PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

PHYSICS



MARK SCHEME

TOPIC 4: WAVES (PAPER 1)

SCORE	PERCENTAGE
/109	%

STEMUP

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(**Q03c 1SC0/1PH, Nov 2020**)

Mark Scheme

Q1.

	Answer	Acceptable answers	Mark
(i)	☒ **A** on the finger		**(1)**
(ii)	infrared (1)	red light	**(1)**
(iii)	89/60 (1) 1.5 (beats/second) (1)	 1.48 (beats/second) Allow 1.49 1.483333etc Accept correct answer no working for 2 marks	**(2)**
(iv)	1/1.5 (1) 0.67(s) (1)	ecf 1/ 89 one mark only Accept correct answer no working for 2 marks	**(2)**

(**Q26 1SC0/1PF, June 2013**)

Q2.

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 $\frac{240}{343} \times 100 = 70\ \%$	(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)**

(**Q04a 1SC0/1PH, Nov 2020**)

Q3.

	Answer	Additional guidance	Mark
(i)	any **one** from electromagnetic (wave) (1) ripples/water (waves) (1) (waves on a) string (1)	 radio(waves) / microwaves / IR / infrared / visible / light / UV / ultraviolet / X(-ray) / gamma / γ allow sea / ocean / tidal wave ignore waves on a spring ignore earthquake or seismic P or S	**(1)** **AO1.1**

	Answer	Additional guidance	Mark
(ii)	a description to include: (causes it to) vibrate/oscillate (1) perpendicular/at right angles to (the direction of travel of) the wave (1)	can be shown on diagram allow shake in this context allow double headed arrow(s) ↔ **or** ↕ **centred on R** on diagram (to show vibration) allow "up and down" or "forwards and backwards" for vibration perpendicular/at right angles to (direction of) energy transfer allow horizontal arrow(s) → **or** ← **centred on R** on diagram (to show direction) allow side to side OR left to right OR in and out for perpendicular ↔ **centred on R** scores 2 marks ignore possible eventual consequences e.g. rock breaks up / heats up	**(2)** **AO2.1**

(**QU06b 1SC0/1PF, June 2025**)

Q4.

Question number	Answer	Additional guidance	Mark
(i)	any **one** from electromagnetic (wave) (1) ripples/water (waves) (1) (waves on a) string (1)	 radio(waves) / microwaves / IR / infrared / visible / light / UV / ultraviolet / X(-ray) / gamma / γ allow sea / ocean / tidal wave ignore waves on a spring ignore earthquake or seismic P or S	**(1)** **AO1.1**

Question number	Answer	Additional guidance	Mark
(ii)	a description to include: (causes it to) vibrate/oscillate (1) perpendicular/at right angles to (the direction of travel of) the wave (1)	can be shown on diagram allow shake in this context allow double headed arrow(s) ↔ **or** ↕ **centred on R** on diagram (to show vibration) allow "up and down" or "forwards and backwards" for vibration perpendicular/at right angles to (direction of) energy transfer allow horizontal arrow(s) → **or** ← **centred on R** on diagram (to show direction) allow side to side OR left to right OR in and out for perpendicular ↔ **centred on R** scores 2 marks ignore possible eventual consequences e.g. rock breaks up / heats up	**(2)** **AO2.1**

Question number	Answer	Additional guidance	Mark
(iii)	calculation of distance from R to L (1) (= 4500 x 3.8) = 17 000 (m) calculation of distance from X to R (1) (= 20 000 – 17 000) = 3000 (m) ALTERNATIVE METHOD calculation of time X to L (1) (20 000 / 4500 =) 4.44 calculation of distance from X to R (1) (=(4.44 - 3.8) x 4500) = 3000 (m)	 accept 17 100 allow ECF from MP1 accept numbers which round to 3000 e.g. 2900 accept numbers which round to 3000 e.g. 2900 award full marks for the correct answer without working	**(2)** **AO2.1**

(**QU02b 1SC0/1PH, June 2025**)

Q5.

	Answer	Additional guidance	Mark
(i)	10(.0) (cm)		**(1)** **AO1.1**

	Answer	Additional guidance	Mark
(ii)	12(.0) (cm)		**(1)** **AO1.1**

	Answer	Additional guidance	Mark
(iii)	a description to include time a wave (crest) over a measured/fixed/known/stated distance (1) use (speed =) $\frac{\text{distance}}{\text{time}}$ (1) ALTERNATIVE METHOD (determine frequency by measuring) the time taken for a set number of waves to pass a point (1) use (speed =) $f \times \lambda$ (1)	measure how long it takes for a wave to travel a set distance measure distance travelled in a stated time (count) the number of waves in a specified time 'measure frequency' is not sufficient for this mark use (speed =) f x (0.)12	**(2)** **AO1.2**

(QU06a 1SC0/1PF, June 2025)

Q6.

