PEARSON EDEXCEL GCSE PHYSICS (HIGHER) · 1PH0

PHYSICS



MARK SCHEME

TOPIC 4: WAVES (PACK 1)

SCORE	PERCENTAGE
/92	%

STEMUP

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Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(i)	substitution (1) % difference = $\frac{(240 - 343)}{343} \times 100$ evaluation (1) (-) 30 (%)	 OR 343 – 240 in numerator award full marks for the correct answer without working allow 1 mark for division by 240 yielding 43% allow one mark for $\frac{240 \times 100}{343}$ = 70 %	**(2)**

Question number	Answer	Additional guidance	Mark
(ii)	explanation linking any two of: reaction time is significant (with 0.5s or less) (1) the reaction time will be different for each of the students (1) effects on reaction times (1) students are at different distances (from starting pistol) (1) anticipation of flash / bang (1)	 accept reaction time is large compared with travel time differences in perception / acuity of light and sound	(2)

Question number	Answer	Additional guidance	Mark
(iii)	explanation linking: use a (much) longer distance **OR** use electronic timer (1) with effect (1) reduces/eliminates the significance/impact of the reaction time **OR** gives a more manageable time to measure	 all stand the same distance from the starting pistol (1)	(2)

Q2.

Question number	Answer	Additional guidance	Mark
	Substitution into $v = \frac{s}{t}$ to find v (1) $v = \frac{1.5 \times 10^{11}}{500}$ Substitution into $v = f \times \lambda$ and unit conversion (1) $v = \frac{1.5 \times 10^{11}}{500} = f \times 670 \times 10^{-9}$ Transposition (1) Rearrangement (1) $f = \frac{(1.50 \times 10^{11})}{500 \times (670 \times 10^{-9})}$ Answer (1) 4.5 x 10^{14} (Hz)	s is distance award full marks for correct numerical answer without working maximum 3 marks if λ in nm 4.4776 x 10^{14} (Hz)	**(4)**

Q3.

Question number	Answer	Additional guidance	Mark
	Substitution (1) PE = 7.26 x 10 x 1.3 Evaluation (1) 94.4 (J)		**(2)**

Q4.

Question number	Answer	Additional guidance	Mark
(i)	substitution (1) 371 = (64.5+ m) x 3.5 rearrangement (1) m+64.5 = 371 / 3.5 evaluation of total mass (1) m+64.5 = 106 (kg) evaluation of woman's mass (1) m = 106-64.5 = 41.5 (kg)	full marks will be awarded for correct numerical answer without working	(4)

Question number	Answer	Additional guidance	Mark
(ii)	substitution (1) KE = ½ x 64.5 x 3.5^2 evaluation (1) 395 (J)	allow answers which round to 395 e.g. 395.0625 full marks will be awarded for correct numerical answer without working	(2)

Q5.

	Answer	Additional guidance	Mark
(i)	selection and substitution (1) (KE) = $\frac{1}{2}$ x 3.6 x 10^5 x 71^2 evaluation (1) 9.1 x 10^8 (J)	accept 9.07 x 10^8 (J) accept 907 380 000 (J) award full marks for correct answer without working do not award a power of ten error	(2) AO2

	Answer	Additional guidance	Mark
(ii)	any **one** from: mechanically (to the thermal store) (1) (heating) due to air resistance / friction (1) thermally (1)	 allow dissipated thermal (store) / heat (energy)	(1) **AO2**

Q6.

