Name: _____

Light and Optics

Mark Scheme

Date:

Time:

Total marks available:

Total marks achieved: _____

Mark Scheme

Q1.

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

Q2.

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

Q3.

Question Number	Answer	Acceptable answers	Mark
(i)	**B** either real or virtual | either magnified or diminished		(1)

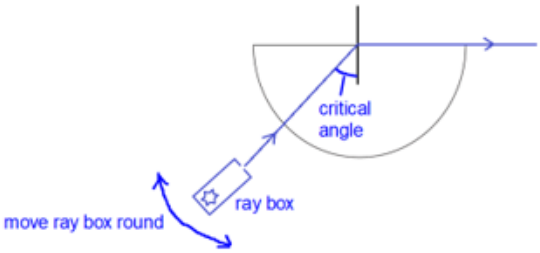
Question Number	Answer	Acceptable answers	Mark
(ii)	A description including:- Effect of change in shape (1) AND Gives greater/ larger power (1) The second mark is dependent on the first	 greater refraction/ more bending (of light) greater curvature / fatter / more curved/ thicker lens shorter focal length / shorter f Or reverse argument Credit clear labelled diagrams that show this difference.	(2)

Q4.

Question Number	Answer	Mark
(i)	 ☒ B **The only correct answer is B** **A** is not correct because it has a smaller power than B **C** is not correct because it is a diverging lens **D** is not correct because it is a diverging lens	(1)

Question Number	Answer	Additional guidance	Mark
(ii)	rearrangement and substitution (1) $\frac{1}{5}$ unit conversion and evaluation (1) 20 (cm)	 award full marks for the correct answer without working accept 0.2 for one mark only	**(2)**

Q5.

Question Number	Answer	Additional guidance	Mark
	a description to include any **four** from: shine a ray (of light) into the block (1) into block through the curved face along a radius (1) {change angle / move ray(box)} until {the angle of refraction is 90°/ TIR just occurs} (1) **measure** angle of incidence {when refracted angle is 90° / when TIR just occurs} (1) repeat measurement of critical angle (1)	 credit marking points in the diagram if they are clear allow 'calculate' for 'measure' plot angle i against angle r if light only enters block at straight edge, maximum 1 mark (for MP1)	**(4)**

Q6.

Question Number	Answer	Acceptable answers	Mark
(a)	**B** 20 cm		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b) (i)	Substitution 12/(14-12) (1) Evaluation 6.0 (1)	Award full marks for correct with no working Ignore any units	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b) (ii)	-12	Negative sign essential	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b) (iii)	Suggestion to include one of: • Shows whether it is real or virtual (1) • A positive sign for magnification indicates a {real image/inverted image/opposite side of lens to object} (1)	 Allow shows whether it is inverted or upright Allow shows which side of lens image is formed A negative sign for magnification indicates a {virtual image/upright image/same side of lens as object} IGNORE simple reference to magnification	**(1)**

Q7.

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

Q8.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	D both real and virtual images		**(1)**

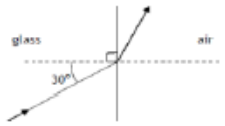
Question Number	Answer	Acceptable answers	Mark
(a)(ii)	A 8.3 dioptre		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(iii)	Diagram showing Convex lens, wider at the centre and more curved (1) shorter focal length identifiable (1)	Lens can be redrawn anywhere on the diagram	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	substitution (1) 1/12= 1/8.5 + 1/v transposition (1) (1/v) = 1/12 - 1/8.5 evaluation (1) (1/v) = -0.034 Inversion (1) v = -29(cm)	substitution and transposition in any order 0.034,-7/204,7/204, 0.03,-0.03 (3) Ignore signs until final value of v is given. -29.1(cm) -29.14(cm) Allow answers that can be rounded down to -29(cm) full marks for the correct numerical answer with no working (-)204/7 or 29(cm) with no working gains 3 marks	**(4)**

(Total marks for question = 8 marks)

Q9.

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

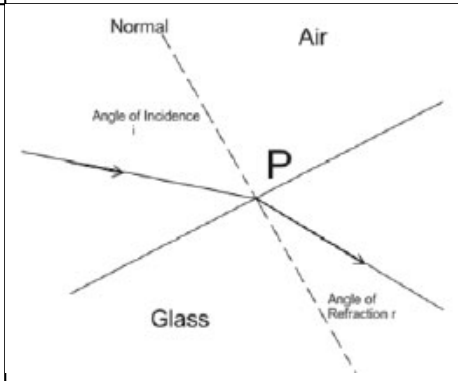
Question Number	Answer	Acceptable answers	Mark
(b)(i)	substitution: (1) 3.2×10^{7} = power/6.3×10^{-6} transposition (1) (power) = $3.2 \times 10^{7} \times 6.3 \times 10^{-6}$ evaluation: (1) 200 (W)	substitution and transposition in any order ignore powers of 10 until evaluation 202(W) or 201.6(W) or 201(W) full marks for the correct numerical answer without working	**(3)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	An explanation linking: EITHER • no light / energy is lost (1) OR • no <u>light</u> is refracted (out) (1) WITH • (because) idea of (total) internal reflection (1)	Ignore references to power No light / energy escapes All <u>light</u> stays in (the fibre) TIR Accept "<u>All light</u> is internally reflected" for 2 marks	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)	substitute and evaluate (sin c) = 1/1.7 (sin c) = 0.59 (1) from graph or calculation c = any value between 34° and 38° (1)	 0.588, 0.58, 0.6 full marks for the correct numerical answer without working	**(2)**

(Total marks for question = 8 marks)

Q10.

	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) some fibres carry light to the inside of	Accept suitable labelling on a Diagram	**(3)**

	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)**

Q11.

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)**

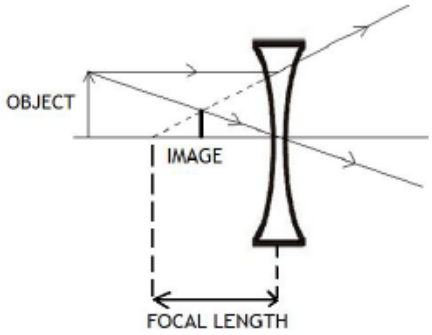
Question Number	Answer	Acceptable answers	Mark
(b)(i)	C it is a longitudinal wave travelling faster than an S wave		**(1)**

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)**

Q12.

Question Number	Answer	Acceptable answers	Mark
		Accept symbols I and f Ignore arrow on image	**(2)**
(i)	Image, line at right angles to principal axis to where rays cross. Judge by eye (1)		
(ii)	Focal length, distance from where virtual ray crosses principal axis to centre of concave lens. Judge by eye (1)		

Question Number	Answer	Acceptable answers	Mark
(iii)	Short sight / short sightedness	Myopia/ myopic/ near sight	**(1)**

Question Number	Answer	Acceptable answers	Mark
(iv)	Substitution $\frac{1}{0.5} + \frac{1}{v} = \frac{1}{-0.33}$ (1) Transformation $\frac{1}{-0.33} - \frac{1}{0.5}$ (1) Evaluation $\left[\frac{1}{v}\right] = -3 - 2 = -5$ (1) $[v] = -0.2$ (m) (1)	Substitution and transformation in any order -5.03 gets 3 marks +5, +5.03 gets 2 marks Any value that rounds up to + or - 0.2 m/ + or - 20 cm gets 4 marks Allow power of ten error for 3 marks Correct answer with no working awarded 4 marks	**(4)**