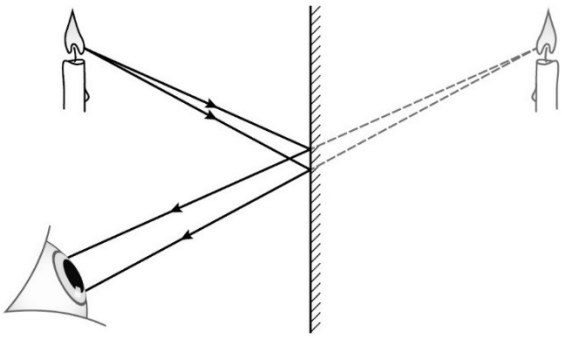
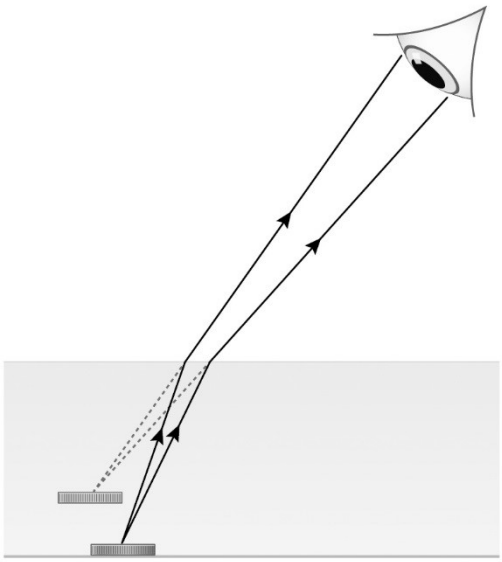
Question	Part	Step	Answer	Mark scheme
1	ai	8	**D** 2 V	**1 mark**
	aii	8	explanation should mention lower resistance and higher current for 1 mark each	**2 marks** – 1 for each point
	bi	7	Any two from: iron nickel cobalt steel	**1 mark**
	bii	7	it can be turned off to drop the metals again	**1 mark**
2	ai	8	ice is less dense than water whereas in most other materials the solid is more dense than the liquid	**2 marks** – 1 for each point
	aii	8	**B** Energy is transferred from the water to the ice cube because the water is warmer.	**1 mark**
	b	8	particles move more slowly in cold water …so take up less volume	**2 marks** – 1 for each point
3	a	5	the wax melted (or any other sensible answer)	**1 mark**
	b	7	**B** conduction	**1 mark**
	c	7	aluminium – 364 s copper – 288 s glass – 652 s	**2 marks** 1 mark for times converted into seconds 1 mark for times written against correct materials
	d	7	Energy transferred by heating/conduction travels fastest through copper and slowest through glass. [Accept 'heat travels…']	**1 mark** – Both materials must be mentioned for the mark
	e	7	all the rods are getting the same amount of energy/heat, *or* the surrounding temperature is the same for all the rods	**1 mark** – Accept any other sensible reason
4	a	7	insulating materials	**1 mark**
	b	7	opposite charges will attract	**1 mark**
	c	8	the charges are equal, but of opposite sign because one object has gained the same number of electrons/negative charges as the other has lost	**2 marks** – Size and nature of charge required for the marks Accept equivalent explanations
5	a	7	(thermal) energy stored in the material of the hot kettle and/or warmer surroundings	**1 mark**
	b	7	kettle A is more efficient, as more/a higher proportion of the energy transferred is useful energy/the amount of energy wasted by kettle A is less	**1 mark** – Need to state kettle A and the explanation to get the mark

Question	Part	Step	Answer	Mark scheme
	ci	8	fill the cups with equal volumes of hot water (hot must be mentioned) record the temperature of the water at the start and after a given time *or* record the temperature of the water at regular intervals	**2 marks** – 1 for each point One variable must be mentioned
	cii	8	Any two from the following, for 1 mark each: same volume of water same starting temperature of water same conditions in the room (accept comment about same room temperature, protecting from draughts, etc.).	**2 marks**
	ciii	8	Any one of: handle hot apparatus carefully clear up water spills immediately handle hot water carefully wear heat-resistant gloves wear safety goggles	**1 mark**
	civ	8	the temperature of the water in the cup which is the best insulator will decrease the least	**1 mark**
6	a	8	hydrogen 140 MJ/kg biodiesel 40 MJ/kg 140 MJ/kg – 40 MJ/kg = 100 MJ/kg	**2 marks** – 1 for extracting information from the graph, 1 for the calculation
	bi	8	a fuel made from plants/animal waste	**1 mark**
	bii	8	it is renewable/will never run out *or* it adds less carbon dioxide to the atmosphere than burning coal/oil because the plants absorb carbon dioxide when they grow	**1 mark**
7		9	when the temperature increases, particles move faster they hit the walls of the tyre more often and/or hit harder	**2 marks** – 1 for each point
8	a	8	340 m/s × 4 s = 1360 m	**1 mark** for recall and substitution **1 mark** for final answer Award marks for a correct answer with no working shown
	b	8	**A** Different colours of light travel at different speeds in the prism.	**1 mark**
	c	8	a red shirt only reflects red light it absorbs blue light/in a blue light there is no red to be reflected	**2 marks** – 1 for each point

Question	Part	Step	Answer	Mark scheme
9	a	8	at least one of the two rays drawn reflecting from the mirror, with equal angles of incidence and reflection reflected rays extended behind the mirror to converge at a point 	**2 marks** – 1 for each point
	b	8	light travels at different speeds in different materials	**1 mark**
	c	9	diagram completed to show two rays of light bending away from the normal as they leave the water refracted rays extended back into the water to converge at a point above the bottom 	**2 marks** – 1 for each point
10	ai	9	**A** P and T	**1 mark**
	aii	9	3 Hz/hertz	**2 marks** – 1 for each point
	bi	9	Any two from: the mass the type of material for the wire the thickness of the wire distance to the microphone temperature of the wire/sonometer	**2 marks** Accept equivalent answers
	bii	9	as wire length increases, the frequency of sound produced decreases	**1 mark** Accept equivalent answers

Question	Part	Step	Answer	Mark scheme
11	a	8	50 N × 2 m = 100 J	**1 mark** for substitution **1 mark** for final answer Award marks for a correct answer with no working shown
	b	9	50 N × 1.9 m = 95 N m	**1 mark** for substitution **1 mark** for final answer Award marks for a correct answer with no working shown
12		**See below**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. ● vertical forces on car throughout are gravity and a reaction force which are balanced ● while stationary there are no horizontal forces ● when the car starts to move, thrust/force from engine accelerates it forward ● as it starts to move, friction/air resistance start to act in a direction opposite to its motion ● as its speed increases, friction/air resistance increase ● when it is travelling at a constant speed, thrust/force from engine is balanced by total of friction/air resistance.	**See marks below**

Marks	Step	Descriptor
1–2	4–5	Level 1 Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. Presents an explanation with some structure and coherence.
3–4	6–7	Level 2 Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. Presents an explanation that has a structure which is mostly clear, coherent and logical.
5–6	8–9	Level 3 Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. Presents an explanation that has a well-developed structure which is clear, coherent and logical.