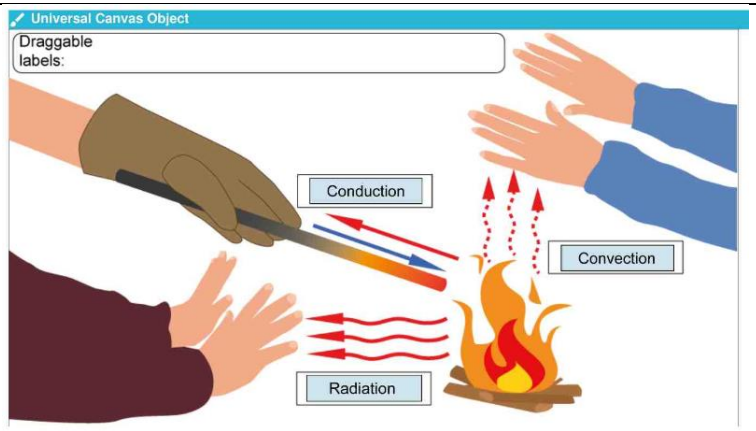
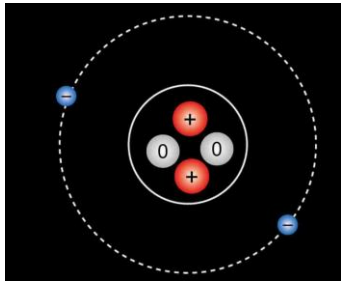
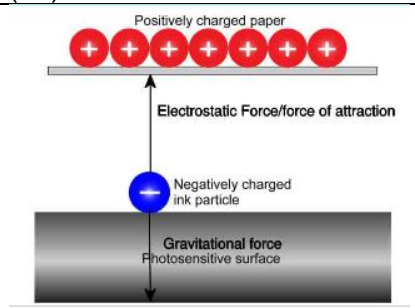
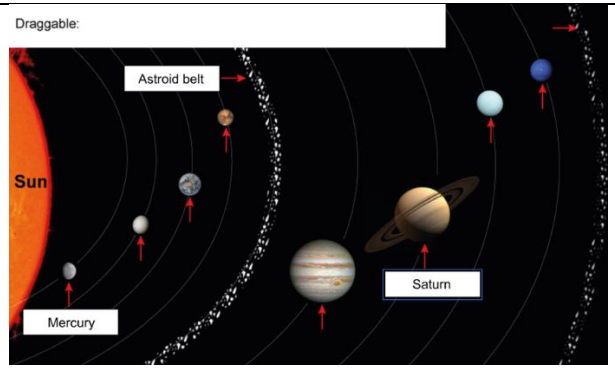
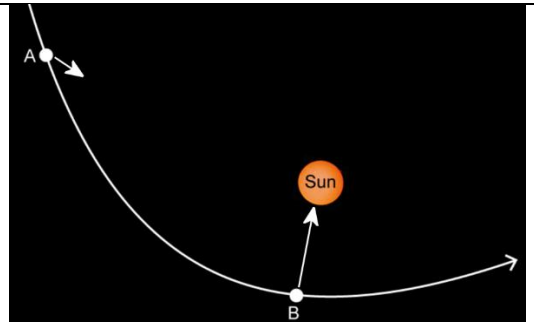
Question		Answers	Notes	Total	Criterion
1	a	 All correct		1	A
	b	Celsius/(º)C ***or*** Kelvin/K Joules/J ***or*** kilojoules/kJ		2	A
	c	***Feature of Dewar flask and named type of heat transfer [2 max]*** ***correctly linked scientific explanation [2 max]*** • silvered surface reflects (infra red) <u>radiation</u> • so the sun's rays are reflected away from the ice • vacuum prevents <u>conduction</u> • because conduction needs a medium and there is no medium for heat / (thermal) energy to transfer (from the surroundings) to the ice • insulated support prevents <u>conduction</u> • heat / (thermal) energy cannot transfer through insulating materials and (so) cannot transfer (from the surroundings) to the ice	*Do **not** accept reference to the stopper* *Accept references to moving particles*	4	A

