Pearson
Edexcel

Mark Scheme
Results

Summer 2022

Pearson Edexcel GCSE
In Physics (1PH0) Paper 1H

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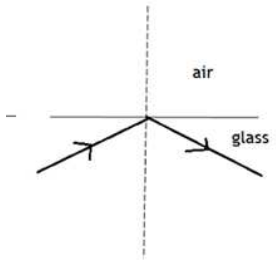
General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Mark schemes have been developed so that the rubrics of each mark scheme reflects the characteristics of the skills within the AO being targeted and the requirements of the command word. So for example the command word 'Explain' requires an identification of a point and then reasoning/justification of the point.
Explain questions can be asked across all AOs. The distinction comes whether the identification is via a judgment made to reach a conclusion, or, making a point through application of knowledge to reason/justify the point made through application of understanding. It is the combination and linkage of the marking points that is needed to gain full marks.
When marking questions with a 'describe' or 'explain' command word, the detailed marking guidance below should be consulted to ensure consistency of marking.

Assessment Objective		**Command Word**	
Strand	**Element**	**Describe**	**Explain**
AO1*		An answer that combines the marking points to provide a logical description	An explanation that links identification of a point with reasoning/justification(s) as required
AO2		An answer that combines the marking points to provide a logical description, showing application of knowledge and understanding	An explanation that links identification of a point (by applying knowledge) with reasoning/justification (application of understanding)
AO3	1a and 1b	An answer that combines points of interpretation/evaluation to provide a logical description	
AO3	2a and 2b		An explanation that combines identification via a judgment to reach a conclusion via justification/reasoning
AO3	3a	An answer that combines the marking points to provide a logical description of the plan/method/experiment	
AO3	3b		An explanation that combines identifying an improvement of the experimental procedure with a linked justification/reasoning

*there will be situations where an AO1 question will include elements of recall of knowledge directly from the specification (up to a maximum of 15%). These will be identified by an asterisk in the mark scheme.

Qustion Number	Answer	Mark
1a	**B**  **Once DTP redraw image, crop and insert here.** ***A*** *is not correct because the angle of incidence is not equal to the angle of reflection* ***C*** *is not correct because glass is more optically dense than air* ***D*** *is not correct because glass is more optically dense than air*	**(1)** **AO1**

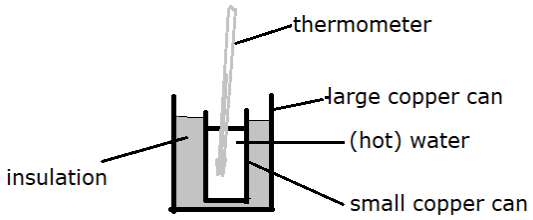
Question Number	Answer	Additional guidance	Mark
1(b)(i)	substitution (1) $\frac{18.0 \pm 1}{7.0 \pm 1}$ **OR** $\frac{3.5 \pm 0.2}{1.4 \pm 0.2}$ evaluation (1) 2.6 ± 0.5	award full marks for correct answer without working	**(2)** **AO2**

Question Number	Answer	Additional guidance	Mark
1(b)(ii)	a description to including one pair of: use different lens/replace lens (1) {higher power / shorter focal length / fatter / thicker / more curved / greater refractive index / more convex} lens (1) **OR** change the distance / move the lens / move the object (1) further away (from the object/lens) (1)	accept stronger curvature of lens increased (2) increase distance between object and lens (2)	**(2)** **AO3**

Question Number	Answer	Additional guidance	Mark
1(c)	substitution (1) $\frac{1}{f}=\frac{20+40}{20\times40}$ evaluation of $\frac{1}{f}$ (1) 0.075 evaluation of f (1) 13 (cm)	accept $\frac{1}{f}=\frac{60}{800}$ OR $\frac{1}{f}=\frac{3}{40}$ accept 13.3 (cm) 13.33 (cm) power of ten error on 13 gains 2 marks 0.075 on answer line gains 2 marks power of ten error on 0.075 gains 1 mark $\frac{40}{3}$ scores 2 marks award full marks for correct answer without working	**(3)** **AO2**

(Total for Question 1 = 8 marks)

