***IB PHYSICS***

Name: _____

Period: _____ Date: _____

# Marks: **74** Raw Score: ____ IB Curve: ____

DEVIL PHYSICS

BADDEST CLASS ON CAMPUS

# CHAPTER 4 TEST REVIEW

**1.** In which of the following regions of the electromagnetic spectrum is radiation of wavelength 600 nm located?

A. microwaves

B. radio waves

C. visible light

D. X-rays

**(Total 1 mark)**

**2.** Which of the following is a value of wavelength that is found in the visible region of the electromagnetic spectrum?

A. $4 \times 10^{-5}$ m

B. $4 \times 10^{-7}$ m

C. $4 \times 10^{-9}$ m

D. $4 \times 10^{-11}$ m

**(Total 1 mark)**

**3.** Which of the following electromagnetic waves has a frequency **greater** than that of visible light?

A. Ultraviolet

B. Radio

C. Microwaves

D. Infrared

**(Total 1 mark)**

**4.** Two waves meet at a point. The waves have a path difference of $\frac{\lambda}{4}$. The phase difference between the waves is

A. $\frac{\pi}{8}$ rad.

B. $\frac{\pi}{4}$ rad.

C. $\frac{\pi}{2}$ rad.

D. $\pi$ rad.

**(Total 1 mark)**

**5.** For a system executing simple harmonic motion, the restoring force acting on the system is proportional to the

A. displacement of the system from equilibrium.

B. amplitude of oscillation.

C. elastic potential energy.

D. frequency of oscillation.

**(Total 1 mark)**

**6.** During one complete oscillation, the amplitude of a **damped** harmonic motion changes from 1.5 cm to 0.30 cm. The total energy at the end of the oscillation is $E_2$ and the total energy at the beginning of the oscillation is $E_1$. The ratio $\frac{E_2}{E_1}$ is

A. $\frac{1}{5}$.

B. $\frac{1}{25}$.

C. 5.

D. 25.

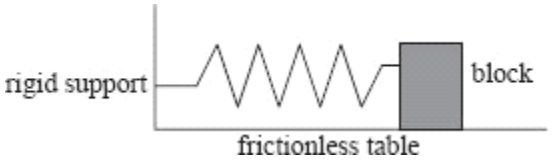
**(Total 1 mark)**

**7.** Which of the following correctly describes the change, if any, in the speed, wavelength and frequency of a light wave as it passes from air into glass?

| | Speed | Wavelength | Frequency |
|---|---|---|---|
| A. | decreases | decreases | unchanged |
| B. | decreases | unchanged | decreases |
| C. | unchanged | increases | decreases |
| D. | increases | increases | unchanged |

**(Total 1 mark)**

**8.** A wooden block is at rest on a horizontal frictionless surface. A horizontal spring is attached between the block and a rigid support.

