IB PHYSICS

Name: _____

Period: _____ Date: _____

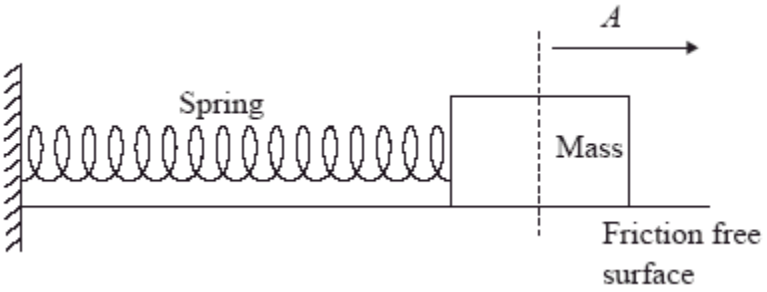
Marks: **83** Raw Score: ____ IB Curve: ____

DEVIL PHYSICS

BADDEST CLASS ON CAMPUS

CHAPTER 9 TEST REVIEW

1. A mass on the end of a horizontal spring is displaced from its equilibrium position by a distance *A* and released. Its subsequent oscillations have total energy *E* and time period *T*.

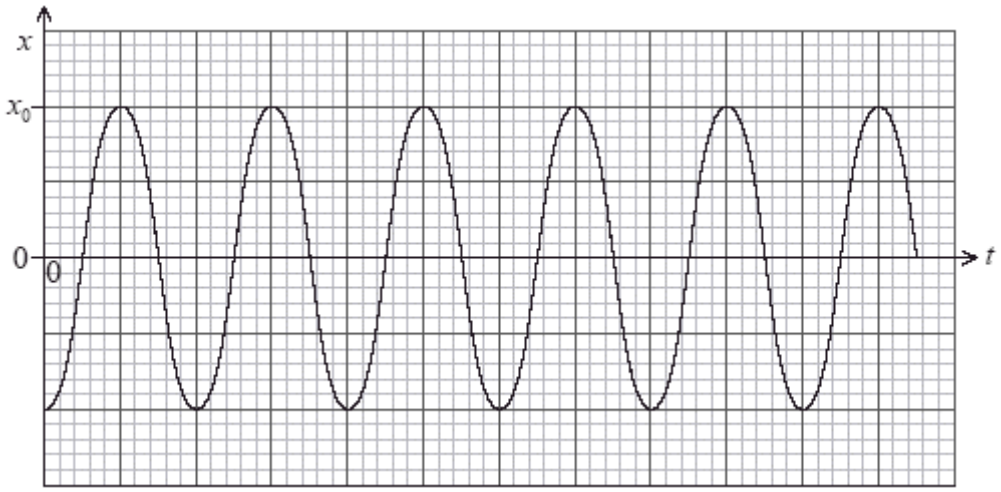


An identical mass is attached to an identical spring. The maximum displacement is 2*A*. Assuming this spring obeys Hooke's law, which of the following gives the correct time period and total energy?

	New time period	New energy
A.	T	$4E$
B.	T	$2E$
C.	$\sqrt{2}T$	$4E$
D.	$\sqrt{2}T$	$2E$

(Total 1 mark)

2. An object at the end of a spring oscillates vertically with simple harmonic motion. The graph shows the variation with time *t* of the displacement *x*. The amplitude is x_0 and the period of oscillation is *T*.



Which of the following is the correct expression for the maximum acceleration of the object?