Question Number	Answer	Mark
2(a)	**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**

Question Number	Answer	Additional guidance	Mark
2(b)(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
2(b)(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**

	Answer	Additional guidance	Mark
2(c)	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**

Total for Question 2 = 9 marks

	Answer	Additional guidance	Mark
3(a)(i)	an explanation linking **two** from: (wet road means) less / no friction (between tyres and road) (1) (wet weather means) increased stopping distance (1) (slower speed means) shorter braking / stopping distance (1) (dry weather / slower speed) reduces possibility of skidding / sliding / idea of losing control / crashing (1)	accept reverse arguments throughout accept (road) more slippery / less grip accept idea of reduced visibility accept braking or thinking distance in this context accept takes longer to slow down / stop ignore harder to brake	**(2)** **AO1**

	Answer	Additional guidance	Mark
3(a)(ii)	convert **either** distance or time (1) (31 m =) $\frac{31}{1000}$ (km) or 0.031 (km) **OR** (1 s =) $\frac{1}{3600}$ (h) = $\frac{1}{60\times60}$ (h) or 0.000 28 (h) evaluation (1) (31 m/s =) 110 (km/h)	 (130 km =) 130 × 1000 (m) or 130 000 (m) **OR** (1 h =) 60 x 60 (s) or 3600 (s) (130 km/h =) 36(.1) (m/s) accept 111.6 or 112 (km/h) for 2 marks if no other marks awarded accept <u>1860 m/min</u> and <u>2167 m/min</u> for 1 mark each award full marks for the correct answer without working	**(2)** **AO2**

	Answer	Additional guidance	Mark
3(a)(iii)	select and substitute into distance travelled = average speed x time (1) 46 = 31 x t rearrangement and evaluation (1) (t=) 1.48(3) (s) evaluation given to 2 sf (1) (t =) 1.5 (s)	 31 = $\frac{46}{t}$ (t =) $\frac{46}{31}$ award two marks for the correct evaluation without working any answer written to 2 sf independent mark 1.5 scores 3 marks 1.4 scores 2 marks 1.50 scores 2 marks 0.67 scores 2 marks 1400 scores 2 marks 0.673(9) scores 1 mark 1426 scores 1 mark	**(3)** **AO2**

Total for Question 3 = 7 marks

Question Number	Answer	Mark
4(a)(i)	**D gamma** ***A*** *is not correct because alpha cannot pass through and out of the body* ***B*** *is not correct because beta plus cannot pass through and out of the body* ***C*** *is not correct because beta minus cannot pass through and out of the body*	**(1)** **AO1**

	Answer	Additional guidance	Mark
4 (a)(ii)1 CLIP with (a)(ii)2	decays too quickly to give a reading (1)	accept (half-life) not long enough for reading to be taken ignore disappear after 12 min	**(1)** **AO1**

	Answer	Additional guidance	Mark
4 (a)(ii)2 CLIP with (a)(ii)1	stays in the body too long (1)	accept could harm / damage other organs patients stay radioactive for too long so the patient does not get too high a dose of radiation	**(1)** **AO1**

	Answer	Additional guidance	Mark
4(a)(iii)	**Two** from: shielding (1) time limiting exposure (1) distance limiting exposure (1) wear PPE / protective clothing (1)	 accept stand behind barriers / store (source) in lead box radiation monitoring badges leave the room / go outside / stay away from the patient / use tongs lead aprons / gloves ignore goggles / masks	**(2)** **AO1**

	Answer	Additional guidance	Mark
4(b)(i)	an explanation linking: (control rods) absorb <u>neutrons</u> (1) (so) fewer (neutrons) available for chain reaction (1)	ignore slow down the nuclear chain reaction accept (control rods) block <u>neutrons</u> accept <u>neutrons</u> can't pass through (control rods) fewer fission(s) (reactions)	**(2)** **AO1**

	Answer	Additional guidance	Mark
4(b)(ii)	$\frac{4(.0 \times 10^3)(\times 100)}{3(.0 \times 10^7)}$ (1) 1.3×10^{-2} (%) (1)	 0. 013 (%) allow 0.01 (%) power of ten error scores 1 mark maximum award full marks for the correct answer without working	**(2)** **AO2**