2	**a**	 All correct	*Accept overlapping protons and neutrons*	**1**	A
	b	Electrostatic force		**1**	A
	c	Positives and negative charges <u>attract</u> ***or*** there is an <u>attractive</u> force (So) the ink sticks ***or*** is attracted to the paper to create the copy	*Ignore references to magnetism*	**2**	A
	d	 single arrow pointing up at 90° to the photosensitive surface single arrow pointing down at 90° to the photosensitive surface labels: electrostatic (force) ***or*** gravitational force	*Ignore relative size of arrows* *Arrows must touch or be very close to touching the surface of the particle (judge by eye)* *Additional arrows are CON* *Award separately* *Accept weight or gravity*	**3**	A
	e	Force ***or*** attraction increases as the distance between charges ***or*** the oppositely charged surfaces decreases Distance needs to be small so the electric force can be greater than any opposing ***or*** downward force or weight Ink will then stick to the paper	*Accept reference to attractive force from positive drum surface*	**3**	A

3	**a**	Draggable:  Two correct – one mark All three correct – two marks		**2**	A
	b	Distance ***or*** mass		**1**	A
	c	 One arrow pointing towards the Sun Both arrows point in the direction of the Sun Arrow at A shorter than arrow at B	*Judge by eye*	**3**	A
	d	evidence of use of the correct equation 562 000 000 (kg) ***or*** 5.62 x 10^8 (kg)	*Seen or implied* *Award two marks for the correct answer.*	**2**	A
	e	Selection of correct equation 56 200 000 (N) ***or*** 5.62 x 10^7 (N)	*Seen or implied* *ECF from part d*	**2**	A

4	**a**	100 kmh^{-1}	*Accept km/h. Do **not** accept kmh^-1or unit written out as words*	**2**	C
	b	Only weight identified as the IV Only air speed identified as the DV Only CSA ***and*** shape identified as the CV		**3**	B
	c	As the weight increases, the air speed needed increases Reference to air speed^2 ***Correct scientific information, for example [1 max]:*** • reference to Newton's first law • description of forces in equilibrium (weight and drag)	*Accept reference to gravitational force, do **not** accept gravity*	**3**	B
	d	All balls have the same CSA Balls with weight 1.20 N and 0.40 N are chosen Only 5 balls chosen	*No ECF from part b* *Award the third mark only if the first two marks are awarded*	**3**	B
	e	***Any two points from the following list [2 max]**:* • greatest possible range • this will generate sufficient data • control variables held constant		**2**	B
	f	Number of trials between 3 and 5 ***Any reasonable justification, for example [1 max]:*** • it is difficult to spot outliers for fewer than three trials • you can be sure you have reliable data • you can calculate the mean/average	*Do **not** accept references to accuracy*	**2**	B

5	**a**	How does the CSA affect the air speed needed for it to float?	*WTTE*	**1**	B
	b	38 cm^2		**1**	D
	c	***Column title:*** CSA ***and*** unit ***Column title:*** speed ***and*** unit Units in column header only All data recorded ***and*** arranged in order	*Accept area for CSA* *Accept table arranged in columns or rows* *Accept ecf from part b* *Accept either ascending or descending*	**4**	C
	d	Graph C Allows for a straight line to be drawn Arranges IV and DV so that relationship can be determined		**3**	C
	e	(If hypothesis supported) a graph of $1/v^2$ ~ CSA would be a straight line (going through the origin) Graph C shows this trend (Therefore) the hypothesis is supported ***or*** (If hypothesis supported) two sets of data would show same constant Data used to demonstrate this (Therefore) the hypothesis is supported	*Award one mark only if candidate has stated there is an (inverse) relationship* *Do **not** award the third mark unless either of the first two marks are awarded* *Seen or implied* *Do **not** award the third mark unless either of the first two marks are awarded*	**3**	C
	f	Repeats measurements ***or*** increases the number of trials Reduces the effect of (random) errors ***or*** increases reliability		**2**	C

