

Q1.

Question number	Answer	Notes	Marks
(a) (i)	substitution; evaluation; e.g. GPE = $19 \times 10 \times 6.3$ GPE = 1200 (J)	allow use of $g = 9.8$, 9.81 -1 for POT error but only from incorrectly converting kg to g 119.7 scores 0 allow 1197, 1170, 1173, 1173.1, 1173.06, 1174, 1174.3, 1174.26, 1174.257 (J)	2
(ii)	same value as answer to (i);	allow ecf from (i)	1
(b)	use of weight = mass \times g; evaluation; e.g. weight = mass \times g (air resistance = $19 \times 10 =$) 190 (N)	allow use of $g = 9.8$, 9.81 allow 186, 186.2, 186.4, 186.39 (N)	2
(c)	A kinetic; B thermal; D by radiation;		3
Total for Question = 8 marks			

Q2.


Question number	Answer	Notes	Marks
(a)	ammeter and voltmeter symbols correct; ammeter in series with resistor; voltmeter in parallel with resistor;		3
(b) (i)	voltage = current \times resistance;	allow standard symbols and rearrangements e.g. $R = V \div I$ ignore c, C for current	1
(b) (ii)	substitution; rearrangement; evaluation; correct answer = 130 (Ω) e.g. $0.92 = 7.3 (\times 10^{-3}) \times \text{resistance}$ $\text{resistance} = 0.92 \div 7.3 (\times 10^{-3})$ (resistance =) 130 (Ω)	ignore units until evaluation -1 POT error allow 126, 126.0... (Ω)	3
Total for Question = 7 marks			

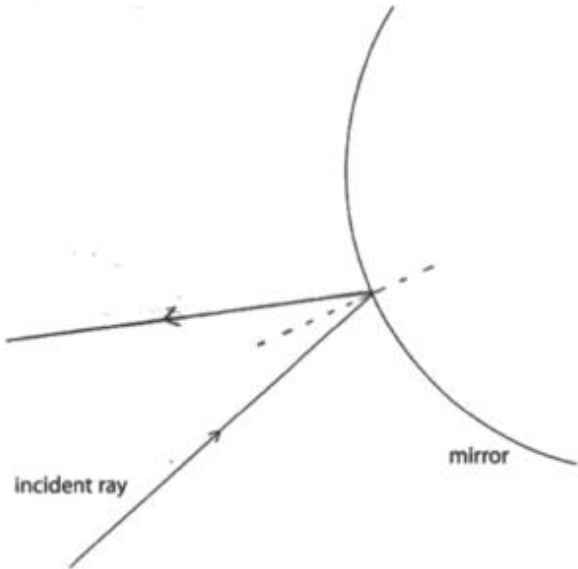
Q3.

Question number	Answer	Notes	Marks
(a) (i)	pressure difference = height \times density \times g;	allow in words or standard symbols e.g. $p = h \times \rho \times g$ condone d for density	1
(ii)	substitution; evaluation of pressure difference in kPa; evaluation of total pressure by adding 100 (kPa); e.g. (pressure difference =) $35 \times 1000 \times 10$ (pressure difference =) 350 (kPa) (pressure = $350 + 100 =$) 450 (kPa)	allow 343 (kPa) for use of $g=9.8$ N/kg ECF candidate's water pressure allow 443 (kPa) for use of $g=9.8(1)$ N/kg allow 450 000 Pa with clear intent from candidate i.e. removal of 'k' from unit on answer line. -1 for POT error but not if due to physics error such as missing g, substitution of 100 (kPa) for g 350 kPa gets 2 marks 350 100 kPa gets 2 marks unqualified 350 000 (kPa) gets 1 mark	3

(b)	(i)	pressure = force ÷ area;	allow in words or standard symbols e.g. $p = F / A$	1
	(ii)	substitution; rearrangement; evaluation; corresponding unit of area; e.g. $260\,000 = 430 / \text{area}$ (area =) $430 / 260\,000$ (area =) 0.0017 m^2	condone pressure in Pa or kPa accept standard form i.e. $1.7 \times 10^{-3} (\text{m}^2)$ allow $0.0016538... \text{m}^2$ etc allow $17, 16.5... (\text{cm}^2)$ etc allow $1.65... \text{m}^2$ scores 3 allow $1.65... \text{cm}^2$ scores 2	4
(c)		pressure (at bottom) is greater than before / eq; wider base / eq;	allow stronger material / eq ignore taller	2
Total for Question = 11 marks				

Q4.