	Answer	Additional guidance	Mark
4(b)(iii)	A description to include: (from) kinetic energy (of fission fragments) (1) (transferred to) thermal energy (of coolant) (1)	accept references to energy stores accept energy in nuclear store accept nuclear energy / gamma radiation energy / binding energy / mass (to) thermal store (in coolant) accept heat for thermal if no other marks awarded allow steam transfers thermal energy/heat from reactor to kinetic energy of turbine for 2 marks	**(2)** **AO1**

Total for Question 4 = 11 marks

	Answer	Additional guidance	Mark
5(a)(i)	selection and substitution (1) (a =) $\frac{82\ (\ -\ 0)}{36}$ evaluation (1) 2.3 (m/s^2)	**note: this is a "show that" question** accept any value that rounds to 2.3 (m/s^2) accept 2.2 (m/s^2) for 1 mark maximum answer of 2 (m/s^2) without a substitution scores 0 marks	**(2)** **AO2**

	Answer	Additional guidance	Mark
5(a)(ii)	substitution (1) 82^2 (– 0^2) = 2 x 2.3 x *x* rearrangement (1) (x) = $\frac{82^2\ (\ -\ 0^2)}{2\times2.3}$ evaluation (1) 1500 (m)	allow substitution and rearrangement in either order accept 2, 2.2, 2.27, 2.3 for "a" throughout (x) = $\frac{v^2\ (\ -\ u^2)}{2\times a}$ ignore sign accept 1460 (m) allow answers in the ranges: 1460 (m) to 1482 (m) 1520 (m) to 1530 (m) 1680 (m) to 1700 (m) award full marks for correct answer without working	**(3)** **AO2**

	Answer	Additional guidance	Mark
5(a)(iii)	one statement from take off aborted (1) mechanical/engine failure (1) acceleration reduced (1) weather related reasons (1) larger mass / heavier plane / extra passengers (1) (longer runway required) for landing (1)	any other sensible suggestion	**(1)** **AO3**

	Answer	Additional guidance	Mark
5(b)(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
5(b)(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**

Total for Question 5 = 9 marks

Question Number	Answer	Mark
Q6	**C** **both Redshift and CMB can be explained by the Big Bang theory** ***A*** *is not correct because CMB can be explained by the Big Bang* ***B*** *is not correct because the Steady State theory cannot explain CMB* ***D*** *is not correct because the Steady state theory can explain red shift*	**(1)** **AO1**

	Answer	**Additional guidance**	**Mark**
6(b)(i)	substitution (1) $(z=)\ \frac{6.72\times10^{-7} - 6.56\times10^{-7}}{6.56\times10^{-7}}$ **OR** $(z=)\ \frac{0.16\times10^{-7}}{6.56\times10^{-7}}$ evaluation (1) 0.024	allow $(z=)\ \frac{6.72\text{-}6.56}{6.56}$ **OR** $(z=)\ \frac{0.16}{6.56}$ do not accept 0.025 on its own accept 0.0243 / 0.02439 / 0.0244 award full marks for the correct answer without working	**(2)** **AO2**

	Answer	Additional guidance	Mark
6(b)(ii)	substitution (1) (v) = 0.024 x 3(.00) x10^8 evaluation (1) 7.2 x 10^6 (m/s)	 accept (v) = 0.025 x 3 x10^8 (v) = 0.02 x 3 x10^8 accept answers which round to: 6.0 x10^6 (m/s) 7.5 x10^6 (m/s) 7.3 x10^6 (m/s) 7.2 x10^6 (m/s) award full marks for the correct answer without working	**(2)** **AO2**

	Answer	Additional guidance	Mark
6b(iii)	An explanation linking :- the redshift / z (value) will be larger (1) the galaxy is moving (away) at a higher velocity / recession velocity increased (1)	 bigger (increase in) wavelength bigger difference in wavelength longer wavelength moving (away) faster	**(2)** **AO1**