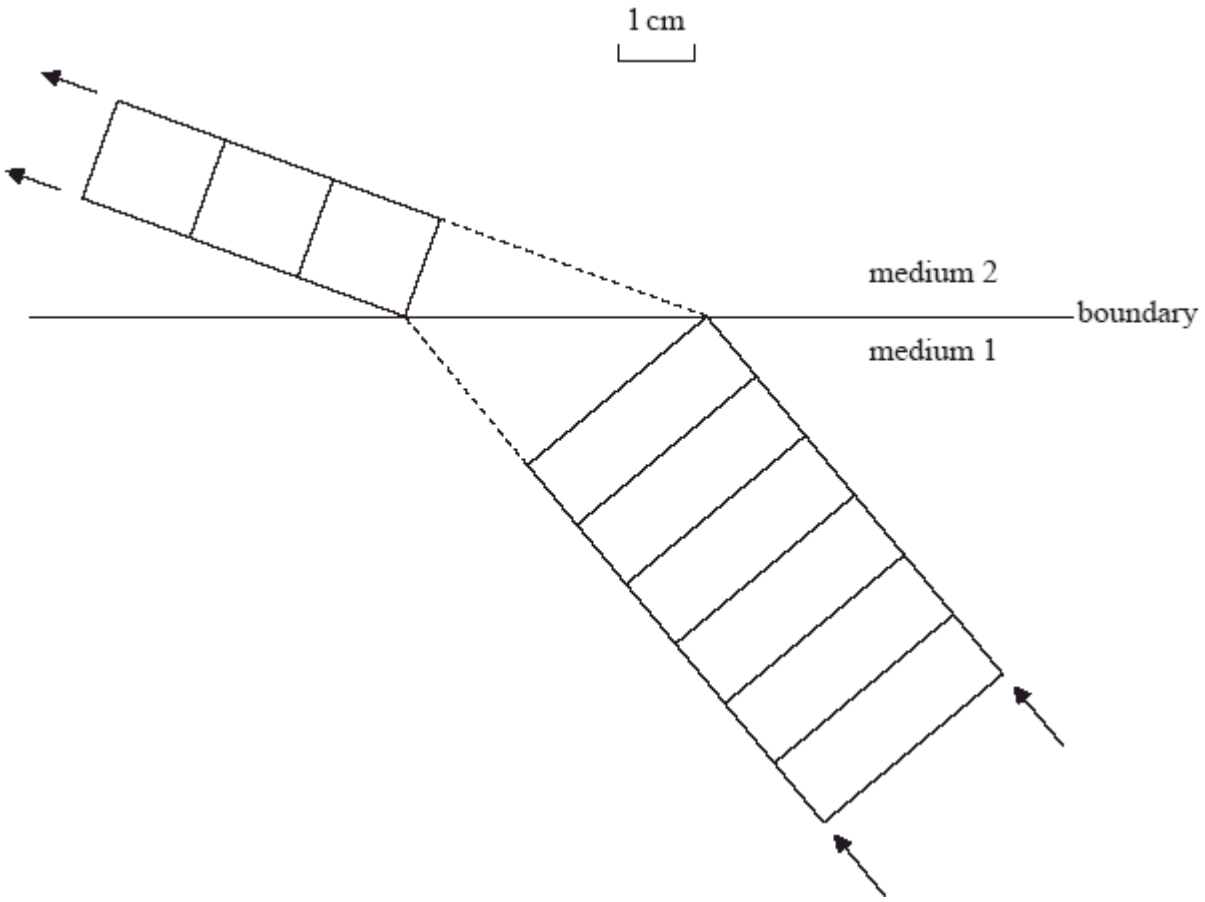



The block is displaced to the right by an amount $X$ and is then released. The period of oscillations is $T$ and the total energy of the system is $E$. For an initial displacement of $\frac{X}{2}$ which of the following shows the best estimate for the period of oscillations and the total energy of the system?

| | Period | Total energy |
|---|---|---|
| A. | $T$ | $\frac{E}{2}$ |
| B. | $T$ | $\frac{E}{4}$ |
| C. | $\frac{T}{2}$ | $\frac{E}{2}$ |
| D. | $\frac{T}{2}$ | $\frac{E}{4}$ |

**(Total 1 mark)**

**9.** Plane wavefronts are incident on a boundary between two media labelled 1 and 2 in the diagram. The diagram of the wavefronts is drawn to scale.




The ratio of the refractive index of medium 2 to that of medium 1 is

A. 0.50.

B. 0.67.

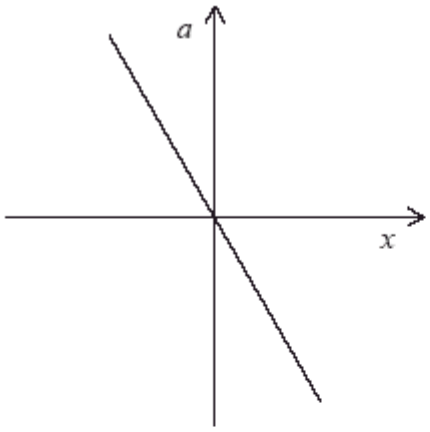
C. 1.5.

