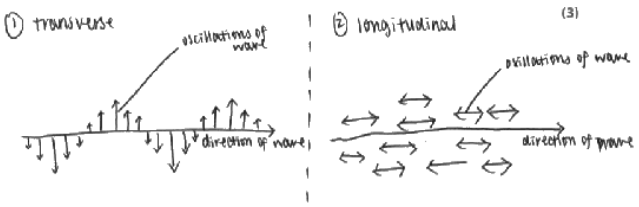
Question number	Answer	Notes	Marks
1 (a) (i)	B (1.0 m); A is incorrect because it is only half the wavelength C is incorrect because it is 1.5 wavelengths D is incorrect because it is 2 wavelengths		1
(ii)	C (4 cm); A is incorrect because it is a quarter of the amplitude B is incorrect because it is half of the amplitude D is incorrect because it is double the amplitude		1
(b)	vibrations / oscillations / disturbance; (are) parallel or perpendicular to direction of energy transfer / wave (travel/movement); correct identification of <u>both</u> types; e.g.  gets 3 marks	allow suitably labelled diagrams	3
(c)	any two from: MP1. speed (in vacuo); MP2. idea that they don't need a medium to propagate; MP3. can all be reflected / refracted / diffracted; MP4. all carry energy / information;	allow quoted speed 3.0×10^8 m/s allow can travel through vacuum apply positive marking, not list marking	2

(d) (i)	A (gamma rays); B is incorrect because infrared is not ionising enough C is incorrect because microwave is not ionising enough D is incorrect because radio is not ionising enough		1
(ii)	D (visible light); A is incorrect because microwave is not visible to humans B is incorrect because radio is not visible to humans C is incorrect because ultraviolet is not visible to humans		1
(iii)	any two from: MP1. idea that x-rays are ionising / cause cell damage; MP2. idea that risk increases with greater exposure; MP3. idea that exposure reduced by increasing distance away;	allow x-rays dangerous to health cause cancer unqualified “dangerous”/”harmful” is insufficient allow “to avoid excessive exposure” allow exposure reduced by shielding of walls	2

Total for question 1 = 11 marks

Question number	Answer	Notes	Marks
2 (a) (i)	C; A is incorrect because it is a thermistor B is incorrect because it is a fixed resistor D is incorrect because it is a variable resistor		1
(ii)	B; A is incorrect because it is a thermistor C is incorrect because it is a LDR D is incorrect because it is a variable resistor		1
(b) (i)	power = current × voltage;	allow rearrangements and standard symbols e.g. P = I × V	1
(ii)	substitution OR rearrangement; evaluation to 2 or more s.f.; e.g. 2200 = current × 230 OR current = power/voltage (current =) 9.6 (A)	 9.565… OR 9.57 condone rounding to 9.5 or 9.56	2
(iii)	D (13 A); A is incorrect because this fuse would blow in normal operation B is incorrect because this fuse would blow in normal operation C is incorrect because this fuse would blow in normal operation		1
(iv)	any two from: fuse (wire) melts / eq.; circuit is broken; preventing heater from overheating;	 condone ‘fuse blows’ allow current is cut off / eq.	2

Total for question 2 = 8 marks

Question number	Answer	Notes	Marks
11 (a) (i)	any two from: MP1. optical fibres for communication; MP2. endoscopes; MP3. optical fibres in decorative lamps etc.; MP4. safety reflector; MP5. prism in {binoculars / camera / periscope / rangefinder};	allow 1 mark for unqualified "optical fibres" in the absence of any other marks e.g. bicycle/car reflector, cat's eye	2
(ii)	idea that light travels from more (optically) dense medium to less (optically) dense medium; incident angle greater than critical angle;	allow if expressed in terms of refractive index allow "has to go from glass to air" / eq.	2
(b) (i)	normal line drawn correctly by eye where light ray meets flat surface at A;		1
(ii)	angle measured in the range 24-30°;	allow ecf from incorrect normal	1
(iii)	ray emerges from block at position A; refracting correctly away from normal;		2
(iv)	sin(c) = 1 ÷ n;	allow rearrangements and word equations	1
(v)	substitution AND rearrangement; evaluation; e.g. n = 1 ÷ sin(40°) (n =) 1.6	 allow 1.557...	2

Total for question 11 = 11 marks