

GCSE PHYSICS LIGHT & THE ELECTROMAGNETIC SPECTRUM
ANSWERS AND MARK SCHEMES

QUESTIONSHEET 1

- (a) (i) Waves bending around the harbour wall into its shadow. 1
Wavelength similar to before. 1
- (ii) Diffraction 1
- (b) Wave diffracted around both sets of walls into their shadows 1
- (c) Number of bobbing boats increased because amount of diffraction increased 1
because the wavelength is now similar to gap width. 1
- (d) The number of boats bobbing increased as diffraction increased 1
as gap reduces nearer to wavelength the amount of diffraction increases. 1
- (e) Two wave fronts from the two gaps intercept/meet/ interfere. 1
At certain positions the two meeting waves will add together by looking identical i.e. have similar phase difference.
This gives rise to constructive interference and waves are seen. 1
At other positions two waves meet and cancel out (antiphase).
Destructive interference. 1
Therefore no wave energy seen. 1

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QUESTIONSHEET 2

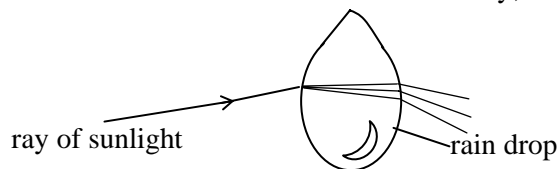
- (a) Rays originating from target. 1
Rays directed out of window. 1
- (b) Cathode 1
- (c) >10,000V (10kV) 1
- (d) Electrons are boiled/ given off 1
Attracted/ accelerated towards anode 1
- (e) Anode becomes warm/ hot 1
due to energy absorbed from electrons. 1
- (f) Electrons would bump into / ionise/ excite gas molecules 1
Fewer electrons would reach the anode
Or
The electrons have not enough energy to make X-rays 1
- (g) Lead. 1
Lead shields will stop the travel of X-rays. 1
X rays are dangerous/ hazardous. 1

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QUESTIONSHEET 3

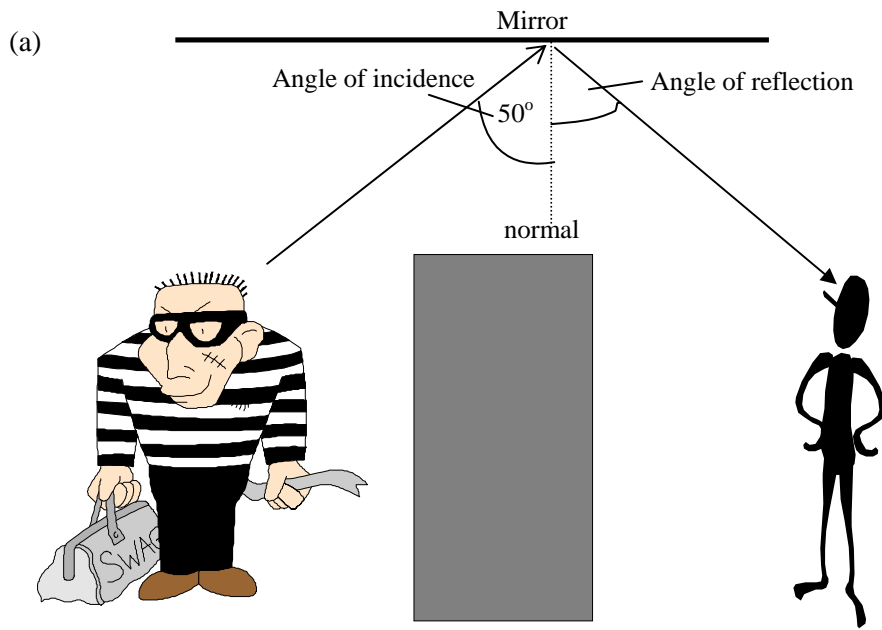
- (a) (i) Two of:
Can be reflected;
can be refracted;
travel as waves; 2
- (ii) Two of
X rays - are more energetic;
- have higher frequency;
- have shorter wavelength; 2
- (b) (i) Diagram shows rays being reflected off inner wall of fibre;
at the angle of incidence; 1
1
- (ii) Light rays strike wall at an angle greater than critical angle;
and are totally internally reflected; 1
1
- (c) Diagram completed showing appropriate refraction at both interfaces;
and dispersion at both interfaces/ second interface only; 1
1