Question number	Answer	Additional guidance	Mark
(i)	10(.0) (cm)		**(1)** **AO1.1**

Question number	Answer	Additional guidance	Mark
(ii)	12(.0) (cm)		**(1)** **AO1.1**

Question number	Answer	Additional guidance	Mark
(iii)	a description to include time a wave (crest) over a measured/fixed/known/stated distance (1) use (speed =) $\frac{\text{distance}}{\text{time}}$ (1) ALTERNATIVE METHOD (determine frequency by measuring) the time taken for a set number of waves to pass a point (1) use (speed =) $f \times \lambda$ (1)	 measure how long it takes for a wave to travel a set distance measure distance travelled in a stated time (count) the number of waves in a specified time 'measure frequency' is not sufficient for this mark use (speed =) f x (0.)12	**(2)** **AO1.2**

(**QU02a 1SC0/1PH, June 2025**)

Q7.

Question Number	Answer	Acceptable answers	Mark
	conversion of time 4x60 (1) substitution (1) 1608 / (4x60) **ecf if conversion shown** evaluation (1) 6.7 (m/s)	award full marks for correct answer with no working [1608 / 4 for 1 mark for these two] **allow** 402 for 2 marks **accept** for 2 marks: 5.36 (t=300 s 60→120→180→240→300, i.e. 4 steps of 60) 4.02 (t=400 s based on the misconception of 100 s to 1 minute) **allow** maximum of 1 mark for any other power of 10 error if no working	**(3)**

(**Q05 1SC0/1PF, June 2015**)

Q8.

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)**

(**Q06c 1SC0/1PH, SAM 2016**)

Q9.

	Answer	Additional guidance	Mark
(i)	calculation of time of travel (1) (120/330 =) 0.36(36) (s) substitution (1) 0.23 x 100 0.36(36) evaluation (1) 63 (%)	 ecf from MP1 for MP2&3 accept values that round to 64 or 63 accept values that round to 0.64 or 0.63 for 2 marks award full marks for the correct answer without working	**(3)** **AO2**

	Answer	Mark
(ii)	**C** Increase the distance between L and M. **A, B** and **D** are incorrect as these would not improve the technicians' measurement	**(1)** **AO3**

(**QU04a 1SC0/1PH, June 2023**)

Q10.

Question number	Answer	Additional guidance	Mark
	two minutes = 120 s (1) substitution (1) 26 400 ÷ 120 answer (1) 220 (m/s)	ecf unit change award full marks for correct numerical answer without working	**(3)**

(**Q02d 1SC0/1PF, SAM 2016**)

Q11.

Question number	Answer	Additional guidance	Mark
	substitution (x) =330 x 4.0 evaluation 1300 (m)	accept 1320 (m) award full marks for correct answer without working.	**(2)** **AO2**

(**Q05c 1SC0/1PF, Nov 2021**)

Q12.

Question Number	Answer	Additional guidance	Mark
	substitution (1) 0.8 =f x 4.0 rearrangement and evaluation (1) 0.2 (Hz) unit (1) Hz / s^{-1} / per sec	(f =) $\frac{0.8}{4.0}$ allow correct substitution into seen incorrect rearrangement award 2 marks for the correct answer with no working accept hz or hertz independent mark accept recognisable spelling	**(3)** **AO2**

(**QU04c 1SC0/1PF, June 2023**)

Q13.

Question number	Answer	Additional guidance	Mark
	substitution (1) 330 = f x 0.75 rearrangement (1) (f =) $\frac{330}{0.75}$ evaluation (1) (f =) 440 (Hz)	substitution and rearrangement may be in either order. f = $\frac{v}{\lambda}$ if no other marks scored then award 1 mark for an answer that rounds to 0.0023 or 250 award full marks for the correct answer without working	**3** **AO2.1**

(**QU03c 1SC0/1PF, June 2024**)

Q14.

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)**

(**Q03a 1SC0/1PH, Nov 2020**)

Q15.

	Answer	Acceptable answers	Mark
	Substitution into correct equation(1) v = 15 × 125 Evaluation (1) 1875 Unit (1) m/s	Power of 10 error max 1 mark for numerical answer 2 marks for correct numerical answer even with no working shown ms^{-1} **not**mps 1.875 km/s or 6750 km/h gain 3 marks	**(3)**

		If numerical answer incorrect, accept any correctly-written unit of speed: eg **k**m/s or km/hr or miles per hour / mph	

(**Q07 1SC0/1PF, Mar 2013**)

Q16.

