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

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	An explanation linking • {X- rays are / ultrasound is not} dangerous (1) • (because X-rays) can {damage / harm} {tissue / DNA} OR mutate cells OR reverse argument for ultrasound (1)	X-rays are ionising ultrasound is not ionising ignore penetration/penetrating ignore bald harm / harmful for MP1 Ignore reference to frequency and energy X-rays cause cancer ignore foetus / baby / body Ignore unqualified 'mutation'	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b) (i)	30 000 Hz / hertz	30 kHz 0.03 MHz unit must be included	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	A description including particles {<u>vibrate</u> / <u>oscillate</u>} (1) (move) in the {same direction as / parallel to the direction } the wave travels (1)	'they' refers to particles to and fro back and forth ignore all up and down and side to side references Both points could be shown on a clear diagram with arrows or labels (e.g. compressions and rarefactions)	**(2)**

Question Number		Indicative Content	Mark
QWC	***1(c)**	An explanation including some of the following points • sonar is ultrasound • travels through water at the speed of sound (1500 m/s) • ultrasound signal generated in the ship • signal emitted from the bottom of the ship • signal travels down through the water • strikes shoal of fish • signal reflected by fish • reflected signal detected on the ship • time between emission and detection measured • either time halved and depth of fish calculated /or distance wave travelled calculated and halved to give depth of fish • calculation done using $x = v \times t$ • comparison of depths of fish and of seabed	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited explanation e.g. A sonar wave (ultrasound pulse) goes down and is reflected. OR An ultrasound pulse is sent from the boat and timed. • 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 explanation e.g. An ultrasound signal goes down through the water and is reflected AND the time taken is measured. • 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 explanation e.g An ultrasound signal is emitted and reflected. The time is measured AND depth is found by halving (the total time or the total distance) AND linking to either the speed equation or the speed of the wave or the depth of fish compared to sea depth. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately. • spelling, punctuation and grammar are used with few errors.	

Question number	Answer	Mark
2(a)	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)

Question number	Answer	Mark
2(b)(i)	A	(1)

Question number	Answer	Mark
2(b)(ii)	C	(1)

Question number	Answer	Additional guidance	Mark
2(c)(i)	electromagnetic wave	allow any named e.m. wave/seismic S wave	(1)

Question number	Answer	Additional guidance	Mark
2(c)(ii)	sound wave	allow ultrasound/infrasound/ seismic P wave	(1)

Question number	Answer	Additional guidance	Mark
2(d)	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)

Question number	Answer	Mark
3(a)	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)**

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

Question number	Answer	Mark
3(b)(iii)	D	**(1)**

Question Number	Answer	Acceptable answers	Mark
4 (a)	**B**		**(1)**

Question Number	Answer	Acceptable answers	Mark
4b(i)	A description including **three** of the following points • reflection (of light) at (either) mirror (1) • (the curved mirror) focuses the light (1) • (mirror) inverts (1) • (lens / eyepiece) magnifies image (1) • image is formed where the light rays cross (1)	Bounces for reflects flips it over/turns over lens/eyepiece refracts light Image is real(1) Accept for 1 mark if no other mark awarded: (Telescope) reflects <u>and</u> refracts light (1)	**(3)**

Question Number	Answer	Acceptable answers	Mark
4(b)(ii)	An explanation including two from • collects more light (1) • produces a magnified/bigger image (1) • shows more detail (1) • shows stars the naked eye is unable to see (1) • can observe stars day and night (1)	brighter looks closer/zooms in makes it clearer/better see further/more (stars)	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(c)(i)	transverse (wave)	mechanical	**(1)**

Question Number	Answer	Acceptable answers	Mark
4(c)(ii)	move up and down a bigger distance		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(c)(iii)	substitution (1) 4 x 0.5 evaluation (1) 2 (m/s)	 give full marks for correct answer, no working Accept power of ten error for 1 mark eg. 0.2, 20, 200, 2000	 **(2)**

Question Number	Answer	Acceptable answers	Mark
5(a)(i)	An explanation linking the following points • 15 % of power /energy (1) • is transferred usefully (1) **Accept reverse argument** • 85% of power / energy (1) • is wasted (1)	15 W / 15 J/s / 15 J transferred as light converted into useful energy/ is not wasted	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(a)(ii)	• two qualitative output labels (1) light (energy) and thermal /heat (energy) • a quantitative output label (1) 15 J for light/used /useful or on narrower arrow (of otherwise unlabelled Sankey diagram)	useful/used (energy) and wasted (e 85 J for heat/wasted or on broader arrow (of otherwise unlabelled Sankey diagram)	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(b)	Any **two** of the following reasons • Energy, e.g. (low-energy lamps) are more efficient / waste less energy / produce less heat (1) • Economy, e.g. (low-energy lamps) use less <u>electrical</u> energy /cost less to run / have a lower power (rating) (1) • Environment, e.g. using (low-energy lamps) reduces CO_2 emissions / saves fossil fuel (1) • Practical, e.g. (low-energy lamps) last longer / need replacing less often / (can be) easier to obtain (1)	Accept reverse arguments Accept 'they' for low-energy lamps idea of Payback, e.g. (low-energy lamps) are (more) cost effective (over time) Ignore unqualified environment statements filament lamps (have been) banned (in some countries)	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(c)	An explanation linking these three points • energy gain is from power supply(1) • energy loss is by radiation(1) • the loss and the gain are equal /at the same rate(1)	energy (comes) from the mains / supplied with electrical energy thermal/heat energy emitted infrared emitted the loss and gain are in equilibrium allow the filament gains <u>and</u> losses energy for (1) only	**(3)**