	Answer	Additional guidance	Mark
6(c)	an explanation linking: telescopes are above Earth / in space / outside the Earth's atmosphere (1) less interference from dust / clouds (1) wavelengths that are absorbed by Earth's atmosphere (microwaves / IR / UV) (1) can view the whole sky (1)	allow any other sensible benefit allow atmospheric distortion/ (light/air) pollution accept named examples of satellites or waves do not accept idea that telescope is closer to object in space	**(2)** **AO1**

Total for Question 6 = 9 mark

Question Number	Answer	Mark
Q7(a)	**A** kg m/s ***B*** *is not correct it is mass divided by velocity* ***C*** *is not correct because it is the product of mass and acceleration* ***D*** *is not correct because it is mass divided by acceleration*	**(1)** **AO1**

	Answer	**Additional guidance**	**Mark**
7(b)(i)	a description using any **four** of the following points in a logical order: measure the mass / weight of the trolley(s) / weigh the trolley(s) (1) determine the speed of trolley A (1) put one light gate (connected to data logger) further down the runway than trolley A and another beyond trolley B (1) trollies A and B stick together (1) measure combined velocity / speed of A and B (1) calculate momentum of trolley A before collision **and** A and B after collision (1) check for equality / velocity after collision is half that before collision (1) repeat **and** take mean / average (1)	 allow determine / find / calculate use (average) speed = distance / time to calculate speed of trolley A may be shown on diagram measure distance and time in appropriate places calculate (total) momentum before and after collision (total) momentum before equals (total) momentum after	**(4)** **AO1**

	Answer	Additional guidance	Mark
7 (b)(ii)	{compensating for / reducing **effect** of / overcoming / balancing / cancelling **effect** of} friction OR so that trolley A travels at a constant speed / doesn't slow down	do not accept reducing / cancelling friction do not accept so trolley accelerates down slope	**(1)** **AO3**

	Answer	Additional guidance	Mark
7 (c)(i)	conversion of time to s (1) (t =) 0.012 **OR** 12×10^{-3} **OR** 1.2×10^{-2} substitution (1) (F=) $\frac{(0.075 \times -15.0) - (0.075 \times 8.2)}{0.012}$ OR (F=) $\frac{(0.075 \times 15.0) - (0.075 \times -8.2)}{0.012}$ OR (F=) $\frac{0.075 \times (15.0 + 8.2)}{0.012}$ evaluation (1) (-)150 (N)	substitution and conversion in either order ignore signs on velocity accept time to any power of ten for substitution mark (F=) $\frac{(1.125) + (0.615)}{0.012}$ 145 (N) scores 3 marks 145 (N) to any other power of ten scores 2 marks maximum 42.5 (N) scores 2 marks maximum 42.5 (N) to any other power of ten scores 1 mark maximum 93.75 (N) or 51.25(N) 1.933 scores 1 mark maximum award full marks for correct answer without working	**(3)**

	Answer	Additional guidance	Mark
7 (c)(ii)	Any two from: (forces are) equal / same size (1) (forces are) opposite (direction) (1) (forces) act on different bodies (1) same type of force (1)	no marks awarded for answers in terms of energy (forces are) one to the left, one to the right one (force) acts on racket, one acts on ball both are contact forces if no other marks awarded, allow action and reaction (acting) for 1 mark	**(2) AO1**

Total for Question 7 = 11 marks

	Answer	Additional guidance	Mark
8(a)	substitution (1) number of atoms = $\frac{4.0\times10^{-7}}{0.15\ (\times10^{-9})}$ evaluation (1) 2 700	$\frac{4.0\times10^{-7}}{1.5\ (\times10^{-10})}$ $\frac{0.000\ 000\ 4}{0.000\ 000\ 000\ 15}$ accept any value that rounds to 2 700 award full marks for correct answer without working	**(2)** **AO2**

	Answer	Additional guidance	Mark
8(b)(i)	reading from graph (1) (at 5 degrees:) number between 10^6 and 10^7 **AND** (at 100 degrees:) 10^2 evaluation (1) $\frac{\text{number between } 10^6 \text{ and } 10^7}{10^2}$ **OR** between 10^4:1 and 10^5:1 between 10 000:1 and 100 000:1 **OR** between 10^4 and 10^5 between 10 000 and 100 000	(e.g. $10^{6.5}$) (e.g. $10^{4.5}$:1 or 10^7:10^2) allow any correct ratio not in its simplest form (e.g. $10^{4.5}$) award full marks for correct answer without working inverted ratio scores 1 mark maximum	**(2)** **AO2**