A. $\frac{2\pi}{T}x_0$

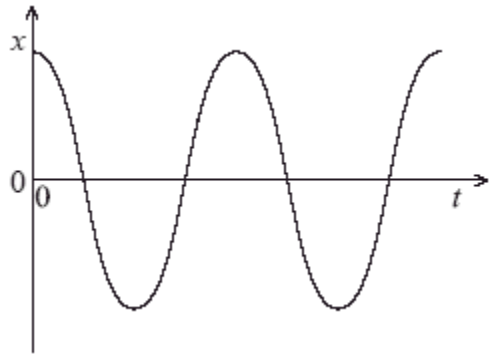
B. $\frac{2\pi}{T^2}x_0$

C. $\frac{4\pi^2}{T^2}x_0$

D. $\frac{4\pi^2}{T}x_0$

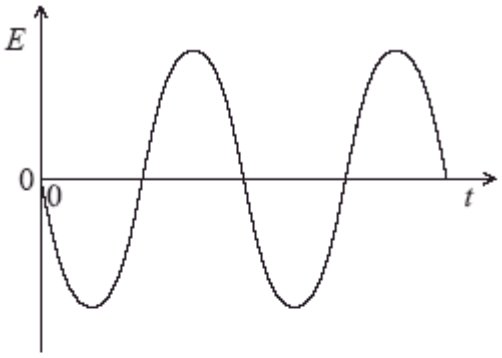
(Total 1 mark)

3. The graph below shows how the displacement x of a particle undergoing simple harmonic motion varies with time t. The motion is undamped.

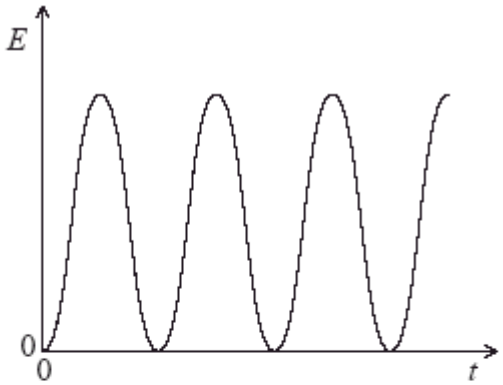


Which of the following graphs shows how the total energy E of the particle varies with time t?

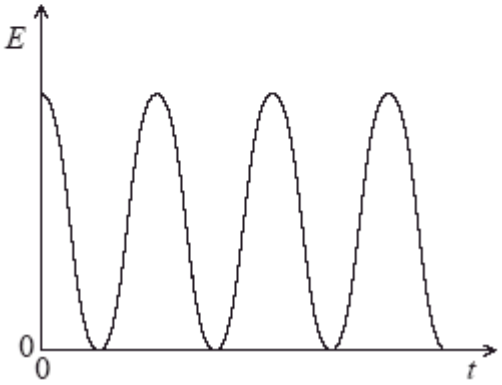
A.



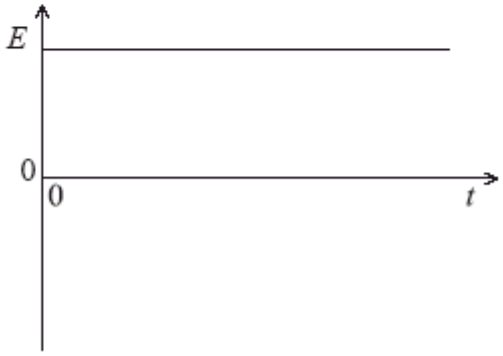
B.



C.

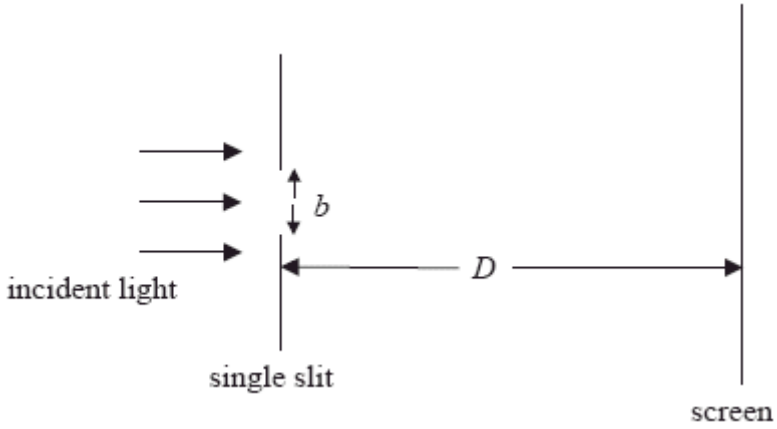


D.



(Total 1 mark)

4. A beam of coherent light is incident on a single slit of width *b*. After passing through the slit, the light is incident on a screen at a distance *D* from the slit.