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QUESTIONSHEET 4

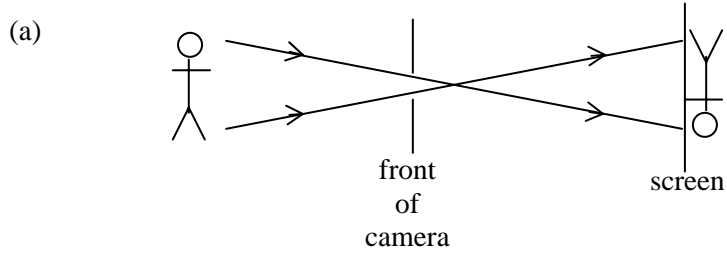


- | | | |
|-------|---|---|
| (i) | Ray continued towards bottom right of diagram after it strikes the mirror. | 1 |
| | Ray drawn precisely (so that the incoming and reflected ray are symmetrical (forms a mirror image about the normal line)) | 1 |
| (ii) | The reflected ray should hit the drawn person's head/eyes. | 1 |
| (iii) | angle marked as 50° labelled angle of incidence | 1 |
| | 50° to other side of normal labelled angle of reflection | 1 |
| (b) | Image size is same size as object. | 1 |

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QUESTIONSHEET 5



one each for: camera, rays, inverted image

3

(b) (i) place a convex lens
in front of pinhole

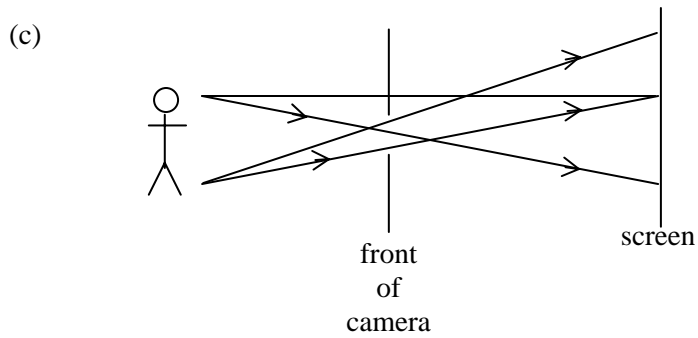
1

1

(ii) move screen
away from pinhole

1

1



one each for: camera, rays, spread image

3

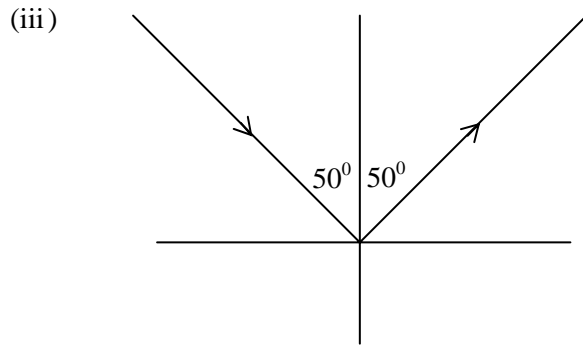
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QUESTIONSHEET 6

(a) (i) $90 - 40$ 1
 $= 50^\circ$ 1

(ii) 50° 1



two rays 1
at 100° to each other 1

(b) (i) 2 metres 1
behind the mirror 1

(ii) her back 1
moving away at 2 m/s 1

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QUESTIONSHEET 7

(a) Two from cooking, radar, satellite communications	2
(b)(i) Ultra high frequency	1
TV	1
(ii) very high frequency	1
radio/police & ambulance communications	1
(c)(i) $90\,000 \times 1000\text{ m}$	1
divided by $300\,000\,000$	1
0.3 s	1
(ii) $165\,000\,000 \times 1000\text{ m}$	1
divided by $300\,000\,000$	1
550 s	1