6	**a**	Scatter / line graph Graph of weight against volume (of boat) below the water *x*-axis: weight of boat ***and*** *y*-axis: volume of boat below the water	 *Accept displaced.*	**3**	C
	b	<u>Straight</u> line through the points Line goes through the origin		**2**	C
	c	***Any reasonable improvement, for example: [2 max]*** • greater range • more trials • regular increment ***Correctly linked effect, for example: [2 max]*** • gives more evidence for a proportional relationship over a greater range • reduces experimental uncertainty • better evidence for an observed trend		**4**	C

	d					**11**	B

	1 mark	**2 marks**	**3 marks**
1. RQ **(Research question)**	Research question links IV and DV	Research question links IV and DV and refers to a control variable	
2.E **(Equipment)**	Specific equipment for measuring mass of boat/cup eg top pan balance	Specific equipment for measuring mass of boat/cup eg top pan balance, ***and*** equipment to monitor at least one control variable	
3. V **(IV and DV)**	IV identified as mass of salt (weight or density accepted) ***or*** DV identified as mass (weight) of boat/cup	IV identified as mass of salt (weight or density accepted) ***and*** DV identified as mass (weight) of boat/cup	
4. M **(Method)**	Attempt at a method but detail is insufficient to follow	Method described and could easily be followed by another student including reference to control of the control of displacement (eg measured line on the boat/cup)	
5. D **(Data)**	Method implies a range of values of the IV (eg. mass of salt added)	Method implies a range of values of the IV (eg. mass of salt added) with at least 3 trials/repeats	Method implies a range of values of the IV (eg. mass of salt added) with 3 trials/repeats ***and*** plans to calculate average (mean)

<table>
<tr><td>7</td><td>a</td><td>Long enough half-life to record images

Short enough to prevent long term exposure</td><td></td><td>2</td><td>D</td></tr>
<tr><td></td><td>b</td><td>Any two reasonable advantages, for example [2 max]:
• gamma rays are not blocked by bone or skin
• they do not damage cells (by ionisation)
• they can be detected by a gamma camera</td><td>Do not accept references to half-life.</td><td>2</td><td>D</td></tr>
<tr><td></td><td>c</td><td colspan="3"><table>
<tr><th></th><th>1 mark</th><th>2 marks</th><th>3 marks</th><th>4 marks</th></tr>
<tr><td>1. A

(Advantages)</td><td>A statement of an advantage</td><td>A statement of two or more advantages
or
A statement of one advantages with an explanation</td><td>A statement of two or more advantages with at least one explained</td><td>A statement of two or more advantages with at least one explained and linked to the specific country</td></tr>
<tr><td>2. D

(Disadvantages)</td><td>A statement of a disadvantage</td><td>A statement of two or more disadvantages
or
A statement of one disadvantage with an explanation</td><td>A statement of two or more disadvantages with at least one explained</td><td>A statement of two or more disadvantages with at least one explained and linked to the specific country</td></tr>
<tr><td>3. C

(Conclusion)</td><td>A simple conclusion</td><td></td><td></td><td></td></tr>
</table></td><td>9</td><td>D</td></tr>
</table>

8							**11**	D

	1 mark	2 marks	3 marks	4 marks
1. Ad/Dis **(Advantages and disadvantages)**	States either an advantage ***or*** disadvantage	An advantage ***and*** disadvantage	An advantage ***and*** disadvantage ***one*** of which is supported with scientific understanding	An advantage ***and*** disadvantage ***both*** of which are supported with scientific understanding
2. P **(Political implications)**	General reference to a factor relating to government or public affairs	Specific reference to a factor relating to government or public affairs with an example (eg public safety)	More than one specific reference to a governmental responsibility each with an example	
3. E **(Environmental implications)**	General reference to an environmental implication	A specific environmental implication with an example		
4. A **(Appraisal)**	A simple conclusion	A concluding appraisal with reference to issues raised		