

	Answers	
1a	uniform / constant acceleration for 6.0 s	B1
	after 6.0 s zero acceleration Reject: constant speed / velocity	B1
1b	$m = F / a$ OR $m = Ft / \Delta v$ in any form i.e. $m = 1880 (6.0) / (22.0 - 0)$	C1
	$m = 513 \text{ kg}$	A1
1c	s = area under graph numerical or algebraic i.e. $s = \frac{1}{2} (3.0 + 9.0) \times 22$	C1
	$s = 132 \text{ m}$	A1
1di	rising of hot air / fluid and sinking of cold air / fluid OR circulation of air / fluid due to / with temperature differences	B1
1dii	High temperature spot on Earth OR Sun heats surface OR (hot) less dense air rises upwards	B1
2a	lamina is in the Earth's gravitational field OR Earth exerts a gravitational force on lamina Accept: gravitational field strength	B1
2bi	$M = F \times \perp d$ OR $0.040(10) \times 0.08$ OR 0.4×8	C1
	0.032 Nm OR 3.2 N cm	A1
2bii	lamina moves clockwise (about the pivot)	B1
	it speeds up and then slows down OR it oscillates with decreasing amplitude	B1
	stops with G vertically / directly below H / pivot / nail	B1
3ai	mercury stops exerting a pressure / weight per unit area on gas when tube is horizontal	B1
3aii	All 3 points mentioned B2, 1 or 2 point(s) mentioned B1 - The gas particles are in continuous, random motion at high speeds. - They collide with the tube walls, exerting an (average) force on the wall. - The average force per unit area exerted by these gas particles give rise to pressure.	B2
3b	$P = \rho gh$ OR 40 800 seen i.e $P = 13600 \times 10 \times 0.30$	C1
	Total pressure = $40\,800 + 101\,000$ $= 142\,000 \text{ Pa}$	A1

4ai	chemical (potential store)	B1
4aii	Energy transferred by (electrical) current / electrically (from chemical store of battery to kinetic store of motor) OR electrons (made to) move	B1
	work is done mechanically by the motor on the (back) wheel OR Energy is transferred mechanically from motor to (back) wheel	B1
4b	KE = $\frac{1}{2}mv^2$ in any form i.e. KE = $\frac{1}{2}(800/10)(5.5)^2$	C1
	1210 J	A1
4ci	energy provided when power is 1 kW for 1 hour / 1000 W for 1 hour	B1
4cii	t = E / P OR 0.45 / 0.075 OR 450 / 75	C1
	6.0 h	A1
5ai	$\Delta E = mc \Delta \theta$ in any form i.e. E = 0.500 x 4200 x 3.5	C1
	7350 J	A1
5aii	energy input = 13 x 600 = 7800 J	C1
	efficiency = useful energy (output) / total energy (input) (× 100%) OR (7800 – 7350) / 7800 x 100	C1
	5.77%	A1
5b	any one from: • temperature change is an underestimate due to energy losses • energy is transferred from the water (to air / beaker / bench / surroundings) • energy other than light transferred in lamp (filament / glass / internal structure) AWW: energy loss	B1
6ai	object within focal length	B1
6aii	Virtual images are formed from divergent rays OR rays that extend back behind lens to meet at point on image OR rays that do not meet / converge on a screen OR rays that appear to come from image	B1
6bi	ray through optical centre from top of object	B1
	ray parallel to axis from top of object to lens AND correctly refracted through lens to appear to come from top of image	B1
	both rays virtually extended back to image + arrows on real rays	B1

6bii	4.0 cm Allow for ½ square (3.8 cm to 4.2 cm)	A1
7a	electrons move from rod to cloth	B1
7bi	region where an electric charge experiences a force OR region where a charge experiences an electric force	B1
7bii	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
7c	arrow through X and away from centre of sphere	B1
8a	horizontal path marked with γ and no other path indicated as γ	B1
8b	beta (β -radiation)	B1
	All 3 points mentioned B2, 1 or 2 point(s) mentioned B1 - Fleming's left-hand rule mentioned - first finger into page AND thumb downwards - second finger which is current opposite to motion (to electron or beta particle)	B2
8c	beta (β -radiation) completely absorbed. Accept: blocked / stopped	B1
	some gamma rays absorbed OR (some) gamma passes through	B1
9a	NIR (shortest wavelength = highest frequency = more energy)	B1
9b	FIR	B1
9c	Any 1 of the 8 properties listed below. - They are transverse waves. - They can travel through vacuum. - They transfer energy from one place to another. - They travel at the speed of 3.0×10^8 m/s in vacuum. - They obey the wave equation, $v = f \lambda$. - They obey the laws of reflection and refraction. - They carry no electric charge. - When they travel from one medium to another, frequency does not change; only speed and wavelength changes. Reject: Non-ionising	B1

