Question		Answers	Notes	Total	Crit.
1	a	Both of these forms of uranium have an atomic number of 92. Uranium-236 has one more neutron than uranium-235. These two different forms of uranium are known as isotopes.		3	A
	b	$^{92}_{36}Kr$		1	A
	c	18.5± 0.5 min(utes)		**2**	A
	d	evidence of energy requirement / energy per g (conversion of MJ into J to give mass of) 1.536… (g) ***or*** 1.54	*Award 2 marks for correct answer with no working shown*	**2**	A
	e	***Any reasonable suggestion, for example [max 1]*** • different skills • complementary skills • science is a creative endeavour		**1**	D

<table>
<tr><td>2</td><td>a</td><td><table><tr><th>Heat energy added</th><th>Heat energy removed</th></tr><tr><td>Boiling</td><td>Freezing</td></tr><tr><td>Melting</td><td>Condensing</td></tr></table>One correct term in blue

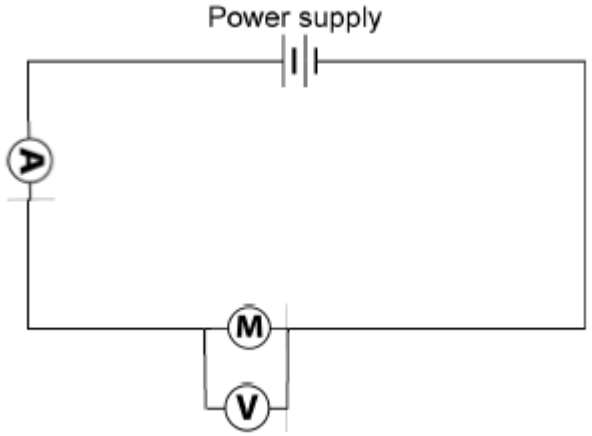
All terms in blue correct</td><td></td><td>2</td><td>A</td></tr>
<tr><td></td><td>b</td><td>Accept any reasonable similarity:
both are types of vaporization
change of state is liquid to gas in both
Accept any reasonable difference, for example [max 1]:
boiling only happens at the boiling point and evaporation can happen at any temperature
boiling happens at constant temperature and evaporation leads to cooling of the liquid
evaporation happens at the surface and boiling does not
evaporation is a slow process and boiling is a fast process
boiling creates bubbles (of vapour) and evaporation does not produce bubbles</td><td></td><td>2</td><td>A</td></tr>
<tr><td></td><td>c</td><td>cooking oil

ethanol</td><td></td><td>2</td><td>A</td></tr>
<tr><td></td><td>d</td><td>20.8± 0.1</td><td></td><td>1</td><td>A</td></tr>
<tr><td></td><td>e</td><td>Cooking oil did not evaporate and a large amount of ethanol evaporates

correct link to amount of energy required for evaporation (so student B is correct)</td><td></td><td>2</td><td>A</td></tr>
</table>

3	**a**	***Accept two valid differences, for example [max 2]*** • stars emit light • moons reflect light • stars are gaseous • moons orbit planets • stars do not orbit planets • moons are solid	*Accept "satellite"*	**2**	A
	b	He saw the moons were orbiting Jupiter (not Earth) If the geocentric model was true, the moons would have been orbiting Earth	*WTTE*	**2**	A
	c	***Accept any reasonable suggestion, for example [max 1]*** • Water could indicate presence of life • Europa could be used as a future settlement		**1**	D
	d	***Accept any two properties from the list [max 2]*** • All travel at the same speed • All transverse waves • Can all travel through a vacuum • All have waves properties (reflection/refraction etc.)		**2**	A

4	**a**	heat ***or*** sound		**1**	B
	b	RQ linked to useful energy, total energy, work done or efficiency RQ correctly linking the amount of work done or mass or height lifted by a motor and its efficiency (DV)		**2**	B
	c	Lift the mass to different heights Use data to calculate work done or change of gravitational potential energy for each height		**2**	B

	d	 Motor ***and*** Ammeter ***and*** voltmeter only Ammeter connected in series Voltmeter connected in parallel across motor	*Ignore any switch if present*	**3**	B
	e	identification of time power * time = work or energy	*WTTE*	**2**	B

5						**14**	B

	1	**2**	**3**	**4**
V (Variables)	time implied as dependent variable	independent variable of voltage ***and*** dependent variable of time stated	independent variable of voltage ***and*** dependent variable of time stated ***and*** two control variables stated ***or*** one control variable with correct justification	independent variable of voltage ***and*** dependent variable of time stated ***and*** two control variables stated ***and*** with correct justification
M (Method)	attempt at a method linked voltage ***or*** time	method is described with measurements of voltage ***and*** time but not detailed enough to be followed by another student	complete method is described with measurements of voltage and time ***and*** could easily be followed by another student	complete method is described with measurements of voltage and time ***and*** could easily be followed by another student ***and*** with details of m and ΔH as CV
D (Data)	at least five increments ***or*** three trials	at least five increments ***and*** three trials	at least five increments ***and*** three trials ***and*** plans to calculate an average	
P (processing)	plans to calculate Useful energy ***or*** total energy	plans to calculate Useful energy ***and*** total energy	plans to calculate Useful energy ***and*** total energy ***and*** Efficiency	