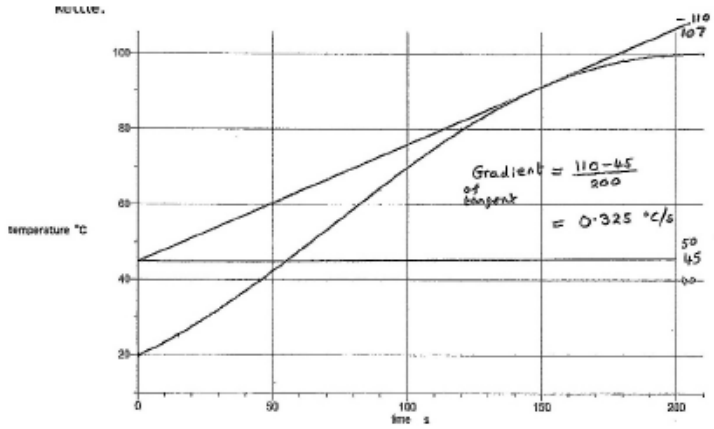
Question number	Answer	Additional guidance	Mark
	recall **and** rearrangement (1) $\lambda = \frac{v}{f}$ evaluation (1) 3.08 (m) (so) length of aerial = 1.54 m (1) check working $\frac{3 \times 10^8}{2} = 1.5 \times 10^8$ gets only 1 mark for ecf	 $\frac{3.0\ (\times 10^8)}{97.4\ (\times 10^6)}$ accept 3.1 (m) award 1 mark for wavelength that rounds to 3.1 to any other power of 10 independent mark. allow ECF from candidate's wavelength accept 1.5 (m) award 2 marks for 1.5 to any other power of 10 award full marks for the correct answer without working Allow 1.46 rounded to 1.5 for 1 mark only if it is ecf from mp2	**(3)**

Q7.

Question number	Answer	Additional guidance	Marks
(i)	recall K.E.= ½ m v^2(1) rearrangement (1) (m =) 2 x K.E. ÷ v^2 substitution (1) (m =) 2 x 960 000 ÷ 40^2 Evaluation (1) = 1200 (kg)	award full marks for the correct answer without working rearrangement and substitution in either order Ignore POT until evaluation	(4)

Question number	Answer	Additional guidance	Marks
(ii)	Use of efficiency equation (1) $\frac{960}{5}$ evaluation (1) =19 (MJ)	award full marks for correct numerical answer without working accept 19.2 (MJ)	(2)

Q8.

Question number	Answer	Additional guidance	Mark
	 drawing tangent attempt (1) correct data points from graph (1) 60,60 and 150,92 evaluation (1) 0.33±0.07 (°C / s)	accept other data from the graph award full marks for the correct answer without working	(3)

Q9.

Question number	Answer	Additional guidance	Mark
	rearrangement and substitution (1) energy supplied = $\frac{\text{useful energy}}{\text{efficiency}}$ = $\frac{3.3 \times 10^5}{0.91}$ evaluation (1) 3.6×10^5 (J)	 (3.626×10^5) number that rounds to 3.6×10^5 (J) 3600 or 3626 scores 1 mark award full marks for the correct answer without working no marks for 91% of $3.3 \times 10^5 = 3.0 \times 10^5$ (J)	**(2)**

Q10.

Question Number	Answer	Additional guidance	Mark
	recall and substitution (1) (v =) 0.25 x 1.5 evaluation (1) 0.38 (m/s)	 accept 0.375 or 0.37 (m/s) accept 37.5, 37 or 38 for 1 mark only award full marks for the correct answer without working	**(2)**

Q11.

Question number	Answer	Additional guidance	Mark
	uses data taken from x axis (1) 28(cm) (1)	award full marks for correct answer without working	**(2)** **AO3**

Q12.

Question Number	Answer	Additional guidance	Mark
(i)	selection and substitution (1) $3(.00) \times 10^8 = 2.45 (\times 10^9) \times \lambda$ rearrangement (1) $(\lambda =) \frac{3(.00)\times 10^8}{2.45 (\times 10^9)}$ evaluation (1) 0.12 (m)	allow substitution and rearrangement in either order $2.45 \left(\times 10^9\right) = \frac{3(.00) \times 10^8}{\lambda}$ $\lambda = \frac{v}{f}$ accept 0.122(m) power of ten error gains 2 marks award full marks for the correct answer without working	**(3)** **AO2**

Question Number	Answer	Additional guidance	Mark
(ii)	selection and substitution (1) $(0.)55=\frac{42\ 000}{\text{total energy supplied (to device)}}$ rearrangement (1) $(\text{total energy supplied to device}=)\frac{42\ 000}{(0.)55}$ evaluation (1) 76 000(J)	allow substitution and rearrangement in either order $(0.)55=\frac{42\ 000}{x}$ accept any value that rounds to 76 000(J) 760/764/763(J) gains 2 marks any other power of ten error gains 1 mark award full marks for the correct answer without working	**(3)** **AO2**

Q13.

