01. 0625_m23_ms_42 Q: 6

Question	Answer	Marks
(a)	(region where) particles are close(r) together (than normal) **OR** (region where) there is a great(er) pressure (than normal)	**B1**
	(region where) particles are further / far apart (than normal) **OR** (region where) there is a low(er) pressure (than normal)	**B1**
(b)	light does not need a medium to travel through **OR** sound needs a medium to travel through (and there is no medium between Sun and Earth)	**B1**
(c)	3100 m **OR** 3.1 km	**A2**
	$v = s / t$ **OR** (s =) vt **OR** 340×9	(C1)
(d)	1400 C	**A3**
	$I = Q / t$ **OR** (Q =)$I\ t$ **OR** $3.0 \times 10^{4} \times 48 \times 10^{-3}$	(C1)
	(t =) 48×10^{-3} OR (t =) 4.8×10^{-2} **OR** (t =) 0.048 SEEN	(C1)

02. 0625_s23_ms_43 Q: 6

Question	Answer	Marks
(a)	(I =) 9.8 A	**A3**
	$P = I^2R$ **OR** $I^2 = \frac{P}{R}$ **OR** $I^2 = \frac{2500}{26}$	**C1**
	$I^2 = 2500 / 26$ **OR** (I =) $\sqrt{(P / R)}$ **OR** $\sqrt{\frac{2500}{26}}$	**C1**
(b)	(R =) 53 Ω	**A3**
	$R \propto l$ **OR** 1.8 / 1.2 **OR** 1.5 seen as multiplier	**C1**
	$R \propto 1 / A$ **OR** 7.9 ($\times 10^{-7}$) / 5.8 ($\times 10^{-7}$) **OR** 1.36(2) seen as multiplier	**C1**
(c)	(cost =) $36	**A2**
	$E = Pt$ **AND** (cost =) $E \times 0.3(0)$ **OR** (cost =) $25 \times 10^{N} \times 2 \times 24 \times 0.3(0)$ **OR** 3.6×10^{N} dollars	**C1**

03. 0625_w23_ms_41 Q: 7

Question	Answer	Marks
(a)	electrons move from cloth to rod	**A2**
	(plastic) rod gains electrons	C1
(b)(i)	(region) where an (electric) charge experiences a force	**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**

04. 0625_w23_ms_43 Q: 7

Question	Answer	Marks
(a)(i)	radial arrow	**B1**
	inward radial arrow	**B1**
(a)(ii)	positive point charge	**A2**
	positive (charge)	C1
(b)	electrons / negative charges (move)	**B1**
	out of (plastic) **OR** removed from / lost from (plastic)	**B1**
(c)	any mention of free / mobile / delocalised electrons	**M1**
	conductors have free / mobile / delocalised electrons **OR** insulators do not have free / mobile / delocalised electrons	**A1**

05. 0625_s22_ms_43 Q: 1

Question	Answer	Marks
(a)(i)	9.7 s	**A2**
	(a =) $\Delta v \div t$ in any form OR 28 (–0)/2.9	C1
(a)(ii)	4600 N	**A2**
	(F =) ma in any form OR 1600 × 2.9	C1
(a)(iii)	630 000 J / 6.3 × 10^5 J	**A2**
	(KE =) ½ mv^2 in any form OR $\frac{1600 \times 28^2}{2}$	C1
(b)	960 000 C / 9.6 × 10^5 C	**A3**
	(Q =) It in any form OR 32 × 8.3 × 60 × 60	C1
	(t s =) 8.3 × 60 × 60	C1
(c)	any **one** explicit example of a variation from *ideal conditions* such as: (repeated) acceleration / deceleration / use of brakes / varying speed motion uphill / uneven road surface cold weather / headwind	**B1**

06. 0625_w22_ms_42 Q: 8

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 × 10^{-19} **OR** (n =) Q / 1.6 × 10^{-19}	C1
(b)(ii)	(P =) 36 W	**A2**
	$P = IV$ **OR** (P =) IV **OR** 3(.0) × 12	C1

07. 0625_w22_ms_43 Q: 8

Question	Answer	Marks
(a)	positively charged / plastic rod is brought close to metal plate	**B1**
	negative charges / electrons (from metal plate) move to top of metal plate / close(r) to rod	**B1**
	earth lead connected to (metal) plate **AND** negative charges / electrons move on to plate	**B1**
	(at the end of the process) earth lead removed (before charged rod removed) **OR** (at the end of the process) metal plate has (net) negative charge	**B1**
(b)	correct direction – pointing away from negative terminal / clockwise arrow **AND** current flow in opposite direction to flow of electrons	**B1**

08. 0625_s21_ms_42 Q: 9

	Answer	Mark
(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 × 1 (= 13 C)	C1
	(n = 13 / 1.6 × 10^{-19} =) 8.1 × 10^{19}	A1

09. 0625_w21_ms_41 Q: 7

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

10. 0625_w21_ms_42 Q: 8

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 × 10^{-3} × 2.2 × 60	C1
	(*Q* =) 0.086 C	A1