D. 2.0.

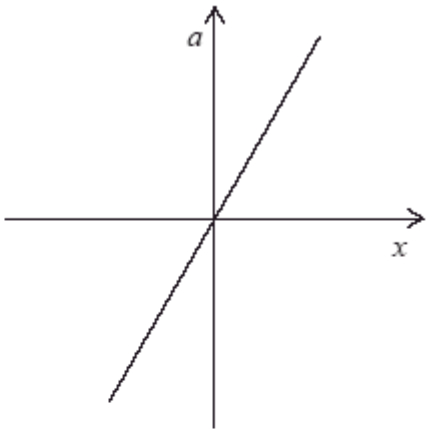
**(Total 1 mark)**

**10.** Which graph correctly shows how the acceleration, $a$ of a particle undergoing SHM varies with its displacement, $x$ from its equilibrium position?

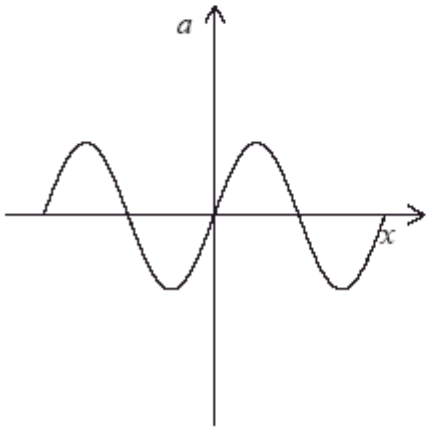
A.



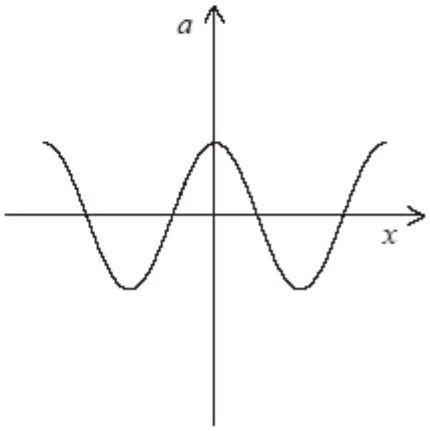

B.




C.

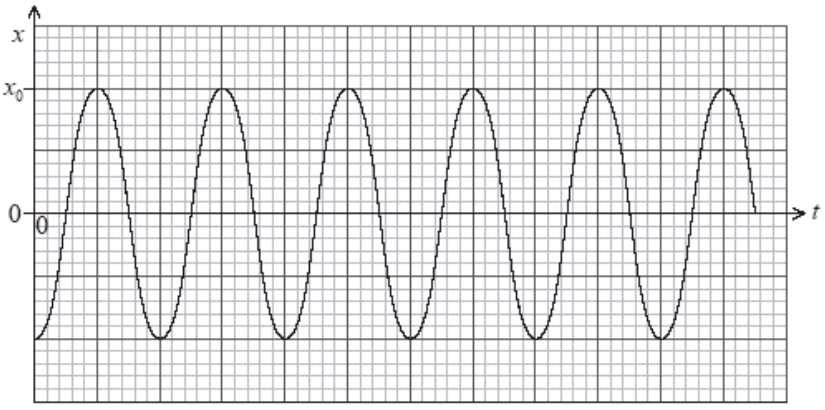



D.