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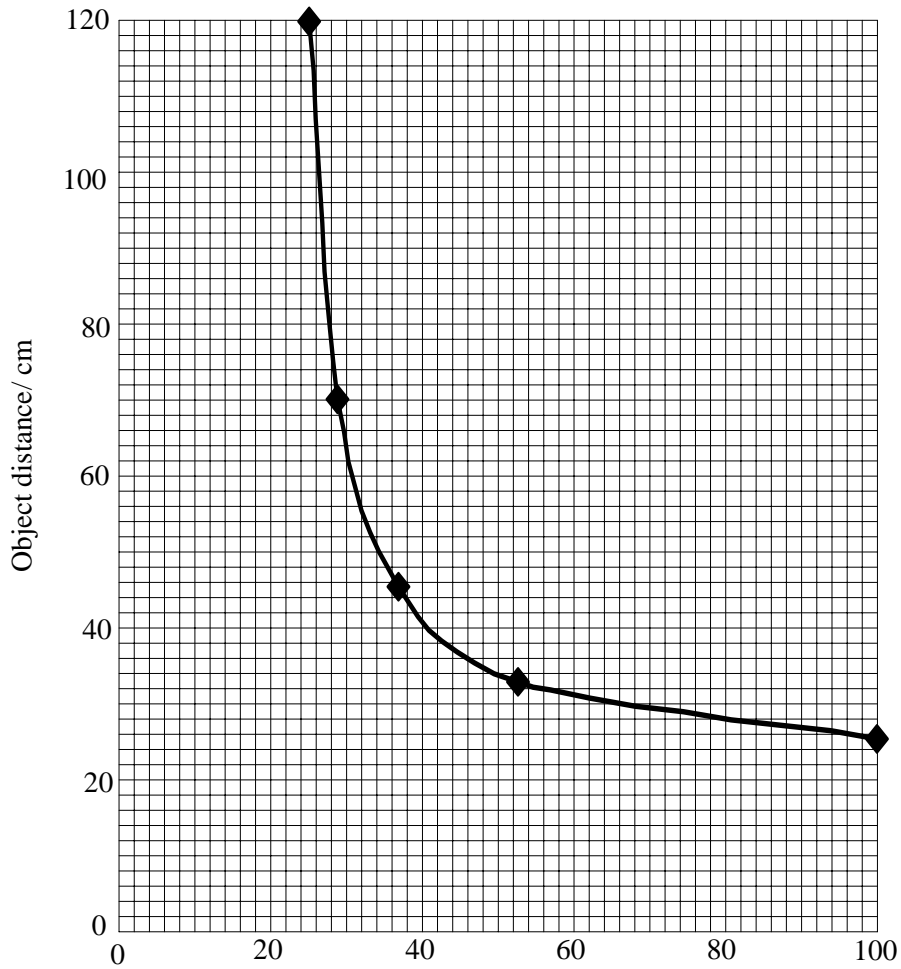
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QUESTIONSHEET 8

(a) results in order 24, 30, 40, 60, 100 (all: 3 marks, 3: 2 marks 2: 1 mark)

3

(b)(i)