Question number	Answer	Notes	Marks												
(a)	B (); A is incorrect because it is an LED C is incorrect because it is a motor D is incorrect because it is an LDR		1												
(b)	one mark for each correctly ticked statement;; <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 80%;">Statements</th> <th style="width: 20%;">Correct (✓)</th> </tr> </thead> <tbody> <tr> <td>visible light is a longitudinal wave</td> <td></td> </tr> <tr> <td>visible light transfers energy</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>visible light transfers matter</td> <td></td> </tr> <tr> <td>visible light has a longer wavelength than x-rays</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>visible light travels faster in water than in air</td> <td></td> </tr> </tbody> </table>	Statements	Correct (✓)	visible light is a longitudinal wave		visible light transfers energy	✓	visible light transfers matter		visible light has a longer wavelength than x-rays	✓	visible light travels faster in water than in air		if 3 or more ticks, then -1 for each incorrectly ticked row	2
Statements	Correct (✓)														
visible light is a longitudinal wave															
visible light transfers energy	✓														
visible light transfers matter															
visible light has a longer wavelength than x-rays	✓														
visible light travels faster in water than in air															

(c)	(i)	normal line drawn correctly at mirror surface;	ignore tangent lines does not need to be labelled but should be drawn at 90° by eye where the ray meets the mirror	1
	(ii)	ray drawn reflecting; angle of reflection correct; e.g. 	reject if ray passes into the mirror DOP judge by eye allow ecf from (c)(i)	2
(d)	(i)	substitution into $E = I \times V \times t$; rearrangement; evaluation; e.g. $120 = \text{current} \times (3 \times) 1.5 \times 3.0(\times 60)$ $\text{current} = 120 / 4.5 \times 180$ (current =) 0.15 (A)	allow if 1.5 V used for voltage ignore unit for time allow substitution into $P = VI$ and $P = E/t$ 26.6..., 8.8..., 0.44... = 2 marks allow 0.148...(A)	3
	(ii)	idea that current in wire produces a magnetic field;	ignore wire becomes magnetic	1

Total for Question = 10 marks

Q5.

Question number	Answer	Notes	Marks
(a) (i)	GPE = mass \times g \times height;	allow standard symbols and rearrangements e.g. GPE = m \times g \times h	1
(ii)	substitution; evaluation; e.g. (GPE =) 0.52 \times 10 \times 0.82 (GPE =) 4.3 (J)	allow use of g = 9.8, 9.81 -1 for clear POT error allow 4.2, 4.26, 4.264, 4.17872, 4.18...	2
(iii)	identical answer to (ii);	allow ecf from (ii) expect 4.3 (J)	1
(iv)	selection of KE = $\frac{1}{2}$ \times mass \times speed ² ; substitution; rearrangement; evaluation; e.g. KE = $\frac{1}{2}$ \times m \times v ² 4.3 = $\frac{1}{2}$ \times 0.52 \times v ² v = $\sqrt{2 \times 4.3 / 0.52}$ (v =) 4.1 (m/s)	seen or implied allow ecf from (iii) allow alternative method using v ² = u ² + 2as allow 4.0-4.1 (m/s)	4
(b)	any three from: MP1. oil is more dense / viscous (than air); MP2. force of friction now present / greater (than before); MP3. ball now does work against friction; MP4. decrease in GPE same as before; MP5. idea that energy is conserved; MP6. some energy transferred to thermal store (of air/ball); MP7. means less energy transferred to KE;	allow oil is thicker allow drag, fluid/liquid resistance for friction allow upthrust is greater ignore resistance	3
Total for question = 11 marks			

Q6.