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)**

(**Q05d 1SC0/1PF, June 2019**)

Q17.

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)**

(**Q01d 1SC0/1PH, June 2019**)

Q18.

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**

(**Q05a 1SC0/1PF, Nov 2021**)

Q19.

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**

(**Q01a 1SC0/1PH, Nov 2021**)

Q20.

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) $(\lambda=) \frac{3(.00)\times10^8}{2.45 (\times10^9)}$ evaluation (1) 0.12 (m)	allow substitution and rearrangement in either order $2.45 \left(\times10^9\right)=\frac{3(.00)\times10^8}{\lambda}$ $\lambda= \frac{v}{f}$ 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**

(**QU06b 1SC0/1PH, June 2022**)

Q21.

	Answer	**Acceptable answers**	**Mark**
	transposition $\lambda = v/f$ (1) substitution $\lambda = 3 \times 10^8/7 \times 10^9$ (1) evaluation	Subst. and transform. either order 1 mark only can be scored for correct substitution after incorrect transposition. $3 \times 10^8/7 \times 10^9$ gains 2 marks	**(3)**

	0.043 (m) (1) Ignore any unit given by candidate	Accept any number of sig.figs. that rounds to 0.04 0.04 , 0.0428 (m) (1) Give full marks for correct answer with no working. 0.04 × any other power of 10 = 2 marks	

(**Q34 1SC0/1PH, June 2013**)

Q22.

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)**

(**Q01b 1SC0/1PH, SAM 2016**)

Q23.

Question Number	Answer	Mark
(i)	**A** longitudinal yes ***B*** *is not correct because sound waves can transfer energy* ***C*** *is not correct because sound waves are longitudinal* ***D*** *is not correct because sound waves are longitudinal and sound waves can transfer energy*	**(1) AO1**

	Answer	**Additional guidance**	**Mark**
(ii)	select wave equation (1) $(v =) f \times \lambda$ evaluation (1) (speed =) 330 (m/s)	 (speed =) freq(uency) × wavelength (speed =) 440 × 0.75 award full marks for the correct answer without working.	**(2) AO2**

(**QU02b 1SC0/1PF, June 2022**)

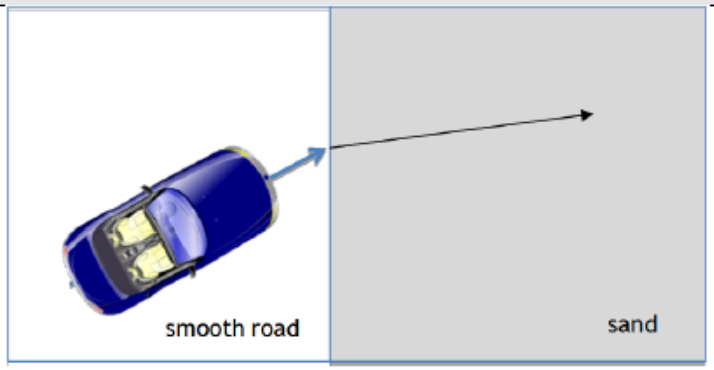
Q24.

	Answer	**Acceptable answers**	**Mark**
(i)	Substitution v = 1920/6.0 (1) Evaluation (1) 320 (m/s)	 300 (m/s) give full marks for correct answer, no working (2) Power of 10 error max. 1 mark.	**(2)**
(ii)	Suggestions including the following: • recognition of any difference in	 e.g. sound travels faster / quicker than light (1)	**(2)**

	speed / velocity (1) • correct difference in speed (1)	c>v / v<c / c>320 (m/s) Light travels (much) faster (2) RA **Ignore**'sound takes longer' or other references to time.	

(**Q09 1SC0/1PF, June 2013**)

Q25.

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)**

(**Q04a 1SC0/1PH, SAM**)

Q26.

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)**

(**Q04c 1SC0/1PH, June 2019**)

Q27.

Question number	Answer	Mark
	An answer that combines the following points of understanding to provide a logical description: • use a stopwatch (1) • start timing when flash is seen and stop when bang is heard (1)	**(2)**

(**Q02a 1SC0/1PF, SAM 2016**)

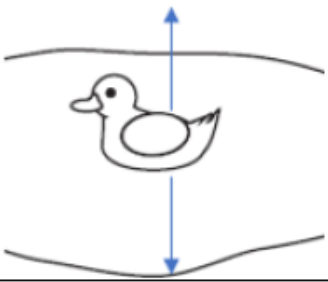
Q28.