**(Total 1 mark)**

**11.** 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. $\frac{2\pi}{T}x_0$

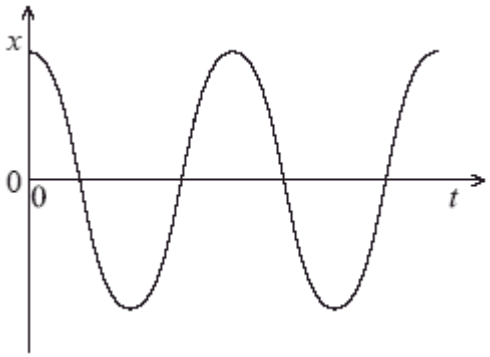
B. $\frac{2\pi}{T^2}x_0$

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

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

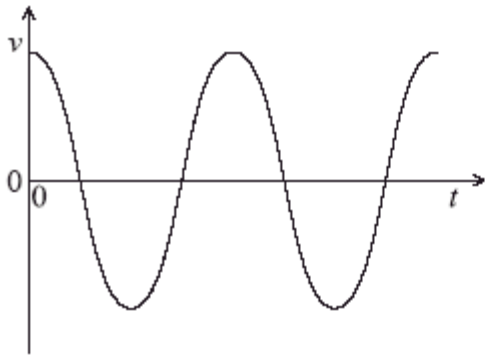
**(Total 1 mark)**

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

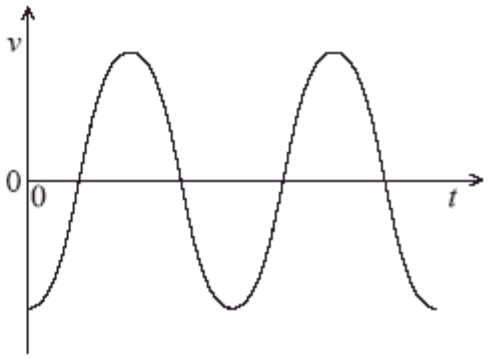



Which of the following graphs correctly shows how the velocity $v$ of the particle varies with $t$?

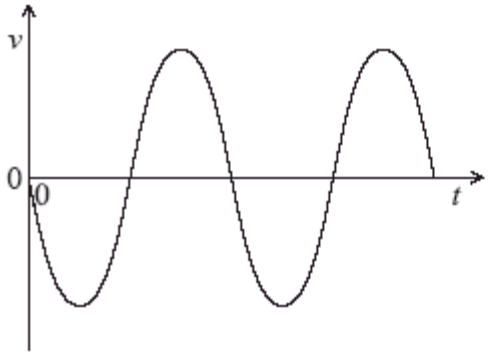
A.



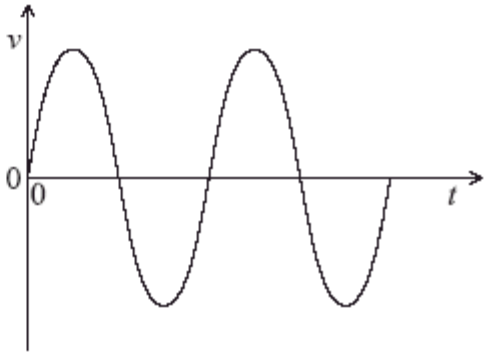

B.




C.




D.




**(Total 1 mark)**

**13.** The fundamental (first harmonic) frequency of the note emitted by an organ pipe closed at one end is $f$. What is the fundamental frequency of the note emitted by an organ pipe of the same length that is open at both ends?