Question number	Answer	Notes	Marks
(a)	idea of a current (in the coil);	ignore references to electromagnets	1
(b) (i)	d.c. travels in one direction only; idea of a.c. continuously changing direction;	allow keeps changing direction, changes direction constantly etc.	2
(ii)	idea of changing magnetic field (from transmitter coil); idea of gold ring cutting field lines; idea of induced voltage for gold ring;	allow field moving through ring ignore ring interacting with field ignore induced current	3
(c)	any four from: MP1. alternating current in loudspeaker ; MP2. magnetic fields interact (in loudspeaker); MP3. causing a force (on loudspeaker cone); MP4. a.c. causes changing force direction; MP5. loudspeaker (cone) vibrates;	ignore fields cutting allow coil for cone allow coil for cone allow description of vibrations e.g. "back and forth"	4
Total for Question			= 10 marks

Q7.

Question number	Answer	Notes	Marks
(a)	any THREE from: MP1 walls further apart; MP2 fewer collisions between particles and walls per second/lower frequency of collisions; MP3 means (average) force on walls lower; MP4 lower force means lower pressure for same wall surface area;	reject unqualified 'fewer collisions' accept idea that force per collision is the same ignore references to particles colliding with each other accept	3
(b)	substitution into given equation " $p_1 \times V_1 = p_2 \times V_2$ "; rearrangement to give p_2 ; evaluation of p_2 ; e.g. $101 \times 110 = p_2 \times 140$ $p_2 = 101 \times 110 / 140$ $p_2 = 79\,000 \text{ (Pa)}$	allow 79357.1... (Pa), 79(.4) kPa , standard form	3
(c)	any THREE from: MP1 pressure outside balloon is lower than inside balloon; MP2 pressure difference causes a force; MP3 force is outwards on balloon; MP4 force causes extension of balloon;	accept 'stretching'	3
Total for Question			= 9 marks

Q8.

Question number	Answer	Notes	Marks
(a) (i)	recall of (unbalanced) force = mass × acceleration; substitution and rearrangement; evaluation to 2 s.f. or more; e.g. $F = m \times a$ $a = 41000 / 830$ $a = 49 \text{ (m/s}^2\text{)}$	allow symbols can be implied from valid substitution of data allow 49.39...	3
(ii)	substitution into $v^2 = u^2 + 2as$; rearrangement; evaluation; e.g. $26^2 = 72^2 + 2 \times (-50) \times s$ (distance =) $5184 - 676 / 100$ (distance =) 45 (m)	allow ecf from (i) expect answers in range 45-46 (m) reject $72 - 26 = 46$ (wrong physics) accept 46 if unqualified	3
(b)	kinetic energy (store) of car decreases; thermal energy (store) of brake(s) increases; energy transferred mechanically;	kinetic energy/ KE of car transforms to {heat/thermal} energy of brakes due to work done by {friction / brakes} NB only award from either the answer column or notes column, not from a mix of the two.	3
(c)	any two from: MP1. idea that insulating materials are poor conductors; MP2. layers trap air; MP3. air itself is a poor conductor/(good) insulator MP4. (energy transfer due to / rate of) conduction reduces; MP5. idea increased thickness reduces (rate of) conduction	condone idea of stopping conduction	2
Total for Question = 11 marks			

Q9.