Which of the following changes, carried out separately, in respect of *b* and *D* will result in an increase in width of the first diffraction maximum formed on the screen?

	b	***D***
A.	decrease	increase
B.	increase	increase
C.	decrease	decrease
D.	increase	decrease

(Total 1 mark)

5. A parallel beam of monochromatic light of wavelength λ passes through a slit of width *b*. After passing through the slit the light is incident on a distant screen. The angular width of the central maximum is

A. $2\frac{\lambda}{b}$ radians.

B. $\frac{\lambda}{b}$ radians.

C. $2\frac{\lambda}{b}$ degrees.

D. $\frac{\lambda}{b}$ degrees.

(Total 1 mark)

6. In two separate experiments monochromatic light is incident on a single slit. The diagrams show the diffraction patterns obtained on a screen far from the slit. In the top diagram the wavelength of light is λ_1 and the slit width is b_1. In the bottom diagram the wavelength of light is λ_2 and the slit width is b_2.

In each experiment the distance between the slit and the screen is the same. Which of the following may be deduced?

A. $\frac{\lambda_1}{b_1} < \frac{\lambda_2}{b_2}$

B. $\frac{\lambda_1}{b_1} > \frac{\lambda_2}{b_2}$

C. $b_1 < b_2$

D. $\lambda_1 > \lambda_2$

(Total 1 mark)

7. Two galaxies with an angular separation at the observer of 5.0×10^{-4} radians are observed with a radio telescope. Both galaxies emit radio waves of wavelength 2.5×10^{-2} m.

The images of the galaxies are just resolved by the telescope. The diameter of the circular collecting dish of the telescope is

A. 61 m.

B. 50 m.

C. 30 m.

D. 25 m.

(Total 1 mark)

8. Which of the following wave phenomena is associated with blood flow measurements?

A. Polarization

B. Diffraction

C. Refraction

D. Doppler effect

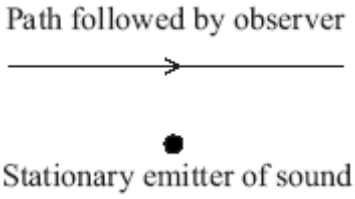
(Total 1 mark)

9. A man standing by the shore observes sea waves approaching at a frequency of 0.20 Hz. A man on a boat observes that waves are approaching the boat at a frequency of 0.50 Hz. The speed of the waves is 2.0 m s^{-1}. Which of the following gives a possible value for the speed of the boat and its direction?

	Speed / m s^{-1}	Direction
A.	3.0	away from the shore
B.	3.0	towards the shore
C.	1.2	away from the shore
D.	1.2	towards the shore

(Total 1 mark)

10. During a journey an observer travels at constant speed towards, and then goes beyond, a stationary emitter of sound.



The frequency of the sound as measured at the emitter is *f*. The frequency according to the observer

A. is always greater than *f*.

B. is always equal to *f*.

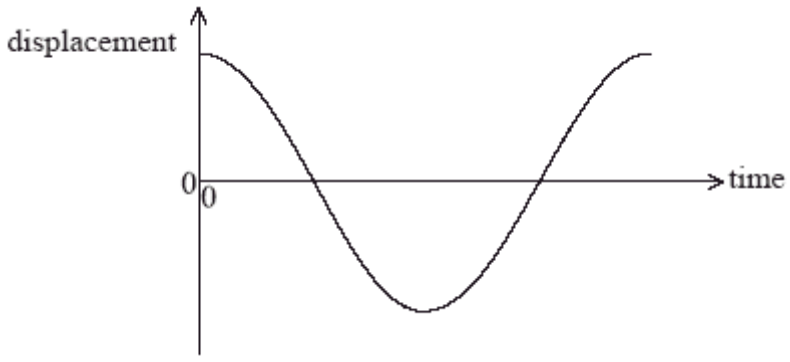
C. is always less than *f*.

D. varies during the journey.

(Total 1 mark)

11. This question is about a simple pendulum.

(a) A pendulum consists of a bob suspended by a light inextensible string from a rigid support. The pendulum bob is moved to one side and then released. The sketch graph shows how the displacement of the pendulum bob undergoing simple harmonic motion varies with time over one time period.



On the sketch graph above,

(i) label with the letter A a point at which the acceleration of the pendulum bob is a maximum.

(1)

(ii) label with the letter V a point at which the speed of the pendulum bob is a maximum.