Question Number	Answer	Additional guidance	Mark
(i)	selection and substitution (1) $3(.00) \times 10^8 = 2.45 (\times 10^9) \times \lambda$ rearrangement (1) $(\lambda =) \frac{3(.00)\times 10^8}{2.45 (\times 10^9)}$ evaluation (1) 0.12 (m)	allow substitution and rearrangement in either order $2.45 \left(\times 10^9\right) = \frac{3(.00) \times 10^8}{\lambda}$ $\lambda = \frac{v}{f}$ accept 0.122(m) power of ten error gains 2 marks award full marks for the correct answer without working	**(3)** **AO2**

Question Number	Answer	Additional guidance	Mark
(ii)	selection and substitution (1) $(0.)55=\frac{42\ 000}{\text{total energy supplied (to device)}}$ rearrangement (1) $(\text{total energy supplied to device}=)\frac{42\ 000}{(0.)55}$ evaluation (1) 76 000(J)	allow substitution and rearrangement in either order $(0.)55=\frac{42\ 000}{x}$ accept any value that rounds to 76 000(J) 760/764/763(J) gains 2 marks any other power of ten error gains 1 mark award full marks for the correct answer without working	**(3)** **AO2**

Q14.

Question number	Answer	Mark
(i)	An answer that combines the following points of understanding to provide a logical description: • take time T for waves to pass a fixed point (1) • and frequency = $\frac{\text{number of waves}}{\text{time taken}}$ (1)	**(2)**

Question number	Answer	Mark
(ii)	A	**(1)**

Question number	Answer	Mark
(iii)	D	(1)

Q15.

Question Number	Answer	Mark
	B. when there are energy transfers, the total energy does not change ***A*** *is not correct because the total energy does not reduce* ***C*** *is not correct because the total energy does not reduce* ***D*** *is not correct because the total energy does not increase*	(1) AO1

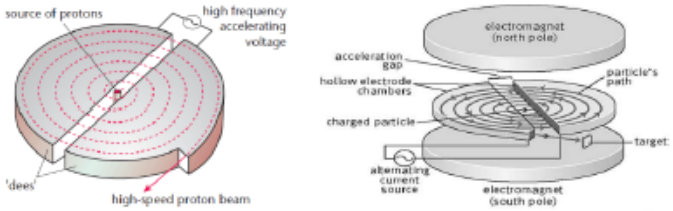
Q16.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	D towards the centre of the circle		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	centripetal (force)	reject centrifugal force accept misspellings where meaning is clear e.g. centripedal	**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(iii)	Any two of the following :- ball slows down (1) ball / it drops (down) / circles at a lower height (1) go in smaller circles (1)	 less **kinetic** energy / momentum any lowering / less **potential** energy stops going in circles the ball/it would not make complete circles (not just 'stops')	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(iv)	An explanation linking: • the idea that momentum (of the closed system) would stay the same (1) • the idea that kinetic energy would not be conserved (1)	 momentum **of the ball** decreases / changes (direction) / passed to wall must specify which momentum; do not credit 'momentum decreases' by itself kinetic energy → heat/sound/wall ignore 'KE decreases / is lost' without qualification allow 'KE is lost because it's not elastic' (i.e. qualified)	**(2)**

Question Number		Indicative Content	Mark
QWC	*** (b)**	A description including some of the following points :- Cyclotron • two D-shaped halves • gap between the Dees • (alternating) voltage across the gap • magnetic field (at right angles to the moving particles) • vacuum enables free movement of particles Particle movement • accelerate • start at the centre • move in a circular path • spiral outwards • exit in a straight line Examples of labelled diagrams which would give Level 3 by themselves (not all labels / details needed)  Level 2 if no labels but Dees AND particle path shown. Level 1 if no labels but either Dees OR spiral of particle shown Ignore uses of cyclotron	**(6)**