Question number	Answer	Notes	Marks
(a)	<p>use of $u=0$ (m/s);</p> <p>correct substitution into '$v^2 = u^2 + 2aS$';</p> <p>correct evaluation of v^2;</p> <p>correct evaluation of v;</p> <p>correct answer = 160 (m/s)</p> <p>e.g. $v^2 = u^2 + 2aS$ $v^2 = 0^2 + (2 \times 10 \times 1300)$ $v^2 = 26000$ $v = 161.245... \text{ (m/s)}$</p>	<p>accept loss of GPE = gain in KE</p> <p>reject use of $v=0$ for this MP</p> <p>$v^2 = 26000$</p> <p>accept 25506, 25480</p> <p>reject $v^2 = 2600$ if no $a=10$ seen.</p> <p>ignore sign</p> <p>accept 159.7059..., 159.62....</p>	4
(b) (i)	<p>any THREE from:</p> <p>MP1. reference to weight and air resistance;</p> <p>MP2. air resistance larger than weight (when parachute opens);</p> <p>MP3. reference to '$F = ma$';</p> <p>MP4. acceleration is upwards;</p> <p>MP5. air resistance decreases as parachutist slows down;</p>	<p>ignore 'upthrust'</p> <p>accept drag for AR</p> <p>accept 'resultant or unbalanced force is upwards'</p> <p>allow idea of increased AR</p> <p>ignore 'decelerates' or 'slows down'</p>	3
(ii)	<p>any THREE from:</p> <p>MP1. GPE reduces as height above ground reduces;</p> <p>MP2. KE reduces as speed reduces;</p> <p>MP3. friction force does mechanical work on parachutist;</p> <p>MP4. thermal store of parachutist increases;</p> <p>MP5. thermal transfer between (warm) parachutist and (cold) air;</p> <p>MP6. thermal transfer happens by conduction or radiation;</p>	<p>accept 'works mechanically'</p> <p>accept 'energy lost to the surroundings'</p> <p>accept idea of conversion to heat energy via friction</p>	3
(Total for Question = 10 marks)			

Q10.

Question number	Answer	Notes	Marks
(a)	<p>any five from:</p> <p>MP1. chemical energy (store of student); MP2. transferred mechanically;</p> <p>MP3. (to) gravitational energy (store of marble); MP4. transferred mechanically;</p> <p>MP5. (to) kinetic energy (store of marble); MP6. idea that thermal energy (store of marble) increases; MP7. idea that thermal energy (store) of marble run / surroundings increases; MP8. energy transferred to surroundings by radiation;</p>	<p>allow idea this is due to a lift force exerted by student</p> <p>must be a clear second reference allow idea this is due to marble's <u>weight</u></p> <p>allow heat for thermal</p> <p>allow heat for thermal</p> <p>allow transferred/lost as sound</p>	5
(b) (i)	<p>let marble roll across table for a known distance;</p> <p>measure time taken;</p> <p>use speed = distance / time;</p> <p>OR</p> <p>use of light gate; connected to datalogger;</p> <p>positioned so that (centre of) marble cuts beam(s);</p>	<p>allow measure distance travelled across table reject if linked to measuring time between A and B</p> <p>allow use of device with two integrated light gates</p>	3
(ii)	<p>substitution into GPE formula;</p> <p>evaluation of GPE;</p> <p>substitution into KE formula;</p> <p>evaluation of KE;</p> <p>subtraction to find energy lost;</p> <p>e.g. GPE = $0.0055 \times 10 \times 0.21$ GPE = 0.01155 (J) KE = $0.5 \times 0.0055 \times 0.76^2$ KE = 0.0015884 (J) energy lost = $(0.01155 - 0.0015884 =)$ 0.010 (J)</p>	<p>ignore units allow use of $g = 9.8, 9.81$ only penalise not converting g to kg once ignore units only penalise not converting g to kg once allow ecf from incorrect GPE and/or KE</p> <p>10, 10.0, 9.96..., 9.7... (J) etc. scores 4 marks</p> <p>allow 0.0113...</p> <p>allow 0.00996..., 0.0097... (J)</p>	5

Total for Question = 13 marks

Q11.

Question number	Answer	Notes	Marks
(a) (i)	acceleration = change in velocity / time (taken);	allow standard symbols and rearrangements e.g. $a = v - u / t$ allow Δv reject $a = v / t$	1
(ii)	substitution; rearrangement; evaluation; e.g. $1.6 = 22 - 14 / t$ $t = 22 - 14 / 1.6$ (t =) 5.0 (s)	allow 5 (s)	3
(iii)	(unbalanced) force = mass \times acceleration;	allow standard symbols and rearrangements e.g. $F = m \times a$	1
(iv)	substitution; evaluation; evaluation correctly rounded to 2s.f.; e.g. $F = 1200 \times 1.6$ (F =) 1920 (N) (F =) 1900 (N)	mark independently	3
(b)	idea that the car slows down; due to friction / air resistance / drag;	allow idea that car becomes stationary ignore "motion decreases"	2