4. Electricity and magnetism

4.2 Electrical quantities

Paper 3 and 4

Answer Key

Paper 3

Q1.

Question	Answer	Marks
(a)	either: close switch (see if) lamp lights OR reading on ammeter OR lamp lights OR reading on ammeter (so material is (a)) conductor OR lamp lights OR reading on ammeter (so must have electric) current in tin	B2
(b)	mention of <u>free</u> OR <u>de-localised</u> electrons (in the metal)	B1
	able to move from one atom / ion / particle to another	B1
	when p.d. OR voltage (applied across the metal / material)	B1

Q2.

Question	Answer	Marks
(a)	(energy =) 2400 (J)	A3
	(energy =) 2.2 × 90 × 12	(C2)
	(energy =) current × time × voltage OR(E) = $V \times I \times t$ OR (energy =) power × time OR $P \times t$	(C1)
(b)	live OR line earth OR ground neutral	B2

Q3.

Question	Answer	Marks
(a)	friction OR rubbing (with cloth) owtte	B1
	electrons / negative charges move / transfer	M1
	from the acetate OR to the cloth	A1
(b)	(strips) repel / move away (from each other) owtte	M1
	same charge (on both strips) / <u>both / they</u> have positive charge	A1

Q4.

Question	Answer	Marks
(a)	(current/reading/it) increases	B1
	(because circuit) resistance decreases	B1
(b)	0.75 (A)	A3
	6(.0) ÷ 8(.0)	(C2)
	V= IR or (I =) V/R	(C1)
(c)	28 (Ω)	A2
	(total resistance =) R_1 + R_2 OR 20 + 8(.0)	(C1)
(d)	tick in 2nd box (magnetic)	B1
	tick in 3rd box (heating)	B1

Q5

(b)(i)	electrons move	M1
	from the rod OR to the cloth	A1
(b)(ii)	**TWO** electrical conductors named	B1

Q6.

Question	Answer	Marks
(a)(i)	voltmeter	B1
(a)(ii)	volts	B1
(b)(i)	$(R=)$ $V \div I$ or $V = I \times R$ or in any form	C1
	$6.4 \div 0.2$	C1
	$32\ (\Omega)$	A1
(b)(ii)	increase the length (of the wire using the same thickness)	B1
	smaller diameter (of wire using the same length)	B1

Q7.

Question	Answer	Marks
(a)(i)	correct symbol for voltmeter correctly connected	B1
(a)(ii)	electrons	B1
(a)(iii)	(current in CD) decreases	B1
	(because thinner wire / CD has) increased / bigger resistance	B1
(a)(iv)	volt(s)	B1
(b)(i)	$16.1\ (\Omega)$	B1
(b)(ii)	$0.40\ (A)$	B1

Q8.

Question	Answer	Marks
(a)(i)	electrons in 1st space	B1
	cloth in 2nd space	B1
(a)(ii)	negative	B1
(a)(iii)	like charges repel (each other)	B1
(b)(i)	ring around copper	B1
(b)(ii)	(earth wire must be good electrical) conductor	B1

Q9.

Question	Answer	Marks
(a)	(rule) rubbed with a cloth owtte	B1
	electrons or negative charges move	B1
	on to the cloth OR from / off the ruler	B1
(b)(i)	positive	B1
(b)(ii)	same charges repel	B1

Q10.

Question	Answer	Marks
(a)	electrons	B1
	move / transfer from the rod OR move / transfer to the cloth	B1
(b)	**Any 3 from:** (idea of bringing) rod near balloon if balloon repels it is positively charged as like charges repel	B3

Q11.

Question	Answer	Marks
(a)	variable resistor or rheostat	B1
(b)	0.8 (A)	B1
(c)	V = IR **OR** (R =) V ÷ I	C1
	4.5 ÷ 0.8	C1
	5.6(25)	A1
(d)	(current) increases **OR** larger	B1
	(as new/thicker wire has) less resistance	B1

Q12.