(1)

(b) Explain why the magnitude of the tension in the string at the midpoint of the oscillation is greater than the weight of the pendulum bob.

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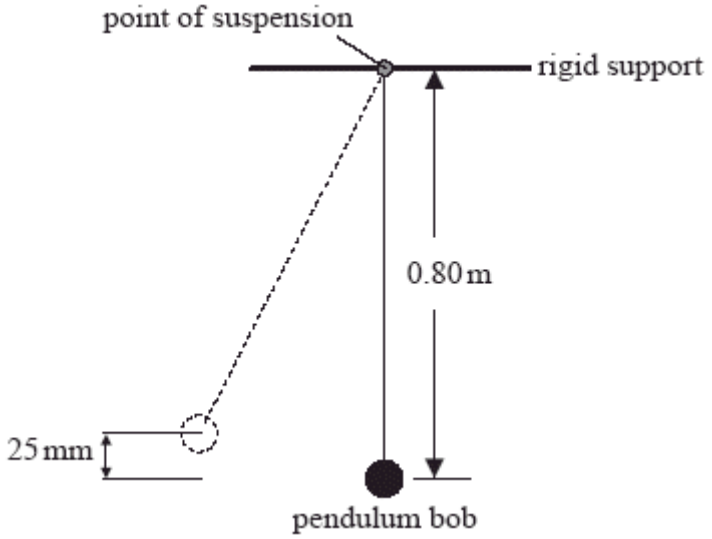
(3)

(c) The pendulum bob is moved to one side until its centre is 25 mm above its rest position and then released.



(i) Show that the speed of the pendulum bob at the midpoint of the oscillation is 0.70 m s^{-1}.

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(2)

(ii) The mass of the pendulum bob is 0.057 kg. The centre of the pendulum bob is 0.80 m below the support. Calculate the magnitude of the tension in the string when the pendulum bob is vertically below the point of suspension.

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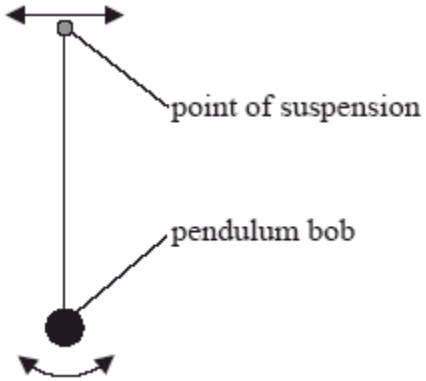
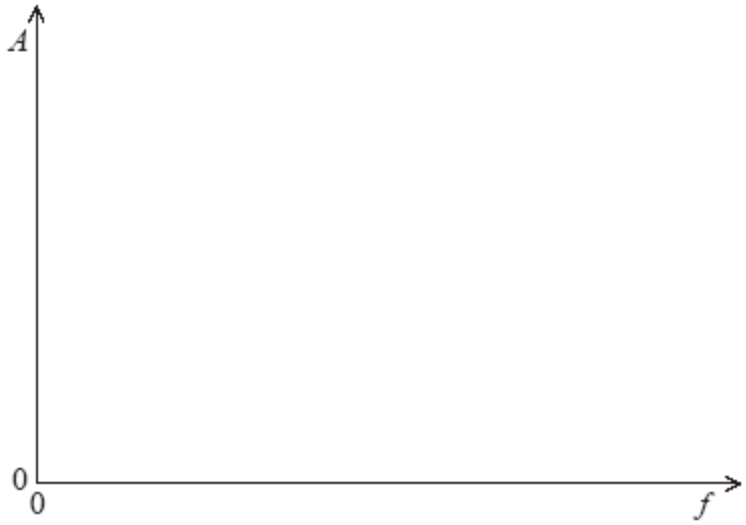
(3)

(d) The point of suspension of the pendulum bob is moved from side to side with a small amplitude and at a variable driving frequency *f*.



For each value of the driving frequency a steady constant amplitude *A* is reached. The oscillations of the pendulum bob are lightly damped.

(i) On the axes below, sketch a graph to show the variation of *A* with *f*.



(2)

(ii) Explain, with reference to the graph in (d)(i), what is meant by resonance.