<table>
<tr><td rowspan="4">6</td><td>a</td><td>correct statement or reference to $\Delta E_p = mg\Delta h$

final answer 0.465975 (J)</td><td>Award 2 marks for any correctly rounded value to 2 or more sf. Award 1 mark for 46(.6 J) no conversion to m</td><td>2</td><td>C</td></tr>
<tr><td>b</td><td>Mass is IV so voltage should be CV

Justification:
Any changes in efficiency must be related to changes in IV only
or
Increasing the voltage would increase the power</td><td>WTTE</td><td>2</td><td>C</td></tr>
<tr><td>c</td><td>Table Object
<table><tr><th>Mass/g</th><th>Current/A</th><th>Time/s</th></tr><tr><td>10</td><td>0.12</td><td>4.32</td></tr><tr><td>20</td><td>0.14</td><td>4.68</td></tr><tr><td>30</td><td>0.15</td><td>4.74</td></tr><tr><td>40</td><td>0.17</td><td>5.16</td></tr><tr><td>50</td><td>0.18</td><td>5.21</td></tr></table>
complete data in increasing or decreasing values of mass

column headers correct

units appearing only in column headers</td><td></td><td>3</td><td>C</td></tr>
<tr><td>d</td><td>use of correct formula to calculate total energy (E = V*I*t)

correct total energy = 1.8756(J)

correct calculation of efficiency = 24.844 = 25 (%)</td><td>ecf from part (a) and mp2</td><td>3</td><td>C</td></tr>
</table>

7	**a**	Graph D LOBF intersects the most points ***or*** correct reference to the number of data points above and below the LOBF ***or*** correct reference to the outlier	*WTTE* *Correct graph has to be selected to award justification mark*	**2**	C
	b	5.1±0.1 (m) 82±2 (degrees)		**2**	C
	c	Maximum height reached decreases when the angle is increased But not in inverse proportion doubling of IV does not halve DV ***or*** inverse proportion would not show an intercept		**3**	C
	d	(Height) Due to the motion of the ball, the height of the ball would be hard to measure	*No mark for height but this should be selected for the mp* *WTTE*	**1**	C
	e	Repeated trials ***or*** Any correct suggestion relating to a more accurate height measurement being taken		**1**	C
	f	Decreased Gain in GPE is less Energy is converted to heat ***or*** kinetic energy is wasted ***or*** Total force acting against the ball is greater (so) deceleration of the ball is increased		**3**	B

	g	Correct statement relating to streamlining due to shape ***or*** small size ***or*** comment relating to inertia/mass of metal ball Air resistance caused by collisions of air particles with the surface of the ball		**2**	C
	h	***Any relevant DV, for example [max 1]*** • Time of flight • horizontal range ***Any 2 control variables consistent with launch angle as IV and DV chosen [max 2]***	*WTTE*	**3**	C

<table>
<tr><td>8</td><td>a</td><td>Use of s=d/t or Total distance of 0.16(m)

Distance to kidney stone = 0.08(m)

Correct conversion to cm</td><td>ecf from an incorrect distance of 0.16</td><td>3</td><td>A</td></tr>
<tr><td></td><td>b</td><td colspan="2"><table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Waves</td><td>description of reflection, absorption or transmission in non-technical terms for one technique</td><td>identification of one wave phenomenon for one technique</td><td>identification of one wave phenomenon for both techniques</td><td>identification of one wave phenomenon for both techniques and how image is produced</td></tr>
<tr><td>Health</td><td>health impact for one technique</td><td>health impact for both techniques</td><td>health impact for both techniques
with one supported by further justification</td><td>health impact for both techniques with both supported by further justification</td></tr>
<tr><td>Economic</td><td>an economic implication</td><td>a positive or a negative economic implication for the government</td><td>a positive and a negative economic implication for the government</td><td>a positive and a negative economic implication for the government with one supported by further justification</td></tr>
<tr><td>Ethics</td><td>a comment</td><td>a comment supported with further justification</td><td></td><td></td></tr>
<tr><td>Conclusion</td><td>a concluding opinion is given</td><td>a concluding appraisal linking to previous arguments</td><td></td><td></td></tr>
</table></td><td>16</td><td>D</td></tr>
</table>

	c	***Accept any reasonable points, for example [max 4]*** • Evidence of a large number of terminations taking place • Terminations should not take place based on sex alone • Stable family structures less likely • Work force supply issues • Future fall in birth rate ***or*** population pyramid issues • Difficult for males to find female partners • Lack of diversity in society ***Accept any reasonable suggestion, for example [max 1]*** • Introduce legislation preventing sex being identified before birth • Run an education campaign		**5**	D