Level	**0**	No rewardable content
1	**1 - 2**	• a <u>limited</u> description of either particle movement OR cyclotron e.g. The particles move in a circle OR Cyclotrons have two Dees OR Cyclotrons are particle accelerators OR there's a vacuum • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	**3 - 4**	• a <u>simple</u> description of particle movement AND cyclotron OR a more detailed description of one e.g. A cyclotron has two D-shaped halves and the particles inside accelerate OR A cyclotron has a magnetic field and a voltage across the gap OR Charged particles increase in speed as they spiral outwards OR vacuum allows free movement of particles • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• a description of particle movement AND cyclotron with a <u>detailed</u> description of one of them e.g. the charged particles get faster as they accelerate across the gap in the Dees **OR** the magnetic field (of the cyclotron) causes the particles to move in a circle • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

(Total for Question = 12 marks)

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Q17.

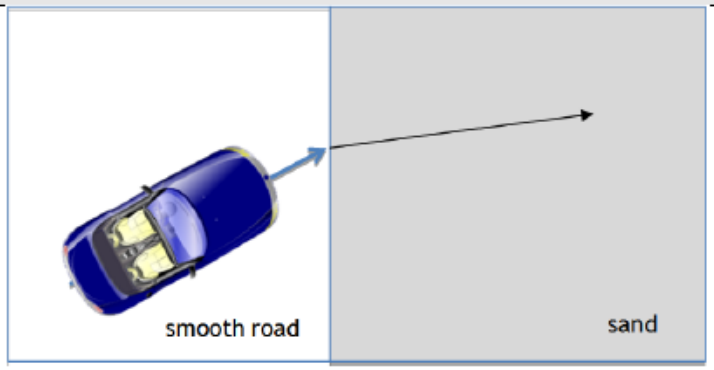
Question number	Indicative content	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive, and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 1 **(6 marks)** **fission** • (heavy) nucleus split • by a neutron • releases 2 daughter nuclei + more neutrons + energy • starts chain reaction **advantages** • already in use **disadvantages** • waste is radioactive • hard to dispose of • risk of accident	**(6)** **AO1**

	fusion • (light) nuclei joined • at high energy/temperature/pressure/particle density • releases (eg) helium + energy **advantages** • no harmful waste products **disadvantages** • not achieved yet (on a practicable scale) • difficulty in achieving high energy/temperature/pressure/particle density	

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	**Mark**	**Additional Guidance**	**General additional guidance – the decision within levels** e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance isolated facts	Possible candidate responses fission involves a nucleus being split by a neutron
Level 2	3–4	Additional guidance simple comparison of fission and fusion	Possible candidate responses fission involves a nucleus being split by a neutron whereas fusion requires combining two light nuclei.
Level 3	5–6	Additional guidance detailed comparison of fission and fusion and one advantage or one difficulty compared to the other	Possible candidate responses Fission involves nuclei split by a neutron. Fusion involves combining two light nuclei. The waste from fission is radioactive. Practicable fusion has not been achieved.

Q18.

Question number	Answer	Mark
(i)	 approx	(1)

Question number	Answer	Additional guidance	Mark
(ii)	An explanation that combines identification - knowledge (1 mark) and reasoning/justification - understanding (1 mark): • both car and light ray slow down when entering sand / glass (1) • direction changes towards normal (1)	Bend towards the normal	(2)

Q19.

Question Number	Answer	Additional guidance	Mark
	single straight line in upper right quadrant (1) direction change **towards** the normal (1)	ignore arrow direction conditional on first mark point	(2)

Q20.

Question number	Answer	Additional guidance	Mark
	A description to include: mention relevant energy store such as GPE or chemical (1) 'correct' transfer in context (1)	 allow KE or mechanical or thermal or heat chemical to (G)PE or chemical to KE (in lifting) allow misread GPE to KE/thermal on slope Allow KE to GPE in lifting	**(2)**

Q21.