11. 0625_s20_ms_43 Q: 5

(a)(i)	E = Pt in any form	C1
	(E =) 6000 J	A1
(a)(ii)	E = mcΔT in any form	C1
	$c = \frac{6000}{550(33-20)}$	C1
	(c =) 0.84 J / (g °C) OR 840 J / (kg °C)	A1
(a)(iii)	EITHER some of energy supplied by the heater heats the heater / goes to lagging / goes to surroundings	M1
	specific heat capacity is lower than value in (ii)	A1
	OR some energy may be absorbed from surroundings if they are at a higher temperature	M1
	specific heat capacity is higher than value in (ii)	A1
(b)	(specific) heat capacity of water is much higher than (specific) heat capacity of sand	B1
	same rate of energy supplied to sand and sea	B1
(c)	cold junction labelled or shown in ice or something similar OR diagram with two junctions with voltmeter labelled	B1
	two different metals labelled	B1
	galvanometer or voltmeter joining ends of wires	B1

12. 0625_s20_ms_43 Q: 8

(a)(i)	region in which an electric charge experiences a force	B1
(a)(ii)	direction of force on a positive charge	B1

(b)	any **four** from: • ball moves towards positive plate • ball touches positive plate • made of conducting material so becomes positively charged • repelled from positive plate • touches negative plate and loses charge • negatively charged ball attracted back to positive plate and process repeats	B4
(c)	I = Q / t in any form	C1
	t = Q / I	C1
	(t = 15 / 0.29 =) 52 s	A1

13. 0625_w19_ms_41 Q: 5

(a)	four or more radial arrows / lines outside surface at least one arrow pointing towards (centre of) sphere **and** none wrong	**B1** **B1**
(b)(i)	positive charges on left **and** negative charges on right of S equal numbers	**M1** **A1**
(b)(ii)	it moves towards / attracted towards the negatively charged sphere / to the left	**B1**
(b)(iii)	electrons / negative charges move (along the wire) towards Earth / towards ground / down the wire S becomes positively charged	**B1** **B1**
(c)	electrons mentioned free (to move) / delocalised / mobile in metals / S **or** fixed in position in plastic / stand	**M1** **A1**

14. 0625_w19_ms_41 Q: 7

(a)	7 / 7.6 / 8 / 10 marked towards top of *y*-axis **and** 1(.0) towards right of *x*-axis a straight line of positive gradient from 0, 0 to point 1.0, 7.6	**B1** **B1**
(b)(i)	energy (transferred) per unit charge energy (transferred) from chemical **or** energy (transferred) to electrical **or** energy (transferred) around / in a (complete) circuit	**B1** **B1**
(b)(ii)	1. $I = V/R$ **or** in any form words, symbols or numbers **or** (I =) V/R **or** 12 / 7.6 1.6 A	**C1** **A1**
	2. 4.2 V **or** 4.3 V	**B1**
	3. $Q = It$ **or** in any form words, symbols or numbers **or** (Q =) It **or** 1.6 × 5.5 × 60 **or** 1.6 × 5.5 **or** 8.8 (C) 520 C **or** 530 C	**C1** **A1**

15. 0625_w19_ms_42 Q: 9

(a)	where / region a(n electric) charge experiences a force	**B1**
(b)	All criteria must be met • 5 lines with both ends within 2 mm of plates by eye • middle 3 lines straight and within 10° of horizontal by eye • top / bottom lines, straight or with outward smooth curves, ends vertically <= 16 mm below / above ends of plates, if curved horizontally symmetrical by eye • spacing between lines: 7 mm ⩽ spacing ⩽ 23 mm	**B1**
	at least 1 arrow left to right NOT any arrow R to L	**B1**
(c)(i)	I = Q / t in any form OR (Q =) It	**C1**
	(Q =) 0.21 × 10 × 60 × 60	**C1**
	(Q =) 7600 C	**A1**
(c)(ii)	E = VQ in any form OR (E =) VQ OR (E =) 1.2 × 7560	**C1**
	(E =) 9100 J	**A1**
(c)(iii)	chemical (potential energy)	**B1**

16. 0625_w19_ms_43 Q: 8

(a)	radial lines from sphere	B1
	arrows pointing towards sphere	B1
(b)	$Q = It$, in any form OR 0.21×75	C1
	16 C	A1

17. 0625_m18_ms_42 Q: 8

(a)	P = IV OR (I =) 50 / 12	C1
	4.2 A	A1
(b)(i)	(E =) QV	C1
	(E =) $270 \times 10^3 \times 12$	C1
	3.2×10^6 J / 3200 kJ	A1
(b)(ii)	Volume of fuel used = $3.2 \times 10^6 / 3.6 \times 10^4$	C1
	89 cm^3 OR 90 cm^3 if 3.24×10^6 used	A1

18. 0625_s18_ms_42 Q: 10

(a)(i)	electrons/–ve charges (in metal) move o.w.t.t.e. to top half/move up	1
(a)(ii)	more –ve charges in top half than bottom **OR** more +ve charges in bottom half than top NOT if contradiction e.g. more +ve in top and more –ve in top	1
(a)(iii)	helps (keep plastic sheet in place)/yes	1
	unlike charges attract **OR** attractive force between metal plate and plastic sheet	1
(b)	**1** both threads angled away from other ball	1
	2 like/same/positive charges repel	1

