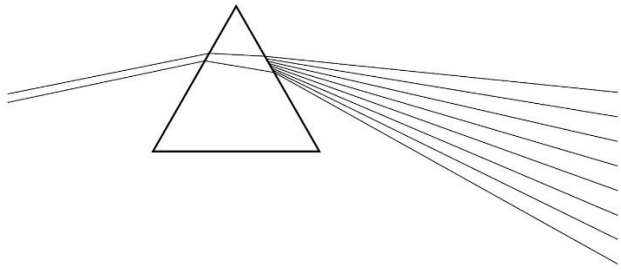


Question	Part	Step	Answer	Mark scheme
1	ai	2nd	force meter (also known as newton meter)	1 mark
	aii	2nd	friction	1 mark
	aiii	3rd	mass on top of block	1 mark
	aiv	3rd	Any one of: size of the block material in contact with the surface material of the surface speed of pulling	1 mark
	b	4th	$15\text{ N} + 3\text{ N} = 18\text{ N}$	1 mark Mark can be awarded for correct answer without any working
2	ai	2nd 2nd	battery – accept ‘cells’ but not ‘cell’ bulb motor	2 marks 1 mark for two correct 2 marks for three correct Answers must be in correct positions.
	aii	3rd 4th	brighter, resistance, current	2 marks 1 mark for two correct 2 marks for three correct Answers in correct order
	b	7th 7th	$6\text{ V} \div 0.5\text{ A} = 12\ \Omega$	1 mark for substitution 1 mark for final answer Award both marks for a correct answer (number and unit) with no working shown
3	a	2nd	a small piece of rock	1 mark
	bi	5th 5th	$95 \times 10 = 950\text{ N}$	1 mark for substitution 1 mark for final answer Award both marks for a correct answer (number and unit) with no working shown
	bii	6th 6th	weight decreases gravitational field strength decreases	2 marks – 1 for each point
	c	7th 7th	she can exert the same force, but her weight is less ...so there is a greater resultant force upwards	2 marks – 1 for each point

Question	Part	Step	Answer	Mark scheme
4	ai	5th	amplitude labelled (peak displacement from zero displacement)	1 mark
	aii	5th	angle of reflection should equal angle of incidence [The angles only need to look the same visually; use of a protractor is not required.]	1 mark
	b	3rd 3rd	transparent – an object that allows light to pass through opaque – an object that absorbs or reflects light rays luminous – an object that emits light	2 marks 1 mark for one or two correct 2 marks for three correct
	ci	5th	B refraction	1 mark
	cii	3rd 5th 7th		3 marks 1 mark for drawing a triangular prism 1 mark for showing the light going in (at roughly the correct angle) 1 mark for showing spectrum coming out (at roughly the correct angle)
5	ai	4th	B chemical energy	1 mark
	aii	5th 5th	$1500 \times 0.3 = 450 \text{ kJ}$	1 mark for working 1 mark for final answer Award both marks for a correct answer with no working shown
	b	6th 6th	Advantage: biofuel is renewable/absorbs carbon dioxide while growing. Disadvantage: biofuel stores less energy per kilogram.	2 marks – 1 for each point
6	ai	6th 6th	ice is less dense than water in most other materials the solid is more dense than the liquid	2 marks – 1 for each point
	aii	6th	B Energy is transferred from the water to the ice cube because the water is warmer.	1 mark
	b	7th 7th	particles move more slowly when the water is cold ...so take up less volume	2 marks – 1 for each point
7	a	4th	the wax melted (or any other sensible answer)	1 mark
	b	6th	B conduction	1 mark