Question	Answer		Marks
(a)	resistor identified		1
(b)	quantity current NOT amps ignore ammeter	unit A/amps/amperes	2
	quantity potential difference or p.d. or emf	unit V/volts ignore voltmeter	2
(c)	increasing (length) increases resistance owtte		1
	increasing (diameter) decreases resistance owtte		1

Q13.

Question	Answer	Marks
(a)(i)	second box (The balloon loses electrons) ticked	1
(a)(ii)	positive (charge)	1
	like charge(s) repel	1
(b)	circle around copper **AND** silver	1

Paper 4

Q14.

Question	Answer	Marks
(a)	(e.m.f. is the electrical) work done (by a source in) moving a unit charge around a (complete) circuit	A2
	(electrical) work done moving a charge	C1
(b)	230 V	B1
(c)	9.2 A	A2
	$R = V / I$ **OR** ($I =$) V / R **OR** $230 / 25$	C1
(d)	(ammeter reading =) {1.6 + candidate's answer to **7(c)**} A	B1
	Sum of currents into a junction = sum of currents out of junction **OR** total current is sum of the current in the branches owtte	B1

Q15.

Question	Answer	Marks
(a)(i)	(region) where (an electric) charge experiences a force **OR** (region) where a force acts on a (an electric) charge	B1
(a)(ii)	at least four straight radial lines **AND** evenly spaced (by eye) surrounding sphere	B1
	four lines touching sphere **AND** no lines inside sphere	B1
	at least **one** arrowhead towards sphere **AND** no incorrect arrowheads	B1

Question	Answer	Marks
(b)(i)	electrons move (through the wire) from the sphere **OR** electrons move (through the wire) to(wards) the Earth	A2
	electrons move (in the wire)	C1
(b)(ii)	2.5 A	A3
	$I = Q / t$ **OR** ($I =$) Q / t **OR** $3.5 \times 10^{-10} / 1.4 \times 10^{-10}$	C1
	2.5×10^{N}	C1

Q16.

Question	Answer	Marks
(a)	electrons move from cloth to rod	A2
	(plastic) rod gains electrons	C1
(b)(i)	(region) where an (electric) <u>charge</u> experiences a <u>force</u>	B1
(b)(ii)	At least three radial field lines distributed evenly around outside of S **AND** touching S **AND** not inside S	B1
	arrow on (at least one) field line pointing towards S	B1
(c)	arrow through Z **and** away from (centre of) sphere	B1

Q17.

Question	Answer	Marks
(a)(i)	900 C	A2
	$I = Q / t$ **OR** $(Q =) It$ **OR** 1.5×600	C1
(a)(ii)	$2.0\,\Omega$	A3
	$R = V / I$ **OR** $(R_{tot} =) V / I$ **OR** $9.(0) / 1.5$ or $6.(0)$	C1
	$(R_{cyl} =)$ total resistance – P **OR** $(R_{cyl} =) 6.0 - 4.0$	C1
(b)	1200 s	A4
	R is directly proportional to l **OR** (new cylinder) twice as long means twice R	C1
	R is inversely proportional to A **OR** (new cylinder) half cross-sectional area means twice R	C1
	(resistance of cylinder =) $4 \times$ **(a)(ii)** (Ω)	C1

Q18.

Question	Answer	Marks
(a)	(p.d. across LED = 4.5 – 1.2 =) 3.3 V	A2
	$(V =) IR$	C1
(b)	LED (is a diode, which) only allows current in one direction / has a very high resistance (when direction of current is reversed.) OR (it) is reverse-biased	B1
(c)	$E = IVt$ **OR** $(t =) E / VI$ **OR** $Q = E / V$ **AND** $Q = I \times t$	B1
	$(t =) 1050 \div [0.02 \times 4.5 \times 3600]$ **OR** $(t =) 3.2\,h$	B1
(d)	(charge =) 72 C	A2
	$I = Q / t$ **OR** $(Q =) It$ **OR** $(Q =) 0.02(0) \times 3600$	C1

Q19.

