4.4 Wave Behaviour

Question Paper

Course	DP IB Physics
Section	4. Waves
Topic	4.4 Wave Behaviour
Difficulty	Easy

Time allowed: 60

Score: /47

Percentage: /100

Question 1a

(a)
State what is meant by:

(i)
The law of reflection.

[1]

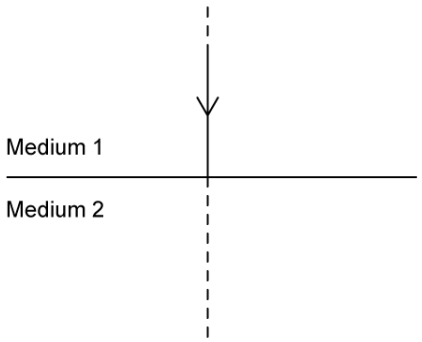
(ii)
Refraction.

[1]

[2 marks]

Question 1b

The following diagram shows an incident ray perpendicular to the boundary between two media.



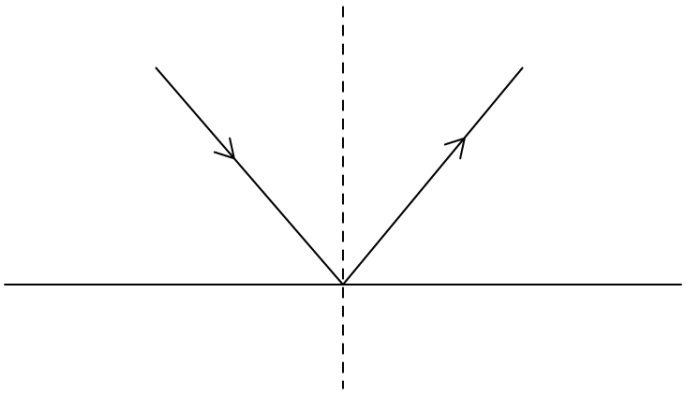
(b)
Complete the ray diagram by drawing the transmitted ray.

[2]

[2 marks]

Question 1c

Ray diagrams can be used to show reflection and refraction. The following diagram shows the reflection of light on a smooth surface.



(c)
On the ray diagram label:

(i)
The incident ray.

[1]

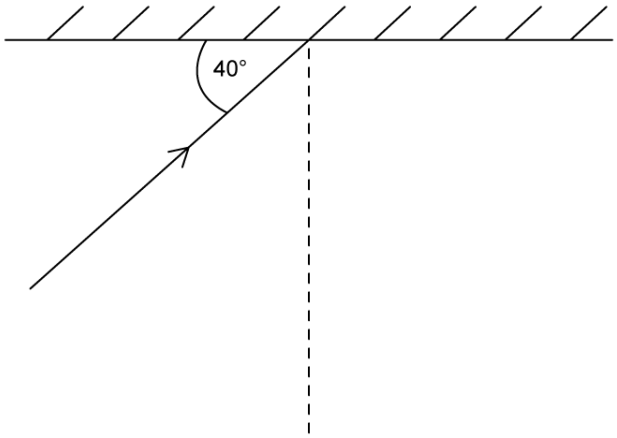
(ii)
The reflected ray.

[1]

[2 marks]

Question 1d

The ray diagram shows an incident ray on a plane mirror.



(d)
Calculate the angle of reflection.

[3]

[3 marks]

Question 2a

Refraction occurs when light travels between media with different optical densities.

(a)
Describe what happens when light passes from a less dense medium into a more dense medium in terms of:

(i)
The relative sizes of the angles of incidence and refraction.

[1]

(ii)
The direction of the refracted light ray in relation to the normal.

[1]

[2 marks]

Question 2b

The refractive index is calculated using the equation:

$$n = \frac{c}{v}$$

(b)
Write in the missing information to complete the following table:

Quantity	Symbol	Units
	n	No units
	c	
Speed of light in medium	v	

[3]

[3 marks]

Question 2c

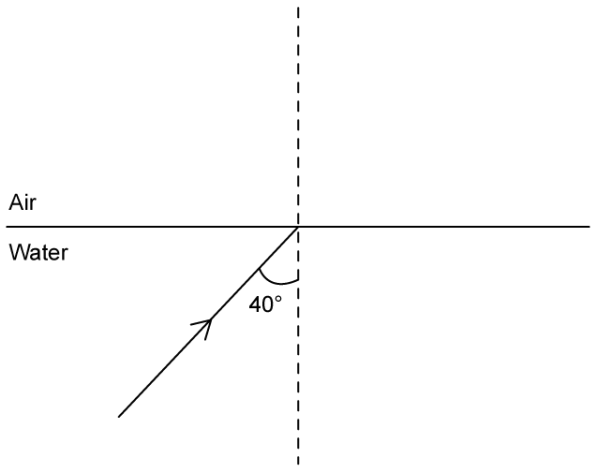
(c)
Define the term critical angle.