A. $\frac{f}{4}$

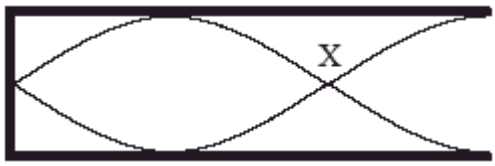
B. $\frac{f}{2}$

C. $2f$

D. $4f$

**(Total 1 mark)**

**14.** A standing wave is established in air in a pipe with one closed and one open end.




The air molecules near X are

A. always at the centre of a compression.

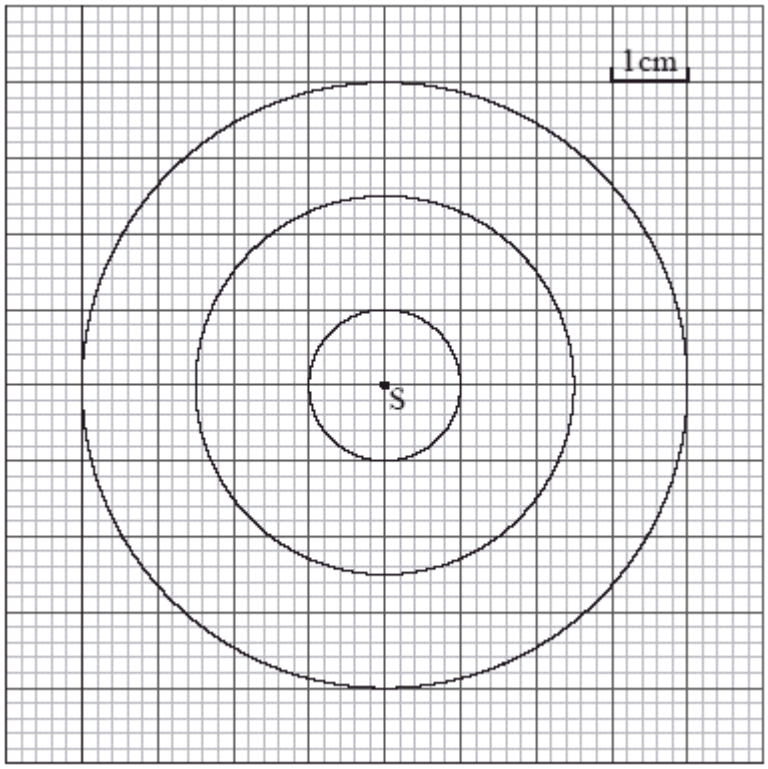
B. always at the centre of a rarefaction.

C. sometimes at the centre of a compression and sometimes at the centre of a rarefaction.

D. never at the centre of a compression or a rarefaction.

**(Total 1 mark)**

**15.** The diagram below is a snapshot of wave fronts of circular waves emitted by a point source S at the surface of water. The source vibrates at a frequency $f$ = 10.0 Hz.




The speed of the wave front is

A. 0.15 cm $s^{-1}$.

B. 1.5 cm $s^{-1}$.

C. 15 cm $s^{-1}$.

D. 30 cm $s^{-1}$.

**(Total 1 mark)**

**16.** Two polarizing sheets have planes of polarization that are initially parallel.


The incoming light on sheet 1 is unpolarized. The intensity of the light transmitted is *I*. To reduce the intensity to $\frac{I}{2}$, which sheet must be rotated and through what angle?

| | Sheet to be rotated | Rotation angle |
|---|---|---|
| A. | 1 only | $\theta = \cos^{-1}\left(\frac{1}{\sqrt{2}}\right)$ |
| B. | 2 only | $\theta = \cos^{-1}\left(\frac{1}{2}\right)$ |
| C. | 1 or 2 | $\theta = \cos^{-1}\left(\frac{1}{\sqrt{2}}\right)$ |
| D. | 1 or 2 | $\theta = \cos^{-1}\left(\frac{1}{2}\right)$ |

**(Total 1 mark)**

**17.** An optically active substance is a substance that

A. has a refractive index that depends on the plane of polarization of incident light.

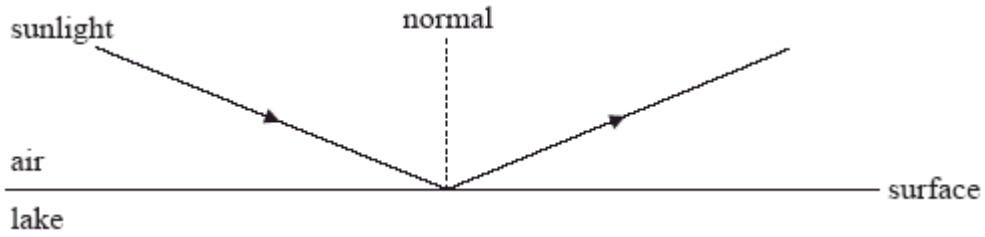
B. completely absorbs incident unpolarized light.