Question	Part	Step	Answer	Mark scheme
	<b>c</b>	<b>3rd</b> <b>3rd</b>	aluminium – 364 s copper – 288 s glass – 652 s	<b>2 marks</b> 1 mark for times converted into seconds 1 mark for times written against correct materials
	<b>d</b>	<b>6th</b>	energy transferred by heating/conduction travels fastest through copper and slowest through glass [Accept 'heat travels...']	<b>1 mark</b> – Both materials must be mentioned for the mark
	<b>e</b>	<b>4th</b>	all the rods are getting the same amount of energy <i>or</i> the surrounding temperature is the same for all the rods	<b>1 mark</b> – Accept any other sensible reason
<b>8</b>	<b>a</b>	<b>5th</b>	insulating materials	<b>1 mark</b>
	<b>b</b>	<b>6th</b>	opposite charges will attract	<b>1 mark</b>
	<b>c</b>	<b>7th</b> <b>7th</b>	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	<b>2 marks</b> – Size and nature of charge required for the marks Accept equivalent explanations
<b>9</b>	<b>a</b>	<b>6th</b>	(thermal) energy stored in the material of the hot kettle and/or warmer surroundings	<b>1 mark</b>
	<b>b</b>	<b>6th</b>	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	<b>1 mark</b> – Need to state kettle A and the explanation to get the mark
	<b>c</b>	<b>4th</b> <b>6th</b>	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 <i>or</i> record the temperature of the water at regular intervals	<b>2 marks</b> – 1 for each point One variable must be mentioned
	<b>d</b>	<b>4th</b> <b>4th</b>	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.).	<b>2 marks</b>
<b>10</b>		<b>7th</b> <b>7th</b>	$1500 \times 2 \div 2 = 1500 \text{ m}$	<b>1 mark</b> for working <b>1 mark</b> for final answer Award both marks for a correct answer (number and unit) with no working shown

Question	Part	Step	Answer	Mark scheme
11		<b>See below</b>	<p>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.</p> <p>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.</p> <ul style="list-style-type: none"> <li>• renewable resources will not run out</li> <li>• renewable resources do not produce polluting gases</li> <li>• fossil-fuelled power stations produce carbon dioxide</li> <li>• which is contributing to climate change</li> <li>• so using renewables instead is a good idea</li> <li>• but renewable resources are not available all the time</li> <li>• and sometimes produce more electricity than is needed</li> <li>• but we cannot store much of the spare electricity</li> <li>• so we need resources that are available at any time, such as fossil fuels and nuclear power.</li> </ul>	<b>See marks below</b>

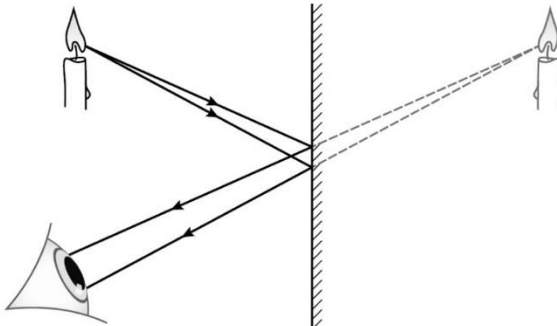
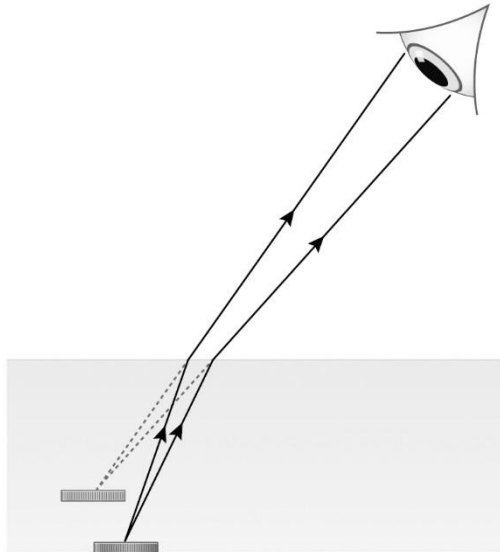
Marks	Step	Descriptor
1–2	5th–6th	<u>Level 1</u> Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. Presents an explanation with some structure and coherence.
3–4	6th–7th	<u>Level 2</u> Demonstrates physics understanding, which 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	7th–8th	<u>Level 3</u> 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.

**Final Step Calculation**

Marks	Step
1–5	Below 2nd
6–10	2nd
11–18	3rd
19–27	4th
28–37	5th
38–46	6th
47–52	7th
53–56	8th
57–60	9th