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)**

(**Q01a 1SC0/1PH, SAM 2016**)

Q29.

Question number	Answer	Additional guidance	Mark
(i)	a description to include: use (wave) speed = $\frac{\text{distance}}{\text{time}}$ (1) find relevant time (1) measure specified distance (1)	 use v = f x λ count number of waves in specified time width / radius / circumference of pond do not accept wavelength	**3** **AO2.2**

Question number	Answer	Additional guidance	Mark
(ii)	arrow(s) up and/or down (1) 	judge by eye need not be on duck do not credit answers that imply duck (also) moves horizontally	**1** **AO1.1**

(**QU03e 1SC0/1PF, June 2024**)

Q30.

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)**

(**Q04b 1SC0/1PH, June 2019**)

Q31.

Question Number	Answer	Additional guidance	Mark
(i)	a description including count the number of waves/ripples (1) (that pass a point) in a certain time (1) OR measure the time for a certain number of waves/ripples (1) use of f = 1/T (1)	 accept use of numerical values calculate the number of waves that pass the point in a second scores 2 marks	**(2)** **AO1**

Question Number	Answer	Additional guidance	Mark
(ii)	a description including any two from the waves/ripples are made to look stationary (1) measure the distance across a number of waves/wave fronts/ripples (1) calculate the wavelength from the measurements (1)	 using camera, video, strobe light, stroboscope, mobile, phone, photo(graph) accept measure the distance across a number of lines divide distance by the number of waves/ripples accept the idea of measuring the distance between one wave/ripple/line and another (successive) wave/ripple/line for 2 marks	**(2)** **AO1**

(QU04b 1SC0/1PF, June 2023)

Q32.

Question number	Answer	Additional guidance	Mark
	An answer that combines the following points to provide a method: • use a stop watch (1) • count number of waves that reach the bank in a given time (1)		**(2)**

(Q03c 1SC0/1PF, SAM)

Q33.

Question Number	Answer	Additional guidance	Mark
	a description to include: • longitudinal – (vibrations) parallel to (direction of travel) (1) • transverse – (vibrations) at right angles to (direction of travel) (1) • (connection between) direction of travel with (direction of) vibrations (1)	 back and forth (oscillations)/ compressions or rarefactions up and down (oscillations)	**(3)** AO 1 1

(**Q07 1SC0/1PF, June 2018**)

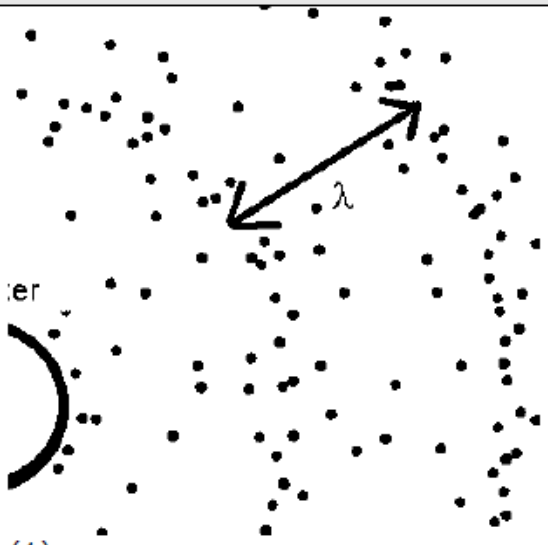
Q34.

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)

(**Q06b 1SC0/1PH, SAM 2016**)

Q35.

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)

(**Q04b 1SC0/1PH, Nov 2020**)

Q36.

Question Number	Answer	Acceptable answers	Mark
(a)	**A** longitudinal : yes		(1)

Question Number	Answer	Acceptable answers	Mark
(b)	An explanation linking any two of: 1. A cause or description of earthquakes (1) 2. why timing of earthquake is uncertain / complex (1) 3. we cannot see {what is happening deep inside the Earth / where the plates are rubbing} (1)	The release of {energy / pressure/friction force} (in Earth's surface) (caused when tectonic) plates slide past each other any idea of relative movement of plates e.g. move over each other, collide (movement of plates is) {sudden / random / jerky} it is too difficult to {work out / measure} when release of energy will happen "it is difficult to measure when the plates will collide" = 2 marks	**(2)**

(**Q07 1SC0/1PF, June 2015**)