[1]

[1 mark]

Question 2d

Incident light travelling through water approaches the surface of the water and meets the boundary with air. The incident ray has an angle of incidence = 40°.



The refractive index of air is 1.00 and the refractive index of water is 1.33.

(d)
Calculate the angle of refraction for the refracted ray.

[2]

[2 marks]

Question 3a

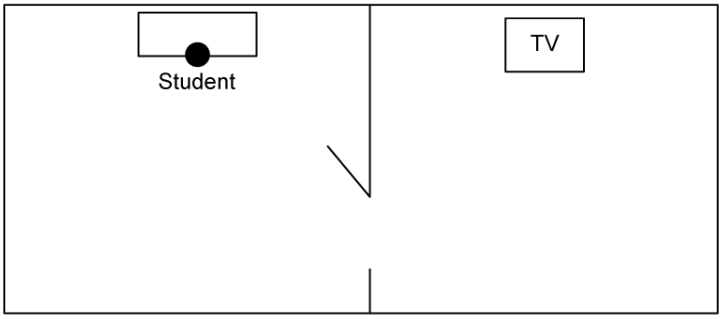
(a)
Define diffraction.

[1]

[1 mark]

Question 3b

The diagram shows a student in a room with an open door and a television in the next room.



The student can hear the sound of the television, but cannot see the picture coming from it.

(b)
Complete the following sentences by circling the correct word to explain why this is the case.

Sound waves emitted from the television **diffract / refract** around the opening of the door because the **amplitude / wavelength** is similar in size to the door. The **amplitude / wavelength** of light is much **larger / smaller** than that of the sound waves, so light is not not **diffracted / refracted** around the opening of the door.

[5]

[5 marks]

Question 3c

(c)
Define coherence.

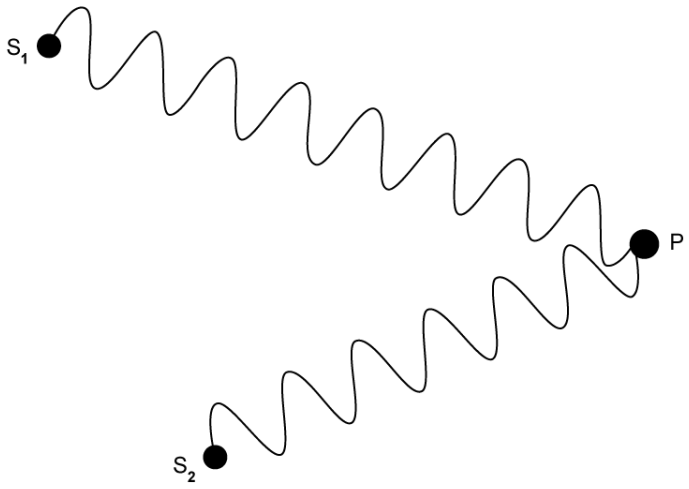
[1]

[1 mark]

Question 3d

The diagram shows two different waves from sources s_1 and s_2 meeting at point P

.



(d)
For the waves meeting at point P:

(i)
Determine the path difference.

[3]

(ii)
State whether the interference will be constructive or destructive.

[1]

[4 marks]

Question 4a

(a)
Outline the conditions for destructive interference.

[1]

[1 mark]

Question 4b

Some light can be described as monochromatic.

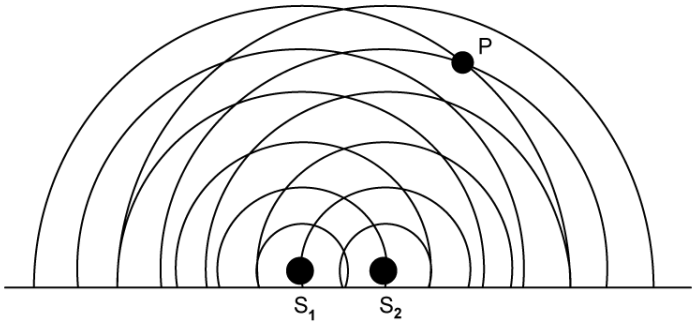
(b)
State what is meant by the term monochromatic.

[1]

[1 mark]

Question 4c

The diagram shows the wave fronts emitted from two point sources s_1 and s_2.



(c)
The waves meet at point P.

(i)
By considering the number of waves, determine the path difference.