Question number	Answer	Mark
	An answer that provides a description by making reference to: • transverse waves have oscillations perpendicular to direction of travel of the wave (1) • whereas longitudinal waves have oscillations in the same direction as the direction of travel of the wave (1)	**(2)**

Q22.

Question Number	Answer	Additional guidance	Mark
	A description including particles (at end) vibrate (more) (about fixed positions) (1) cause neighbouring particles to vibrate (more) (1)	 allow atoms / ions / molecules for particles vibrations passed along OR reference to longitudinal waves / compressions and rarefactions	**(2)**

Q23.

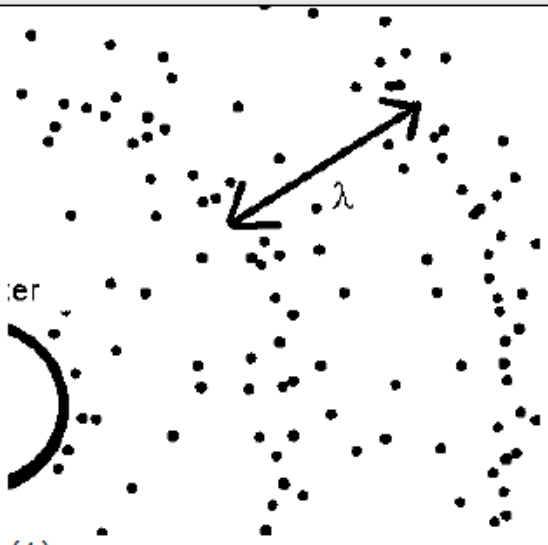
	Answer	Additional guidance	Mark
	a description giving as the density (of expanded polystyrene) increases the (thermal) conductivity decreases (1) non-linear / gradient decreases / at a decreasing rate / levels off / plateaus / becomes (almost) constant (1)	 ORA allow inversely proportional / exponential for non-linear in this context ignore negative correlation unqualified quoted values are insufficient	**(2)** **AO2**

Q24.

Question number	Indicative content	Mark
	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. **AO1 (6 marks)** • point A reaches the glass block before point B • A moves into the glass block and slows down • as light travels more slowly in glass than in air • B is still in air so is travelling faster than A • this causes part of the wavefront to change direction/refract • by the time B reaches the block it will have travelled further than A • therefore, the whole wavefront changes direction/refracts towards the normal • at the other face, A exits first so the process is reversed • the wavefront changes direction again so it is parallel to its original direction/refracts away from the normal	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Q25.

Question number	Answer	Additional guidance	Mark
(i)	 (1)	any similar distance labelled wavelength / λ between the equivalent of 2 consecutive compressions	(1)

Question number	Answer	Additional guidance	Mark
(ii)	description including any two from: particles vibrate / oscillate/ move backwards and forwards (1) along a radius/ parallel to direction of travel/ energy transfer (1) about mean /fixed positions (1)	 allow air for particles in same direction as wave allow one mark for 'sound is a longitudinal wave' if no other mark awarded	(2)

Q26.

	Answer	Acceptable answers	Mark
(ai)	(Bow and arrow:) kinetic (1) (Electric kettle:) heat (thermal) (1) (Microphone:) sound (1)	Heat/thermal	(3)
(a)(ii)	Any **one** from (transferred into) {thermal/heat/sound}(energy) (1) (Energy) is dissipated (1)	Do not accept light energy or it disappears goes into surroundings/air (energy) is wasted/lost	(1)
(b)(i)	12 (J)	20 - 8 (J)	

	Ignore any unit given by candidate.		**(1)**
(b)(ii)	An explanation linking any **two** of • (For the) same amount of {electrical/supplied} (energy/power) (1) • (CFL/it) has a greater output (of light energy) (1) • (CFL/it) wastes less (electrical energy) (1)	Same input (energy) gives out/produces more {light/useful} (energy) Do not accept more energy is used in the (CFL/it) Ignore brightness. (CFL/it) produces less thermal/heat (energy) Accept explanations using data from the energy transfer diagrams as comparisons eg (CFL/it) is four times as efficient gains both marks	**(2)**
(c)	An explanation linking • dissipating heat (1) • at same (rate)/as quickly as energy is being supplied (1)	{gives out/radiates/conducts/ convects /loses /produces} {heat/thermal/ energy} gives out as much energy/power as it takes in(each second) Gains both marks If no other marks scored: There is a constant current/ steady flow of energy into the heater gains one mark Ignore refs to thermostat	**(2)**

Total for Question = 9 marks

Q27.