C. rotates the plane of polarization of incident polarized light.

D. polarizes unpolarized light.

**(Total 1 mark)**

**18.** The diagram shows sunlight reflected from a lake surface. The reflected sunlight is plane-polarized.




The plane of polarization of the reflected sunlight is

A. parallel to the lake surface.

B. perpendicular to the lake surface.

C. parallel to the direction of the reflected sunlight.

D. in the plane of the diagram.

**(Total 1 mark)**

**19.** This question is about simple harmonic motion.

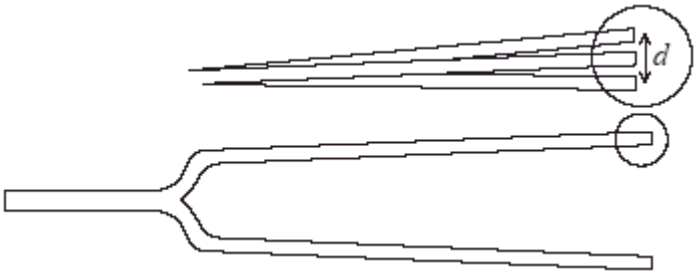
(a) In terms of the acceleration, state **two** conditions necessary for a system to perform simple harmonic motion.

1. .....

2. .....

**(2)**

(b) A tuning fork is sounded and it is assumed that each tip vibrates with simple harmonic motion.




The extreme positions of the oscillating tip of one fork are separated by a distance *d*.

(i) State, in terms of *d*, the amplitude of vibration.

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**(1)**

(ii) On the axes below, sketch a graph to show how the displacement of one tip of the tuning fork varies with time.


**(1)**

(iii) On your graph, label the time period *T* and the amplitude *a*.

**(2)**

(c) The frequency of oscillation of the tips is 440 Hz and the amplitude of oscillation of each tip is 1.2 mm. Determine the maximum

(i) linear speed of a tip.

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**(2)**

(ii) acceleration of a tip.

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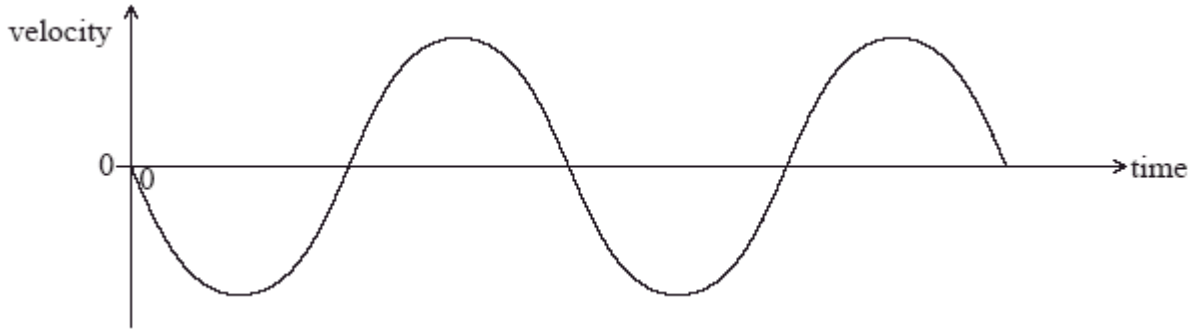
**(2)**

(d) The sketch graph below shows how the velocity of a tip varies with time.




On the axes, sketch a graph to show how the acceleration of the tip varies with time.

**(2)**

(e) In practice, the motion of the tips of the tuning fork is damped.

(i) Describe what is meant by damped motion.

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**(1)**

(ii) Suggest **one** reason why the motion of the tips is damped.

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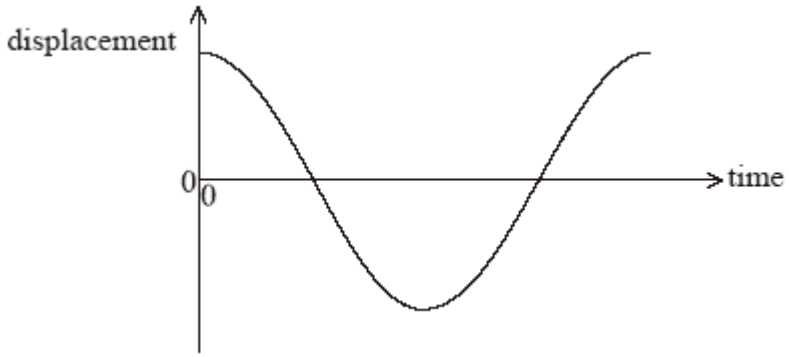
**(1)**