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(2)

(e) The pendulum bob is now immersed in water and the variable frequency driving force in (d) is again applied. Suggest the effect this immersion of the pendulum bob will have on the shape of your graph in (d)(i).

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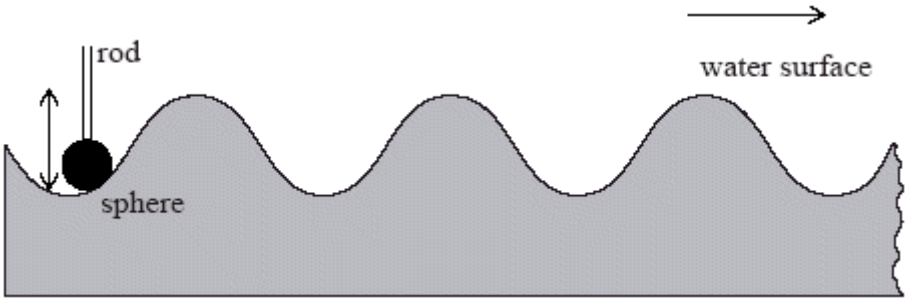
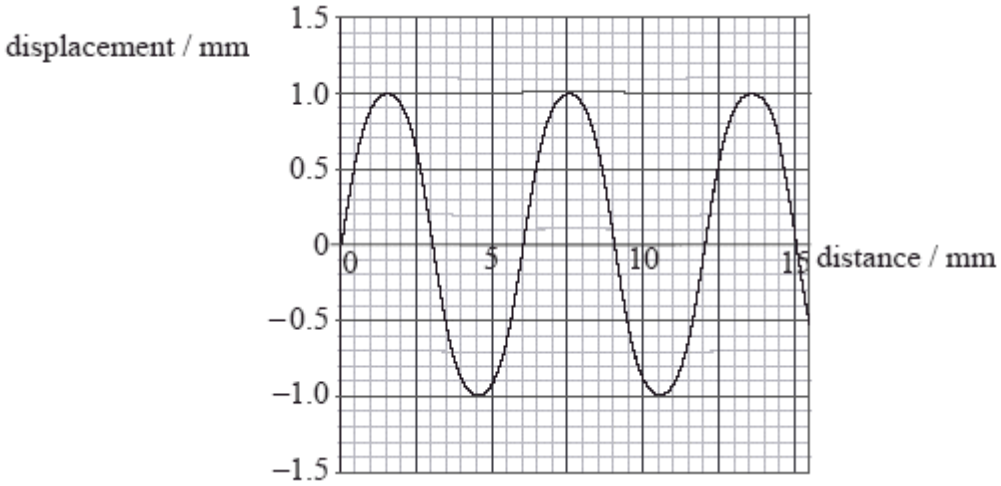
(2)

12. This question is about water wave motion.

A small sphere, mounted at the end of a vertical rod, dips below the surface of shallow water in a tray. The sphere is driven vertically up and down by a motor attached to the rod.
The oscillations of the sphere produce travelling waves on the surface of the water.



(a) The diagram shows how the displacement of the water surface at a particular instant in time varies with distance from the sphere. The period of oscillation of the sphere is 0.027 s.



Use the diagram to calculate, for the wave,

(i) the amplitude.

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(1)

(ii) the wavelength.

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(1)

(iii) the frequency.

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(1)

(iv) the speed.

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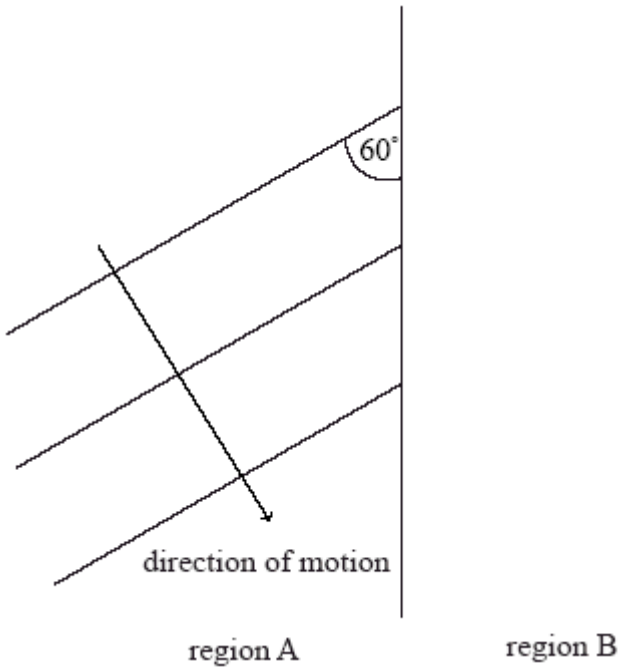
(1)

