B1  
larger period shown B1

Page 6	Mark Scheme	Syllabus	Paper
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- 11 (a) (nucleus/nuclide/atom) with same number of protons B1
- (b) (i) 2 B1
- (ii) neutron B1
- (iii) 2 B1
- (iv) 4 B1
- (c) nuclei repel B1  
or like/positive charges repel  
(needs) high kinetic energy/speed (to overcome repulsion) B1
- (d) ANY 3 lines from B3  
(dust/gas) collapses/comes together/clusters/condenses  
gravitational attraction or gravity mentioned B1  
temperature rises or KE (dust/gas) increases B1  
(nuclear) fusion occurs B1  
equilibrium established as radiation pressure/outward  
force balances inward force B1
- (e) (i) time for a quantity to halve C1  
time for (radio)activity/count rate/number of atoms/number of nuclei to halve A1
- (ii) any relevant halving seen, e.g. 16 000/2 C1  
1000 A1