Question	Part	Step	Answer	Mark scheme
1	ai	5th	D 2 V	1 mark
	aii	5th 6th	explanation should mention lower resistance and higher current for 1 mark each	2 marks – 1 for each point
	bi	4th	Any two from: iron nickel cobalt steel	1 mark
	bii	6th	it can be turned off to drop the metals again	1 mark
2	ai	6th 6th	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	6th	B Energy is transferred from the water to the ice cube because the water is warmer.	1 mark
	b	7th 7th	particles move more slowly in cold water ...so take up less volume	2 marks – 1 for each point
3	a	4th	the wax melted (or any other sensible answer)	1 mark
	b	6th	B conduction	1 mark
	c	3rd 3rd	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	6th	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	4th	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	5th	insulating materials	1 mark
	b	6th	opposite charges will attract	1 mark
	c	7th 7th	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	6th	(thermal) energy stored in the material of the hot kettle and/or warmer surroundings	1 mark
	b	6th	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	4th 6th	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  <i>or</i>  record the temperature of the water at regular intervals	<b>2 marks</b> – 1 for each point  One variable must be mentioned
	cii	4th 4th	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.).	<b>2 marks</b>
	ciii	4th	Any one of:  handle hot apparatus carefully  clear up water spills immediately  handle hot water carefully  wear heat-resistant gloves  wear safety goggles	<b>1 mark</b>
	civ	4th	the temperature of the water in the cup which is the best insulator will decrease the least	<b>1 mark</b>
6	a	5th 5th	hydrogen 140 MJ/kg  biodiesel 40 MJ/kg  $140 \text{ MJ/kg} - 40 \text{ MJ/kg} = 100 \text{ MJ/kg}$	<b>2 marks</b> – 1 for extracting information from the graph, 1 for the calculation
	bi	4th	a fuel made from plants/animal waste	<b>1 mark</b>
	bii	6th	it is renewable/will never run out  <i>or</i>  it adds less carbon dioxide to the atmosphere than burning coal/oil because the plants absorb carbon dioxide when they grow	<b>1 mark</b>
7		7th 7th	when the temperature increases, particles move faster  they hit the walls of the tyre more often and/or hit harder	<b>2 marks</b> – 1 for each point
8	a	8th 8th	$340 \text{ m/s} \times 4 \text{ s} = 1360 \text{ m}$	<b>1 mark</b> for recall and substitution  <b>1 mark</b> for final answer  Award marks for a correct answer with no working shown
	b	6th	<b>A</b> Different colours of light travel at different speeds in the prism.	<b>1 mark</b>
	c	5th 5th	a red shirt only reflects red light  it absorbs blue light/in a blue light there is no red to be reflected	<b>2 marks</b> – 1 for each point

Question	Part	Step	Answer	Mark scheme
9	a	5th 5th	<p>at least one of the two rays drawn reflecting from the mirror, with equal angles of incidence and reflection</p> <p>reflected rays extended behind the mirror to converge at a point</p> 	2 marks – 1 for each point
	b	5th	light travels at different speeds in different materials	1 mark
	c	7th 7th	<p>diagram completed to show two rays of light bending away from the normal as they leave the water</p> <p>refracted rays extended back into the water to converge at a point above the bottom</p> 	2 marks – 1 for each point
10	ai	5th	A P and T	1 mark
	aii	6th 5th	3 Hz/hertz	2 marks – 1 for each point
	bi	3rd 3rd	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	5th	as wire length increases, the frequency of sound produced decreases	1 mark Accept equivalent answers



Question	Part	Step	Answer	Mark scheme
11	a	7th 7th	$50 \text{ N} \times 2 \text{ m} = 100 \text{ J}$	<b>1 mark</b> for substitution <b>1 mark</b> for final answer Award marks for a correct answer with no working shown
	b	8th 8th	$50 \text{ N} \times 1.9 \text{ m} = 95 \text{ N m}$	<b>1 mark</b> for substitution <b>1 mark</b> for final answer Award marks for a correct answer with no working shown
12		See below	<p>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.</p> <p>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.</p> <ul style="list-style-type: none"> <li>vertical forces on car throughout are gravity and a reaction force which are balanced</li> <li>while stationary there are no horizontal forces</li> <li>when the car starts to move, thrust/force from engine accelerates it forward</li> <li>as it starts to move, friction/air resistance start to act in a direction opposite to its motion</li> <li>as its speed increases, friction/air resistance increase</li> <li>when it is travelling at a constant speed, thrust/force from engine is balanced by total of friction/air resistance.</li> </ul>	See marks below

Marks	Step	Descriptor
1–2	4th	<u>Level 1</u> 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	5th–7th	<u>Level 2</u> 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	9th–10th	<u>Level 3</u> 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.

**Final Step Calculation**

Marks	Step
1–6	Below 3rd
7–13	3rd
14–22	4th
23–32	5th
33–42	6th
43–49	7th
50–54	8th
55–57	9th
58–60	10th