Question Number	Answer	Acceptable answers	Mark
(a)	A transverse and electromagnetic		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	Evaluation 171.5 (1) Substitution (34.3/171.5) x 100 (1) Evaluation 20 (%) (1)	award full marks for correct answer with no working 34.3 x 5 [34.3 /(34.3 x 5)] x 100 [34.3 /(34.3 x 5)] [34.3 /171.5] Allow 0.2 or 1/5 for 3 marks	**(3)**

Question Number	Answer	Acceptable answers	Mark
(c)	rate of {energy/heat} (from the Sun){absorbed/taken in} (1) equals rate of {energy/heat} {radiated/emitted/given out}(1)	Allow 'energy in = energy out' for 1 mark 'power in = power out' for 2 marks	**(2)**

Q28.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	B (50 m)		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	kinetic (1) electrical (1) in this order.	movement electric, electricity poor spellings of electrical electronic Reject 2 forms of energy in one answer	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	140 (J)	200 – 60 140 in words	**(1)**

Question Number	Answer	Acceptable answers	**Mark**
(b)(ii)	• substitution (1) $\frac{60}{200} \times 100$ % • evaluation (1) 30 %	$\frac{60}{200}$ 0.3 ignore units Award full marks for correct answer with no working	**(2)**

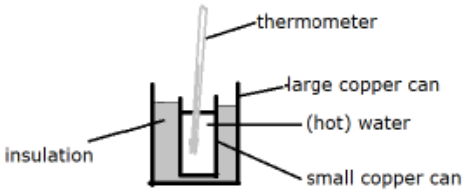
Question Number	Answer	Acceptable answers	**Mark**
(b)(iii)	explanation linking: • energy supplied and radiated (1) • (at) equal (rate) (1)	allow used for radiated heat gained = heat lost 2 marks input energy = output energy 2 marks input power = output power 2 marks input = output 1 mark	**(2)**

Question Number	Answer	Acceptable answers	**Mark**
(c)	• substitution (1) $\frac{6000}{250}$ • evaluation (1) 24 (years)	Award full marks for correct answer with no working ignore units	**(2)**

Q29.

Question Number	Answer	Additional guidance	Mark
	An explanation linking: make the distance between students larger (1) OR viable alternative method such as use microphones / sound sensors / datalogger (to start and stop timer) (1) **with:** to give a more measurable time (1) OR to remove (variable) reaction times (at start and end) / to reduce effect of reaction times / improve accuracy of timing (1)	50 m is too short (a distance to produce a measurable time) gives a longer time – more accurate measurement do not accept 'more accurate' without qualification for either method	**(2)**

Q30.

Question Number	Answer	Additional guidance	Mark
(i)	a diagram showing: apparatus labelled to include **three** from • thermometer • water • insulator / sand / sawdust / material • (copper) can (1) thermometer in the **water** (1) arrangement for water and insulator in and between copper cans (e.g. as in diagram below) (1)  	independent of arrangement ignore kettle and stop clock accept reverse positions for water and insulator	**(3)** **AO2**

Question Number	Answer	Additional guidance	Mark
(ii)	any **three** factors from: {mass / volume} of water (1) {volume / thickness / mass} of insulators / materials (1) {starting / initial} temperature of water (1) time interval / temperature change (1)	 accept amount / specified values / "how much" accept amount / specified values / "how much" accept temperature of hot / boiling water / specified values accept specified values of interval or change unqualified "same time" is insufficient	**(3)** **AO3**