Q37.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	Gamma/ γ (wave(s)/ ray(s)/radiation)	X-rays/ radiation	**(1)**
(a)(ii)	Any two from It fluoresces (1) UV (radiation) transfers/gives energy to ink/ink absorbs energy from UV (radiation) (1) (energy from UV is)(re-)radiated/(re)- emitted by ink at lower frequency/as (visible) light (1)	 fluorescent Ink/it absorbs UV (light/radiation) Ignore UV is reflected as visible light Ignore luminous emits visible light	**(2)**
(b)	transposition λ = v/f (1)	Subst. and transform. either order 1 mark only can be scored for	**(3)**

	substitution $\lambda = 3 \times 10^8/7 \times 10^9$ (1) evaluation 0.043 (m) (1) Ignore any unit given by candidate		correct substitution after incorrect transposition. $3 \times 10^8/7 \times 10^9$ gains 2 marks Accept any number of sig.figs. that rounds to 0.04 0.04 , 0.0428 (m) (1) Give full marks for correct answer with no working. 0.04 × any other power of 10 = 2 marks	

			Indicative Content	
QWC		***c**	A discussion including some of the following points Possible dangerous e-m radiations Microwaves Infrared Ultraviolet (UV) X-rays gamma rays Correctly linked to Internal heating of body cells (microwaves) Skin burns (infrared) Damages skin cells/sunburn (UV) Damages eyes (UV) Can cause skin cancer (UV) Can cause cataracts (UV) Damage to cells inside the body(X-rays) Mutate/ kill cells in the body (gamma) Damages DNA (X-rays and gamma rays) Link to frequency As the frequency increases/wavelength decreases (microwave -> gamma) the waves become more penetrating and do more damage/danger as they h more energy.	
Level	**0**	No rewardable content		
1	**1 - 2**	• a limited description e.g. gives at least 2 correct radiations and links both to correct damage OR at least 2 correct radiations named with link to correct damage from one and idea that frequency is linked to damage OR just has link between higher frequency and more damage/dangerous e.g. infrared burns your skin and X-rays can damage cells. OR X-rays have a higher frequency than microwaves and can cause cancer OR Higher frequencies cause more damage to cells. • 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 simple description e.g. gives most of the correct radiations and links		

		to correct damage, at least one with detail of the damage that is caused OR links two to detail of the damage, AND has a link between frequency and energy/danger e.g. Microwaves are absorbed by water in body cells. UV can cause skin cancer and damages your eyes. Xrays and gamma rays can damage cells inside your body OR Gamma and X-rays can penetrate deep into the body. Gamma does most damage as it has the highest frequency. • 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 detailed description e.g. gives most of the correct radiations with links to detail of the damage AND explains the link between frequency and energy/danger. e.g Microwaves heat up the water in cells. UV can cause cataracts. Gamma rays are the most penetrating and can mutate cells inside the body because they have the highest frequency. • The answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(**Q28 1SC0/1PH, June 2013**)

Q38.

Question	Answer	Additional guidance	Mark
(i)	An explanation linking UVC/it has the smallest wavelength / highest frequency/ highest energy/most ionising (1) (it doesn't cause harm to people because) 100% absorbed by the Earth's atmosphere/no UVC reaches the Earth's surface/people (1)	 allow shortest wavelength allow smaller for smallest / higher for highest / more for most	**2** **AO3.2**

Question	Answer	Additional guidance	Mark
(ii)	wavelength 280(nm) (1) substitution and rearrangement (1) $f = \frac{3.0 \times 10^{8}}{280 (\times 10^{-9})}$ evaluation (1) 1.07×10^{15} (Hz)	allow 2.8 to any power of ten accept numbers that round up to 1.1 $\times 10^{15}$ (Hz) award 2 marks for values that round up to 1.1 to any other power of ten if no other mark scored allow substitution and rearrangement using an incorrect wavelength for 1 mark award full marks for correct answer without working	**3 AO2.1**

(**QU03a 1SC0/1PH, June 2024**)

Q39.

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)**

(**Q04a 1SC0/1PH, June 2019**)

Q40.

Question number	Answer	Additional guidance	Mark
	explanation linking: wave P refracts (towards the normal) (1) because P slows down (1) AND wave Q is reflected (at an equal angle from the boundary) (1) without change of speed of Q (1)	accept 'upper layer' for 'P' accept 'wavelength decreases' accept 'bends' for 'refracts' in this instance accept 'lower layer' for 'Q' accept 'wavelength unchanged' accept 'wave Q bounces off' (at an equal angle) allow one mark for refraction and reflection if no other mark awarded	**(4)**

(**Q03c 1SC0/1PH, Nov 2020**)