(b) The wave moves from region A into a region B of shallower water. The waves move more slowly in region B. The diagram (not to scale) shows some of the wavefronts in region A.



(i) With reference to a wave, distinguish between a ray and a wavefront.

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(2)

(ii) The angle between the wavefronts and the interface in region A is 60°. The refractive index ${}_{A}n_{B}$ is 1.4.

Determine the angle between the wavefronts and the interface in region B.

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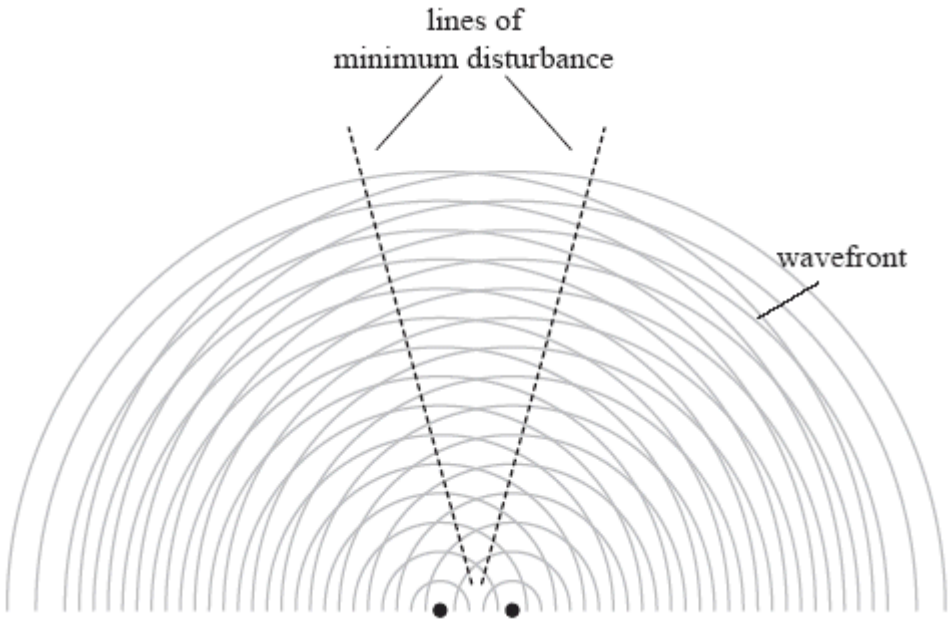
(2)

(iii) On the diagram above, construct **three** lines to show the position of three wavefronts in region B.

(2)

(c) Another sphere is dipped into the water. The spheres oscillate in phase. The diagram shows some lines in region A along which the disturbance of the water surface is a minimum.



(i) Outline how the regions of minimum disturbance occur on the surface.

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(3)

(ii) The frequency of oscillation of the spheres is increased.

State **and** explain how this will affect the positions of minimum disturbance.

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(2)

13. This question is about the diffraction of light.

(a) (i) Describe what is meant by the diffraction of light.