19. 0625_w18_ms_42 Q: 8

(a)(i)	(moves) towards negative rod / to right	B1
	opposite / unlike charges attract	B1
(a)(ii)	(wood / it) or cubes(/ float) rotates / turns / spins	B1
	2 forces cause moment / couple / torque / turning effect	B1
(b)	conductors: free / delocalised electrons OR electrons move	B1
	insulators: no free / delocalised electrons OR electrons / charges cannot move OR electrons fixed in place	B1
(c)	at least 4 approx. evenly spaced straight lines with correct arrows radially outwards	B1

20. 0625_w18_ms_43 Q: 7

(a)(i)	no delocalised / free / mobile electrons in an insulator **or** electrons fixed (in place) / tightly bound in an insulator	**B1**
(a)(ii)	no charge flows / current in doctor **or** doctor does not receive an electric shock	**B1**
	which might prove fatal / kill / injure / harm doctor **or** so charge flows / current in patient	**B1**
(b)	electrons move (from one contact to the other)	**B1**
	negative contact gains electrons / negative charges **and** positive contact loses electrons / negative charges	**B1**
(c)	(I =) Q/t **or** $9.1 \times 10^{-3}/6.5 \times 10^{-4}$	**C1**
	14 A	**A1**

21. 0625_m17_ms_42 Q: 10

(a)	Electrons / negative particles	**B1**
	Move (in circuit) from negative (terminal) to positive (terminal of battery)	**B1**
(b)(i)	(I =) Q / t OR 0.60 / 0.000050	**C1**
	12000 A	**A1**
(b)(ii)	(E=) I V t OR $12000 \times 2.5 \times 10^8 \times 0.000050$	**C1**
	1.5×10^8 J	**A1**
	OR	
	(E=) Q V OR $0.60 \times 2.5 \times 10^8$	(C1)
	1.5×10^8 J	(A1)
(b)(iii)	Converted to any two of: thermal energy / heat, light and sound	**B1**
	Total:	**7**

22. 0625_s17_ms_41 Q: 10

(a)	Electrons/negative charges removed from/flow from/lost (from the object)	**B1**
(b)(i)	At least 3 plus signs in top half of sphere	**B1**
	Same number of minus signs in bottom half of sphere	**B1**
	OR Excess of plus signs over minus signs in top half of sphere	**(B1)**
	Equal excess of minus signs over plus signs in bottom half of sphere	**(B1)**
(b)(ii)	(with rod present) connect earth (to sphere) OR touch (sphere) with conductor/finger	**M1**
	Remove earth wire **and** then remove charged rod OR remove conductor/finger **and** then rod.	**A1**
	Total:	**5**

23. 0625_w17_ms_41 Q: 8

	Hydroelectric	
(a)	Hydroelectric named OR water from behind dam	**B1**
	K.E. of (falling) water used / P.E. of stored water	**B1**
	Turbine / waterwheel / paddle wheel operated	**B1**
	(Turbine) turns / drives a generator (that produces electricity)	**B1**
(b)	Rain (fills lakes in high places)	**B1**
	Cause of rain is the Sun, so renewable	**B1**
(c)	Sun evaporates water from sea etc. to fall (later) as rain	**B1**
	Sun is the source of energy.	**B1**
	Tidal flow	
(a)	Tides / tidal flow named	**B1**
	K.E. of water used	**B1**
	Turbine / waterwheel / paddle wheel operated	**B1**
	(Turbine) turns / drives a generator (that produces electricity)	**B1**
(b)	Moon (and Sun) causes tides	**B1**
	Moon (and Sun) permanently in place, so renewable	**B1**
(c)	Attraction due to Moon's (and Sun's) gravity causes tides	**B1**
	Sun is a source of (part of) the energy OR Sun is not the primary source of energy	**B1**

	Waves	
(a)	Waves on surface of sea	**B1**
	K.E. of water used to oscillate a floating mechanism	**B1**
	Turbine / waterwheel / paddle wheel operated	**B1**
	(Turbine) turns / drives a generator (that produces electricity)	**B1**
(b)	Wind causes waves	**B1**
	Sun causes wind, so renewable	**B1**
(c)	Winds are air currents caused by thermal energy / heat from the Sun	**B1**
	Sun is the source of energy	**B1**

24. 0625_w17_ms_43 Q: 8

(a)	touch the sphere with the earth wire	**B1**
	negatively charged **and** electrons flow to sphere	**B1**
	remove earth wire **or** electrons / negative charges attracted (by rod)	**B1**
(b)	four **or** more straight, radial lines **and** uniformly spaced	**B1**
	at least one arrow outwards **and** no wrong arrows	**B1**
(c)	(I =) Q/t **or** 7.0 / (5.0 × 60) **or** 7.0 / 5.0 **or** 1.4 (A)	**C1**
	0.023(3333) A	**A1**