	Answer	Additional guidance	Mark
8(b)(ii)	an explanation including any **four** from: Observations most (alpha particles) pass (straight) through the foil (with little deflection) (1) some (alpha particles) are {scattered / deflected} through {small angles / less than 90 degrees} (1) (very) few (alpha particles) are {scattered / deflected} through {large angles / greater than 90 degrees} (1) Conclusions atoms are mainly empty space (1) there must be a nucleus / something inside the atom (1) (nucleus / something) must be {small / heavy / dense / concentrated / charged / positive} (1)	ignore electrons ignore refracted allow repelled allow rebound / reflect / back scattering / bounce back ignore electrons	**(4)** **A01,AO3**

	Answer	Additional guidance	Mark
8(c)(i)	A description including: roll / release / drop a marble (down the slope) (1) and **one** from record where the marbles go (1) **OR** measure the angle of path (1)	 allow alpha particle for marble allow any method of recording	**(2)** **AO3**

	Answer	Additional guidance	Mark
8(c)(ii)	any **one** from marble / weight has no charge (1) the edge of the paper is not far enough away from the weight (1) the marble / weight is too big / small (1) there is only one marble / weight (1) it is 2 dimensional / not 3D (1) all marbles have the same speed / alpha particles different speed to marbles (1) marbles (only deflect on) hitting / contact with weight (1)	 not to scale allow marble cannot pass through the weight (1)	**(1)** **AO3**

Total for Question 8 = 11 marks

Question Number	Answer	Mark
9a	**B** frequency increases ***A*** *is not correct because the danger does not increase with decreasing frequency* ***C*** *is not correct because all waves in the e-m spectrum have the same velocity* ***D*** *is not correct because all waves in the e-m spectrum have the same velocity*	**(1)** **AO1**

Question Number	Answer	Additional guidance	Mark
9b(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
9b(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**

Question number	Indicative content	Mark
9c	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 **Comparison** X–rays: high frequency / short wavelength / ionising / high energy Radio waves: low frequency / long wavelength / not ionising / low energy **X ray are used** • in medical diagnosis, to find broken bones, damage to lungs • radiotherapy • treatment of cancer • airport security • revealing counterfeit art **X-rays are emitted when electrons change energy levels because** • electrons in lower energy levels can absorb energy • the electrons move to higher energy levels • when the electrons return to a lower energy level • the electrons lose energy as radiation. • the electrons need to lose a large amount of energy • (so that) they emit x-ray radiation of high energy/frequency • **Radio waves are used** • broadcasting television • broadcasting radio • communications • satellite transmissions • mobile phones • radar	**(6)** **AO1**

	Radio-waves are emitted when • electrons oscillate in electrical circuits **oscillations are** • current (flow of electrons) that continually change direction • current flows up and down in a (transmitting) aerial • alternating current (AC) • this generates radio waves in the air around the aerial • the frequency of the radio waves corresponds to the oscillation frequency **N.B. No credit is given for:** **Electrons within an atom go through energy changes** **OR** **Radio waves are produced in electrons in circuits** **These phrases are in the stem of the question**	

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3–4	Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5–6	Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Additional Guidance	General additional guidance – the decisions within levels
	0	No rewardable material	
Level 1	1-2	Additional guidance Elements of physics present i.e. isolated knowledge of principles, **two** unconnected statements	Possible candidate response any use of X rays any use of radio waves any comparison electrons are around the nucleus a current is electrons (moving) electrons oscillate
Level 2	3-4	Additional guidance Some knowledge of principles with limited detail on use and a comparison or process	Possible candidate response any use of x-rays and of radio waves with limited detail and one of: a comparison or electrons lose energy to emit X-rays or electrons oscillate in circuits
Level 3	5-6	Additional guidance Detailed knowledge of principles on use with logical connections made about one process	Possible candidate response Use of X-rays and of radio waves with detail and one of: electrons lose energy to change to lower energy level and emit energy as X–rays or electrons oscillate in circuit and currents move up and down in aerials to generate radio waves