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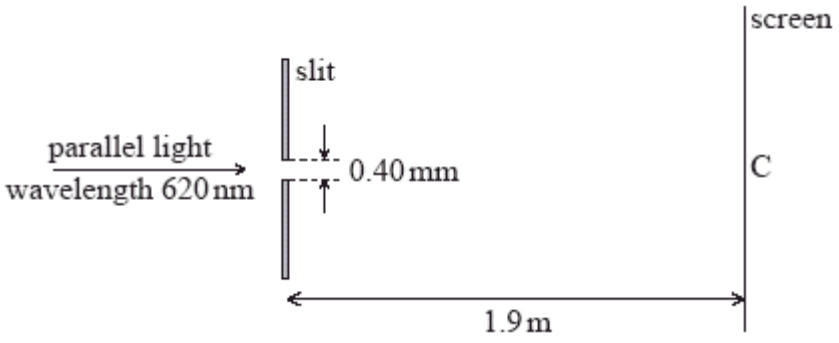
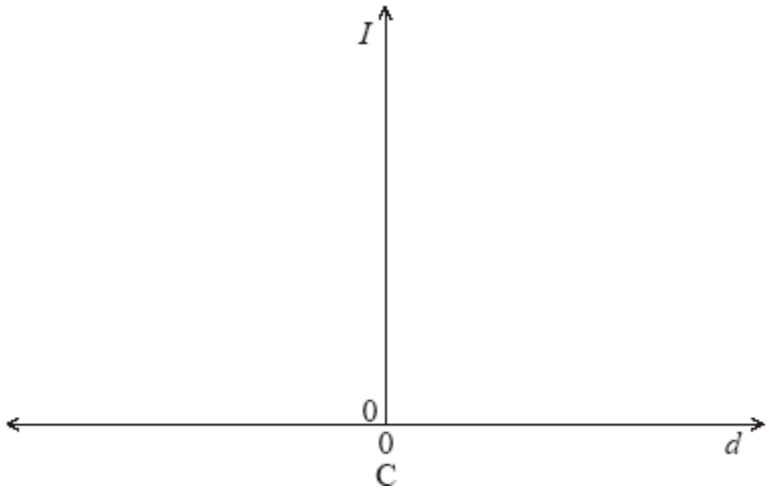
(2)

(ii) A parallel beam of monochromatic light from a laser is incident on a narrow slit. The diffracted light emerging from the slit is incident on a screen.



(not to scale)

The centre of the diffraction pattern produced on the screen is at C. On the axes sketch a graph to show how the intensity *I* of the light on the screen varies with the distance *d* from C.



(3)

(iii) The slit width is 0.40 mm and it is 1.9 m from the screen. The wavelength of the light is 620 nm. Determine the width of the central maximum on the screen.

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(3)

(b) (i) When two separate lasers are used as sources, the images of the slit formed by the light from each laser are resolved. State what is meant by the term resolved in this context.

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(1)

(ii) A car, with its two headlights switched on, is approaching an observer who has good eyesight. Outline why, at a long distance from the observer, the images of the headlights of the car are not resolved by the observer.

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(4)

14. This question is about interference and lasers.

(a) Two overlapping beams of light from two flashlights (torches) fall on a screen. Explain why no interference pattern is observed.

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(3)

(b) Light from a laser that passes through a double slit is incident on a screen and produces observable interference.

(i) Outline how the laser produces light.

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(2)

(ii) State the name of the property that enables the laser light to produce observable interference.

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(1)

(c) Outline how a laser can be used to read a bar-code.

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(2)

(d) A plane is flying at 100 m s^{-1} in a direction parallel to the line joining two identical radio towers as shown in the diagram.

(not to scale)

The two towers each emit a coherent radio signal of wavelength of 5.0 m. The separation of the towers is 200 m. To an observer on the plane the intensity of the received signal goes through a maximum every 5.0 s. Determine the distance from the plane to the line joining the radio towers.