9d	$v = f \lambda$ in any form For 3 μm , $f = 3.0 \times 10^8 / 3.0 \times 10^{-6} = 1.0 \times 10^{14} \text{ Hz}$ For 8 μm , $f = 3.0 \times 10^8 / 8.0 \times 10^{-6} = 3.75 \times 10^{13} \text{ Hz}$ Correct substitution and working Range: $3.75 \times 10^{13} \text{ Hz}$ to $1.0 \times 10^{14} \text{ Hz}$	C1 } }C1 } A1
9e	If clouds or haze present, photograph will show the clouds and haze which blocks the forest fire spots.	B1
	IR, on the other hand, can pass through the clouds or haze and an IR image will show the spots (that are red in colour) which are on fire	B1
9f	Any 2 from - Remote controllers to control a variety of electrical devices - Forehead / Ear thermometers to determine body temperature - Intruder alarms to detect trespasser other acceptable common answers - NIR: Night Vision Goggles for enhance imaging in the dark - SWIR: Long distance telecommunications for used in fibre optics communication - MWIR: Infra-red tracking or homing for guided missiles - LWIR: Thermographic cameras for Thermal imaging & - FIR: Infra-red telescope for astronomy & Infra-red lamp for heat therapy method of physiotherapy (or pain relief) Reject: remote controller only, digital thermometer, radiator, heater & oven	B2
10a	9.0 V	A1
10b	$I = V / R$ OR $9.0 / 900$ 0.010 A	C1 A1
10c	0 A 0.010 A	A1 A1
10d	resistance decreases no change (OR remains at 0)	B1 B1
10e	<u>sketch</u> : x-axis labelled V and the y-axis labelled I, AND steeper curve from origin curving such that I/V decreases <u>explanation</u> : as current / temperature increases so resistance increases	B1 B1
	if V on y-axis: gradient must increase OR if V on x-axis: gradient must decrease Accept gradient = I/V ratio	B1

11a	switch is in the live wire	B1
	so when switch is off, hifi is disconnected / isolated from mains supply / high voltage (so no risk of electrocution)	B1
11bi	step-down (transformer)	B1
11bii	• (soft) iron core • two coils of copper wire OR primary coil AND secondary coil • turns ratio of 20 : 1 OR 240 : 12 owtte OR use of transformer equation Reject: 240V & 12V	B3
11ci	current repeatedly changes direction	B1
11cii	magnetic effect of current causes coil to become an electromagnet	B1
	coil attracted to magnet and repelled by magnet repeatedly / alternately	B1
11ciii	any values(s) between 20 to 20 000 Hz	B1
12ai	magnetic field or magnetic flux (from magnets) mentioned	B1
	sides of coil cut (magnetic) field OR (magnetic) field / flux in coil changes	B1
	Reject: magnetic field from coil	
12aai	horizontal line, labelled B on the left and A on the right	B1
12aaii	vertical line, labelled A at top and B at bottom	B1
12aiv	horizontal line, labelled A on the left and B on the right	B1
12bi	one ring (instead of two) with gaps between the two halves	C1
	each side of split ring connected to a different end of the coil and to a brush	A1
12bii	magnetic field of coil (due to current) interacts with field of magnet	B1
12biii	turning effect is greater. Accept motor / coil rotate faster	B1
12biv	turning effect is less. Accept motor / coil rotate slower	B1

1. B	11. D	21. D	31. B
2. A	12. A	22. D	32. C
3. C	13. A	23. B	33. C
4. D	14. D	24. D	34. D
5. B	15. A	25. B	35. D
6. A	16. D	26. D	36. D
7. B	17. A	27. B	37. A
8. C	18. D	28. B	38. B
9. B	19. D	29. A	39. C
10. C	20. D	30. D	40. B