Question	Answer	Marks
(a)(i)	region in which a (magnetic) pole experiences a force	B1
(a)(ii)	in the direction of the force on the N pole	B1

Question	Answer	Marks
(b)	4 radial lines outside sphere, touching the sphere and equally spaced all around sphere	B1
	direction of arrows towards the sphere	B1

Q20.

Question	Answer	Marks
(a)	(R_Y) decreases	B1
	change in V consistent with stated effect on R_Y	B1
	change in R_Y / R_{total} consistent with their stated effect on R_Y **OR** change in proportion of the total p.d. across Y (or proportion of total p.d. across fixed resistor) consistent with their stated effect on R_Y	B1
(b)(i)	(n =) 1.9×10^{19}	A3
	$I = Q / t$	C1
	(n =) $3(.0) / 1.6 \times 10^{-19}$ **OR** (n =) $Q / 1.6 \times 10^{-19}$	C1
(b)(ii)	($P =$) 36 W	A2
	$P = IV$ **OR** ($P =$) IV **OR** $3(.0) \times 12$	C1

Q21.

Question	Answer	Marks
(a)	(t = 1/60 =) 0.017 s OR 1.7×10^{-2} s	B1
(b)(i)	diode	B1
(b)(ii)	(I =) 1.4 A	A3
	(I =) Q/t in any form	C1
	(I =) $1.5 \times 10^{17} \times 1.6 \times 10^{-19}$ / 0.017 OR 0.024 / 0.017	C1

(c)	one arrow clockwise AND one arrow anticlockwise	B1
	arrow anticlockwise (around circuit) <u>labelled</u> I	B1
(d)	(P = 0.35 × 12 =) 4.2 W	A2
	(P =) IV in any form	C1

Q22.

Question	Answer			Marks
(a)	electrons mentioned			B1
	negative charges / electrons move from cloth **or** move to rod			B1
(b)(i)	electrons / negative charge(s) repelled to earth **or** ball charged by induction			B1
	ball positively charged			B1
	opposite charges attract			B1
(b)(ii)	negatively charged (by rod)	**or**	ball discharges / becomes neutral	B1
	repelled by rod	**or**	pulled down by gravity / its weight	B1

Q23.

Question	Answer	Marks
(a)(i)	clearly more –ve (than +ve) on left AND more +ve (than –ve) on right	B1
	same number of +ve and - ve	B1
(a)(ii)	-ve charges (flow) from earth OR -ve charges flow to object	B1
	electrons flow to balance (excess) +ve charge on the object	B1
(b)	$I = Q/t$ in any form OR $(Q =) It$	C1
	$(Q =) 0.65 \times 10^{-3} \times 2.2 \times 60$	C1
	$(Q =) 0.086\,C$	A1

Q24.

Question	Answer	Marks
(a)	anti-clockwise arrow labelled (conventional) current somewhere in circuit	B1
	electron (flow) arrow opposite to (conventional) current	B1
(b)	$Q = It$ in any form or $(Q =) It$ OR 13×1	C1
	$(Q = It =) 13 \times 1 (= 13\,C)$	C1
	$(n = 13 / 1.6 \times 10^{-19} =) 8.1 \times 10^{19}$	A1

Q25.

Question	Answer	Marks
(a)(i)	$P = IV$ in any form OR $(I =) P/V$	C1
	$(I = 60 / 110 =) 0.55\,A$	A1
(a)(ii)	$(I =) 1.6\,A$	B1
(a)(iii)	110 V	B1
(b)(i)	$I = V/R$ in any form OR $(R =) V/I$ OR $(R =) V^2/P$ OR $(R=) P/I^2$	C1
	$(R = 110 / 0.55 =) 200\,\Omega$	A1
(b)(ii)	2nd box (twice the length)	B1
	4th box (half the area of cross-section)	B1