[3]

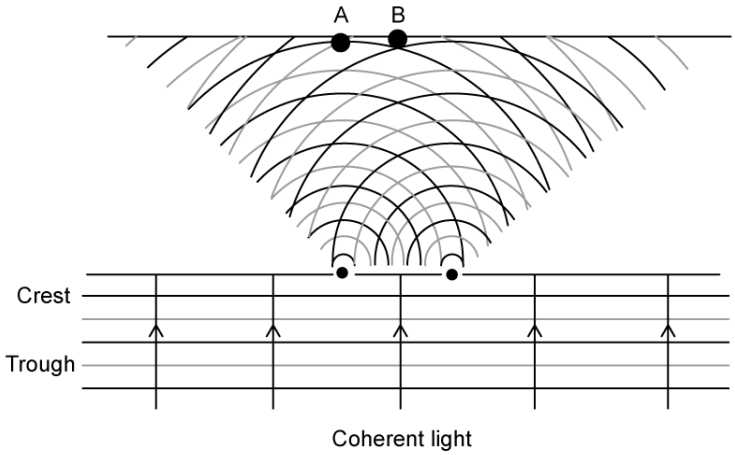
(ii)
State whether constructive or destructive interference would occur at point P.

[1]

[4 marks]

Question 4d

The diagram shows two sources of coherent light producing a double-slit interference pattern.



(d)
State whether the interference is constructive or destructive at point:

(i)
A.

[1]

(ii)
B.

[1]

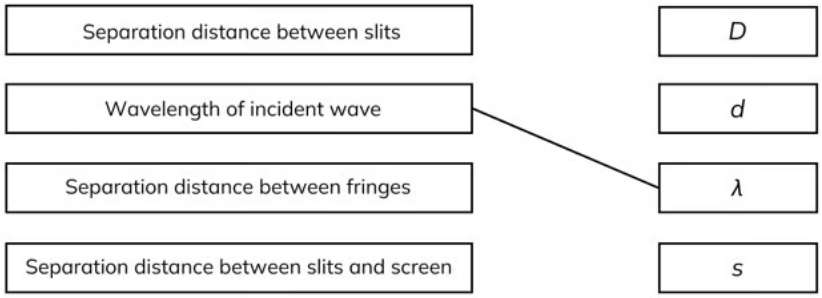
[2 marks]

Question 5a

The distance between the bright fringes in a double-slit interference pattern can be determined by the double-slit equation

$$s = \frac{\lambda D}{d}$$

(a)
Draw a line to match the quantity to the correct symbol.

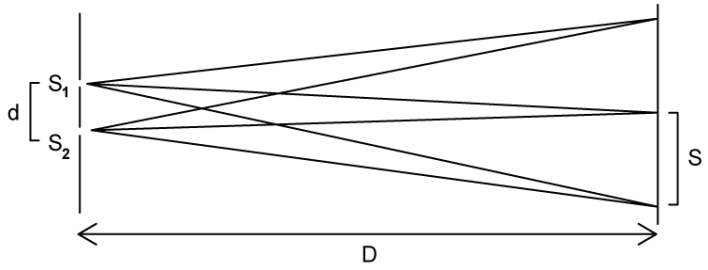


[3]

[3 marks]

Question 5b

Red laser light is used to form a double-slit interference pattern on a screen.



The distance between the bright fringes depends on the wavelength of the incident light.

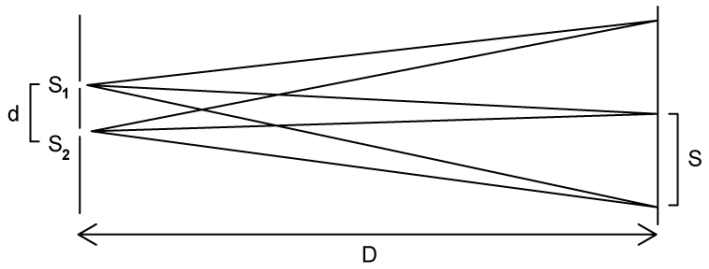
(b)
Outline how the interference pattern would be affected if blue laser light were used instead.

[2]

[2 marks]

Question 5c

Red laser light of wavelength $\lambda = 650$ nm is used to form a double-slit interference pattern on the screen as shown.



The separation distance of the slits $d = 0.2$ mm, and the distance between the slits and the screen $D = 1.2$ m.

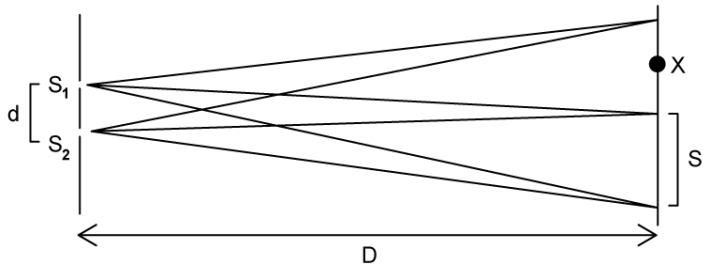
(c)
Calculate the separation distance between the fringes on the screen s.

[4]

[4 marks]

Question 5d

For the interference pattern shown in part (c):



(d)

Explain why there is no bright fringe at point X.

[2]

[2 marks]