Total for Question 9 = 13 marks

Question Number	Answer	Mark
Q10(a)	**B** 20k Hz to 20 Hz ***A*** *is not correct because 2Hz is an infrasound frequency* ***C*** *is not correct because 2000kHz is an ultrasound frequency* ***D*** *is not correct because 200kHz is an ultrasound frequency*	**(1)** **AO1**

	Answer	**Additional guidance**	**Mark**
10 (a) (ii)	An explanation linking any two of :- the size of the parts of the (inner) ear (1) vibrations at (limited) range of frequencies/range of sounds most common as adapted through evolution (1) (membrane) variations in stiffness/ width/thickness (1) different parts vibrate at different frequencies (1) eardrum not sensitive enough to detect low/high frequencies (1) brain cannot interpret low/high frequencies (1)	 allow length of cochlea allow cochlea allow ultrasound / infrasound allow ultrasound / infrasound	**(2)** **AO2**

	Answer	Additional guidance	Mark
10 (b) (i)	An explanation linking two of: the crack reflects/bounces back /echoes the signal (1) in a shorter time/ before it reaches the base of the metal (1)	 Q is reflection from crack/P and R are reflections from the base	**(2)** **AO3**

	Answer	Additional guidance	Mark
10 (b) (ii)	One from:- less of the pulse reaches the base (1) some energy is absorbed by the crack (1) some energy is reflected by the crack (1)	 allow less of the pulse is reflected/bounces off base allow signal/wave/energy/ultrasound for pulse allow signal/wave/pulse/ultrasound for energy allow signal/wave/pulse/ultrasound for energy	**(1)** **AO1**

Question number	Indicative content	Mark
10c	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 3 marks AO3 Strand1 3marks When there is an Earthquake **At A** • Longitudinal and transverse waves detected • P arrive before S. • must be travelling in a solid because S waves only travel through solids • the region just under the Earth's crust (mantle) must be a solid • the diagram show the waves refracting so the mantle must be getting more dense as it gets deeper **At B** • No S waves or P waves detected • S waves do not pass through liquid so do not get to B • P waves pass through liquid but are refracted at a solid/ liquid boundary so do not arrive at B • The core of the Earth must be liquid to stop both P and S waves arriving at B **At C** • No S waves arrive at C • P waves arrive at C at different times because the waves have travelled at different speeds. • This suggests the very centre of the Earth would be solid because the P waves that go through the solid would travel faster and arrive before those that just travelled through liquid	**(6)** **AO1** **AO3**

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) • Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3)
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) • Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3)
Level 3	5–6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3)

Level	Mark	Additional Guidance	General additional guidance – the decisions within levels
	0	No rewardable material	
Level 1	1-2	Additional guidance Elements of physics present i. e. isolated knowledge of principles, **two** unconnected statements from any section	Possible candidate responses core is liquid/ mantle (crust) is solid waves refract P waves change direction S and P waves travel through mantle(crust) at A, S and P waves detected at B, no waves detected at C, only P waves detected S waves are transverse P waves are longitudinal
Level 2	3-4	Additional guidance Some knowledge of principles with a logical connection made in **ONE** section and a statement in **ONE** other Or From ONE section detailed knowledge of principles with logical connections	Possible candidate response at A, S and P waves are detected so must pass through solid at B no waves are detected, the waves change direction/ Region B is the shadow zone at C, P waves are detected because they go straight through the Earth/can travel through the core in Earth's core there are different densities/waves change direction
Level 3	5-6	Additional guidance Detailed knowledge of principles with logical connections made in **TWO** of the sections	Possible candidate response at A, S and P waves are detected so must pass through solid and refract/curve at B, no waves are detected because S waves do not pass through liquid core and P waves are refracted away by the liquid. At C, only P waves are detected because they can pass through the liquid core and change direction in the core(refracted) In the Earth's core there is refraction of waves/ inner and outer core have different densities

Total for Question 10 = 12 marks

Total for paper = 100 marks

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