sensible scales
correct plotting
line drawn accurately

1
1
1

(ii) 26 +/- 1 cm

1

(c) 25 cm

1

(d) $40 / 2$
= 20 cm

1
1

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QUESTIONSHEET 9

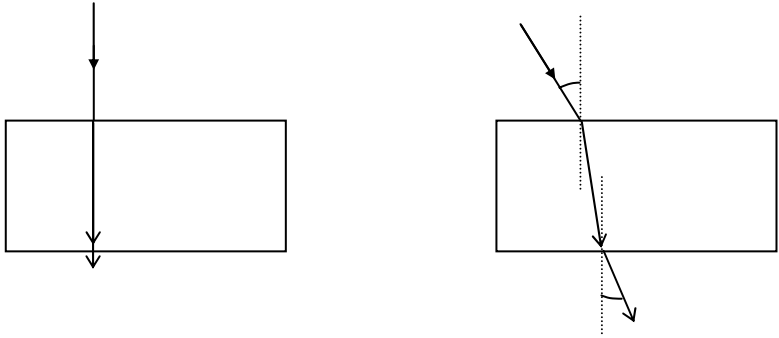
- | | |
|--|---|
| (a) Refraction. | 1 |
| (b) Violet light is bent more than red and continues from left to right. | 1 |
| (c) More refraction of red ray to bend downwards at glass/air boundary. | 1 |
| More refraction of violet ray to bend downwards at glass/air boundary. | 1 |
| Amount of refraction of violet ray is more than red ray. | 1 |
| (d) Orange | 1 |
| (e) Any from Infra red, Microwaves, Radio waves. | 1 |
| (f) Any from Ultraviolet, X-rays, Gamma-rays. | 1 |
| (g) Colours have different wavelengths. | 1 |
| Wavelengths will bend by different amounts. | 1 |
| Because different wavelengths will slow down by different amounts. | 1 |

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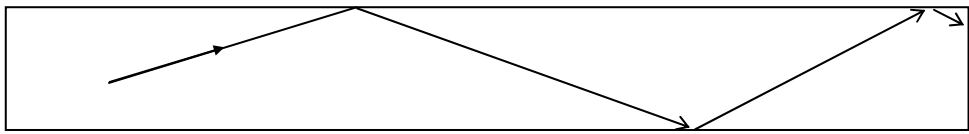
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QUESTIONSHEET 10

- (a) Right hand ray refracted inwards/ downwards. 1
 When it hit the boundary it is refracted in towards the right direction so
 outgoing ray parallel with incoming ray. 1
 Left hand ray is undeviated at both boundaries. 1



- (b) The angle of reflection is the same as the incident angle. 1
 The ray is continued until it hits the bottom edge of the glass. 1
 Again Total Internal Reflection takes place. 1



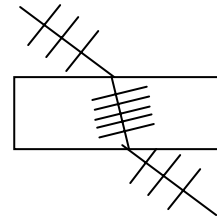
- (c) Light is sent along the fibre by total internal reflection. 1
 light hits the patient's insides and returns along the receiving fibre. 1
 Travels along receiving fibre towards eye by total internal reflection. 1

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QUESTIONSHEET 11

- | | | | |
|---------|---|---|------------------|
| (a) (i) | 90 degrees/ Right angle/ Perpendicular. | | 1 |
| | (ii) | Ray refracted into glass in the right direction and refracted out of glass in the right direction so that it is parallel to incident ray.
Wavefronts still at right angles in glass block.
Wavefronts closer together in glass block.
Wavefronts same distance as before and also at right angles when ray is back in air. | 1
1
1
1 |
| (b) | Slows down in the glass block.
Speeds up to same speed as before. | | 1
1 |
| (c) | Difference in refractive index/ optical density. | | 1 |
| (d) | The wave slows down because the refractive index has increased.
and so the wavefronts 'bunch up'.
As it leaves glass the index reduces and the wave speeds up again so wavefronts can spread out.
(Or equivalent but inverse pattern with frequency) | | 1
1
1 |



TOTAL / 11

QUESTIONSHEET 12

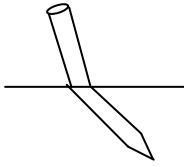
- | | | |
|---------|---|---|
| (a) | yellow | 1 |
| | magenta | 1 |
| | cyan | 1 |
| (b) | white | 1 |
| (c) (i) | any two colours which make white when mixed | 1 |
| | (ii) | |
| | blue & yellow | 1 |
| | red & cyan | 1 |
| | green & magenta | 1 |

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QUESTIONSHEET 13

(a)



light slower in water
changes angle of light

1

1

1

(b) (i) refractive index = speed of light in air/speed in water
 $300\,000\,000 / 225\,000\,000$
 $= 1.33$

1

1

1

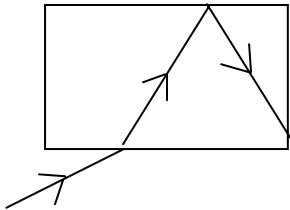
(ii) $\sin i / \sin r$

1

(c) (i) angle of incidence above which angle of refraction = 90°

1

(ii)