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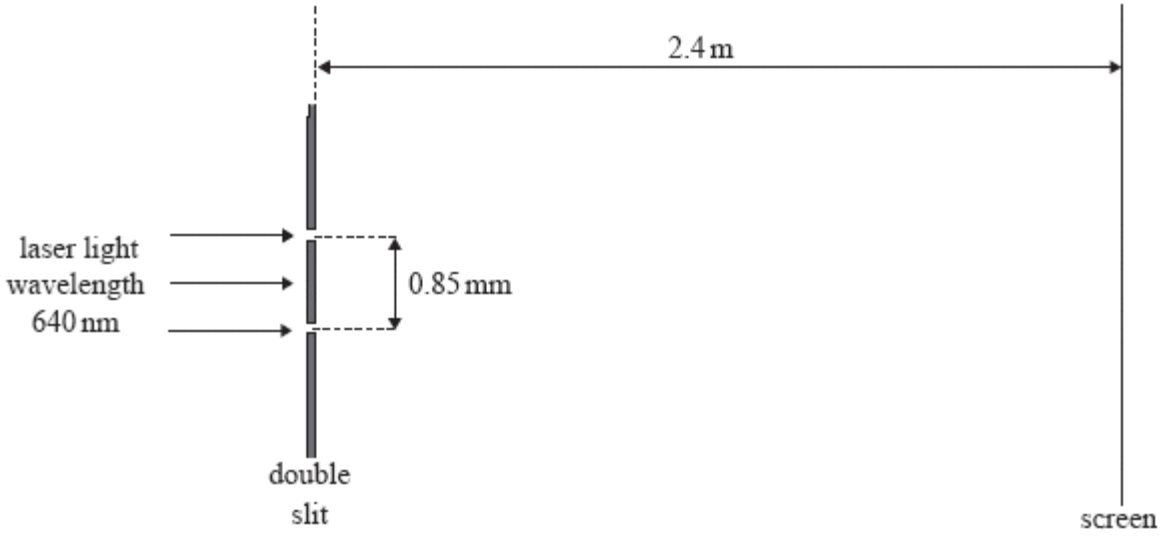
(3)

15. This question is about two-source interference.

A double slit is arranged so that its plane is normal to a beam of laser light, as shown below.



The wavelength of the light is 640 nm. The slit separation in the double slit arrangement is 0.85 mm.

Coherent light emerges from the slits and an interference pattern is observed on a screen. The screen is parallel to the plane of the double slits. The distance between the slits and the screen is 2.4 m.

(a) (i) State what is meant by coherent light.

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(1)

(ii) Explain how an interference pattern is formed on the screen.

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(3)

(b) Calculate the separation of the fringes in the interference pattern on the screen.

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(2)

(c) The interference pattern in (b) consists of a series of alternate light and dark fringes. The intensity of the light from one slit is now reduced. Suggest the effect on the appearance of the fringes.

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(2)

16. This question is about using a diffraction grating to view the emission spectrum of sodium.

Light from a sodium discharge tube is incident normally upon a diffraction grating having 8.00×10^5 lines per metre. The spectrum contains a double yellow line of wavelengths 589 nm and 590 nm.

(a) Determine the angular separation of the two lines when viewed in the second order spectrum.

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(4)

(b) State why it is more difficult to observe the double yellow line when viewed in the first order spectrum.

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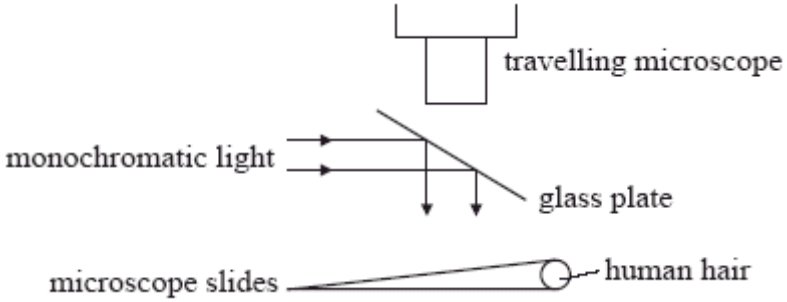
(1)

17. This question is about thin-film interference.

The diagram (not to scale) represents an experimental set-up designed to measure the diameter of a human hair.



A hair is used to separate two microscope slides. A monochromatic beam of light is reflected onto the two slides by the glass plate. The light is then reflected from the two slides and transmitted through the glass plate and is viewed by the travelling microscope.

(a) State why the light reflected from the two microscope slides produces a system of interference fringes.

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(1)

(b) The condition that a bright fringe is observed in the field of view of the travelling microscope is given by the relationship

$$2t = \left(m + \frac{1}{2}\right)\lambda$$

where t is the thickness of the air film formed by the wedge at the point where the bright fringe is observed, m is an integer and λ is the wavelength of the incident light.

State the reason for the factor $\frac{1}{2}$ in the relationship.

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(1)

(c) In the diagram, the length of the slides is 5.00 cm. The wavelength of the monochromatic light is 5.92×10^{-7} m. Using the travelling microscope it is observed that 50 fringes occupy a length of 0.940 cm. Show that the diameter of the hair used to separate the slides is about 80 μm.

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(3)