Name: _____

Light and Optics

Mark Scheme

Date:

Time:

Total marks available:

Total marks achieved: _____

Mark Scheme

Q1.

	Answer	Acceptable answers	Mark
	2100/500 = 4.2 (1) 4.2 × 150 = 630 (million km) (1) Accept ratios as speed is constant 150/500 = distance to Jupiter/2100 OR Distance to Jupiter = (150/500) × 2100 Either for 1 mark	Power of 10 error maximum of 1 mark (speed of light) about 150 000 000 ÷ 500 = 300 000 (km/s) (1) (distance to Jupiter)= 300 000 × 2100 = 630 000 000 km (1) / = 630 (million km) An answer with no calculation of 630 (million km) gains 2 marks If an answer of 630 million/ 630 000 000 is given with correct working award both marks	**(2)**

Q2.

Question Number	Answer	Additional guidance	Mark
	substitution (1) $\frac{3.0 (\times 10^{8})}{5.8 (\times 10^{-7})}$ evaluation (1) 5.2×10^{14} unit (1) Hz	 answers that round to 5.2×10^{14} award 2 marks for a correct answer without working allow 1 mark for answers that round to 5.2 to any power of ten independent mark accept hz or s^{-1} or per sec(ond) or hertz accept kHz, MHz etc with correct power (10^{11} kHz, 10^{8} MHz)	**(3)** AO 2 1

Q3.

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

Q4.

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

		references to time.	

Q5.

Question Number	Answer	Additional guidance	Mark
	an explanation linking: (the colours have) different wavelengths (1) different wavelengths / colours travel at different speeds (1) so refract by different amounts (1)	 allow the word frequencies for wavelengths for refract allow bend/change direction/follow different path	**(3)** AO 2 1

Q6.

Question Number	Answer	Additional guidance	Mark
	a description including: UVA **mostly** transmitted OR **some** absorbed (1) UVB **some** transmitted OR **mostly** absorbed (1) UVC **not** transmitted OR **mostly** absorbed OR **some** reflected (1) correct relationship of absorption/ transmission to wavelength / □ (1)	UVA **mostly** travels through accept **less** transmitted than UVA **more** absorbed than UVA or UVB wavelength decreasing (with) absorption increasing OR longer wavelengths transmit more □ / abs / trans inc / dec / inc dec / inc / dec	**(4)**

Q7.

Question Number	Answer	Additional guidance	Mark
	(Jupiter is) 5 times (further away) (1) radio waves and light waves travel at the same speed (in space) (1)	All electromagnetic (EM) waves travel at the same speed accept attempt to use consistent speed (of light) to calculate two distances	**(2)**

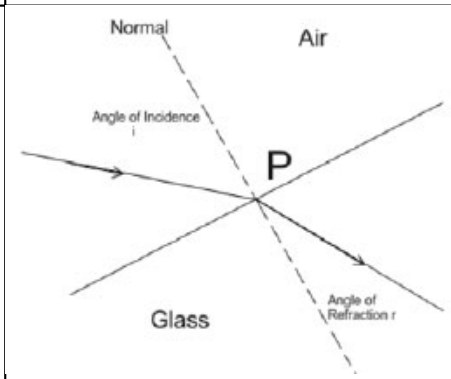
Q8.

Question Number	Answer	Mark
(i)	**D** refraction **is the only correct answer** *A 'deflection' is an incorrect distracting description* *B 'incidence' is incorrect, that would be angle X* *C 'reflection' is incorrect, no reflection being shown in the diagram*	**(1)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(ii)	any pair of coordinates selected from the line (1) in range → 0.6(0) to 0.7(0) (1)	e.g. 20 and (13 or 14) or 10 and (6 or 7) ignore any units given award full marks for a correct answer without working	**(2)** AO 2 1

Question Number	Answer	Additional guidance	Mark
(iii)	an explanation linking: repeat (1) different angles / more values of X (1) for larger angles / values of X (1)	 allow 'more measurements' / 'repeat experiment' / collect more data > 20°	(3) AO 3 3a

Q9.

	Answer	Acceptable answers	Mark
(a)(i)	An explanation linking: Angle (of incidence) in glass (1) greater than critical angle / 42° (1)	 Angle in air cannot be greater than 90° for 1 mark Glass has a higher refractive index than air for 1 mark	(2)
(a)(ii)	 angle i from normal in air (1) angle r from normal in glass (1)	accept for 1 mark angle i in air <u>and</u> angle r in glass/ <u>both</u> angles measured from normal	(2)
(a)(iii)	☒**C** speed decreases		(1)
(b)(i)	An explanation linking any three of the following: (Optical fibres) bend (1)	Accept suitable labelling on a Diagram	(3)

	some fibres carry light to the inside of the patient (1) some fibres transmit the reflected light (1) light passes up/down fibres by TIR (1) light is reflected inside the patient (1) image is analysed by computer (1)	Image projected on a screen	
(b)(ii)	Either Breaks/blasts/smashes (1) Kidney stones (1) or Energy absorbed (1) to help repair muscle tissue (1) or Use of gel (1) to prevent loss of intensity (1) or	bruising/clots increases blood flow Allow (1) mark for suitable diagnosis e.g. prenatal scan	**(2)**

Q10.

Question Number	Answer	Acceptable answers	Mark
(a)	• below 20 Hz (1) • above {20 000 Hz / 20 kHz} (1) If Hz or kHz is not seen somewhere, the maximum score is 1 mark.	infrasound ultrasound (in either order) (no units needed for the names)	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	C it is a longitudinal wave travelling faster than an S wave		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	Explanation linking the following:- MP1 refraction /changing speed (1) MP2 (due to) changing {material/medium /rock type / density} (1)	ignore changes in direction/ bending (in this case) rock becomes {more / less} {dense / compact}	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)(iii)	Explanation linking the following:- MP1 (S / transverse waves) they cannot travel through liquid (1) MP2 Earth's core is (at least part) {liquid/molten} (1) MP3 (so) (S waves) they cannot travel through core (to other side of Earth) (1)	Check diagram for creditworthy points. they can only travel through solids may be stated in part (ii) (S / transverse waves) they cannot be detected on opposite side of the Earth to (collision site / earthquake)	**(3)**

Question Number	Answer	Acceptable answers	Mark
(b)(iv)	Suggestion to include any two from: MP1 idea that {kinetic energy/force/ momentum} of meteor might cause the earthquake (1) MP2 (earthquakes happen where) plates slide {past/over/under/away from/against} each other (1) MP3 (plates move) suddenly MP4 (meteor collision) starts seismic waves /P/S (1)	(meteor) it has large amount of kinetic energy (earthquakes happen where) plates collide rub/move for slide (earthquakes happen when) large amount of energy released in / near Earth's surface (plates) jolt/jerk vibrations passing through the Earth condone earthquake waves {kinetic energy/force /momentum} of meteor can cause the plates to slide past each other = 2	**(2)**