1

TOTAL / 9

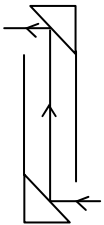
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ANSWERS AND MARK SCHEMES

QUESTIONSHEET 14

(a) (i) larger, less sharp, dimmer	3
(ii) moved closer to slide	1
(b) (i) convex	1
(ii) larger, less clear at edges	2
(c) focuses light through lens	1
burns film or shutter	1

TOTAL / 9

QUESTIONSHEET 15

(a) make up or shaving mirrors	1
magnifying glass	1
reflectors in torches	1
(b) see upstairs	1
wide field of view	1
(c) (i)	
	
mirrors	1
openings in tube	1
light ray	1
(ii) 45°	1
(iii) triangular prism	1

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QUESTIONSHEET 16

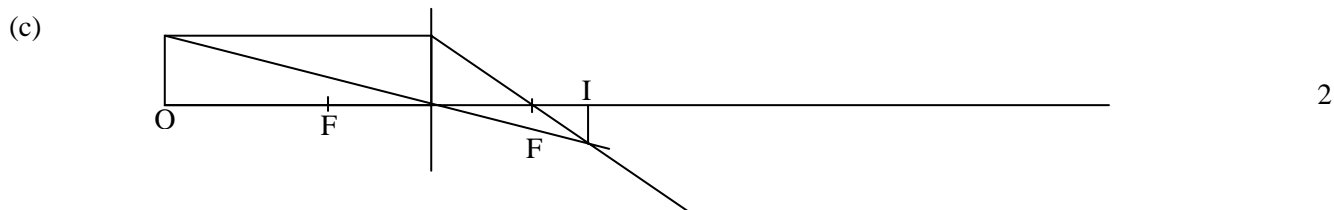
(a) convex – centre ray straight 1
others converging to point 1

concave – centre ray straight 1
others diverging 1

(b)(i) larger image 1

(ii) smaller image 1

(iii) same size image 1



distance – 8 cm 1

height – 2 cm 1

TOTAL / 11

QUESTIONSHEET 17

(a) Ray drawn with ruler from source to top of ball onto screen 1
Second ray drawn with ruler from source to bottom of ball
then continued to screen and shadow written between where these two rays hit the screen. 1

(b) Size will be different (complete shadow will be smaller) 1
Area of grey around the area of complete shadow (black) 1

(c) (i) Rays come from bulb into his eyes. 1

(ii) Rays from bulb bounce/ reflect off book into his eyes. 1

(iii) Paper scatters/ reflects at different angles. 1
Rays from different part of light bulb enter eye together. 1

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QUESTIONSHEET 18

(a) (i)	Angle of reflection correct (same as incident angle)	1
	Drawn with a ruler.	1
(ii)	The same size	1
	The same way up	1
	Virtual	1
(b)	Diagram roughly same size	1
	Orientation correct (so end of screwdriver pointing away from object)	1
(c) (i)	Angles of reflection at top mirror correct (so rays go vertical downwards)	1
	Angles of reflection at bottom mirror correct (so rays go horizontally towards eye)	1
	Rays drawn with a ruler and direction arrows drawn on constructed rays	1
(ii)	To see over or around any object (i.e. wall, crowd of people etc)	1

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QUESTIONSHEET 19

(a) (i)	Increasing wavelength.	1
(ii)	Increasing frequency.	1
(b)	Red on the right hand side.	1
	Violet on the left hand side.	1
(c)	Gamma rays.	1
(d) (i)	To examine bones or structure of the body.	1
(ii)	Sun tans or sterilisation.	1
(e)	All these waves have a lot of energy.	1
	Which is transferred to object it hits (and can kill cells etc.)	1

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QUESTIONSHEET 20

(a) she would see her name	1
retention of vision	1
(b)(i) to enable them to see all round	1
without moving head	1
(ii) judge distance	1
for catching prey	1
(c)(i) jerky or slow	1
(ii) no time for brain to register still image	1
before next one appears	1
(iii) 24 frames per sec	1
$\times 5 \times 60$	1
= 7200 frames	1

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