**20.** This question is about the 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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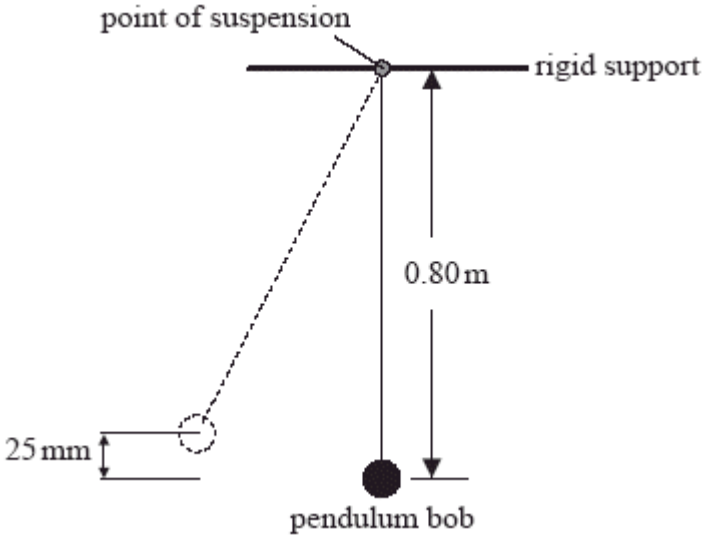
**(3)**

(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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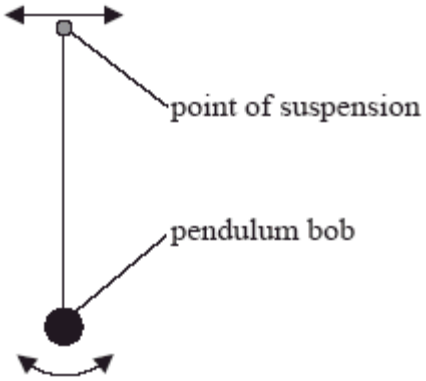
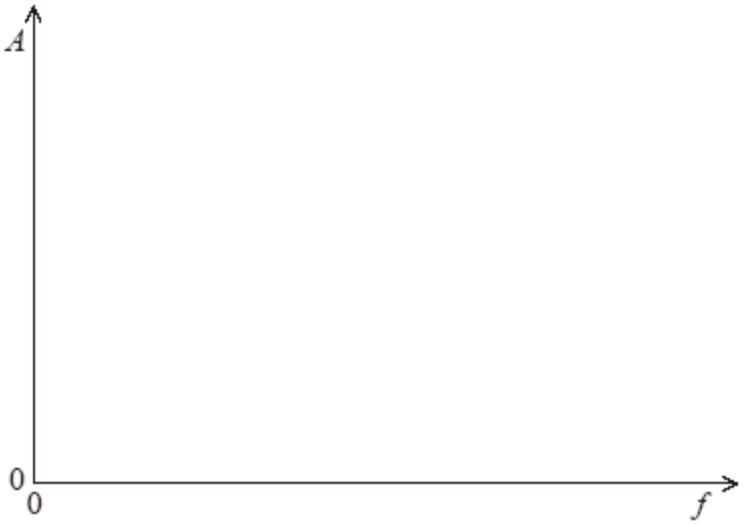
**(3)**

(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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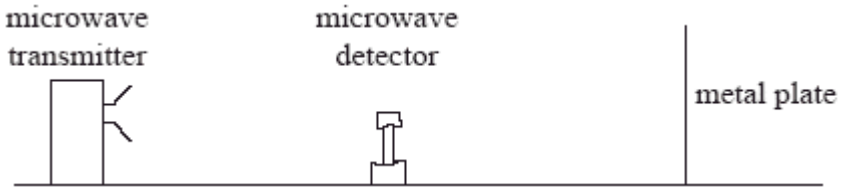
**(2)**

**21.** This question is about microwave radiation.

A microwave transmitter emits radiation of a single wavelength towards a metal plate along a line normal to the plate. The radiation is reflected back towards the transmitter.




A microwave detector is moved along a line normal to the microwave transmitter and the metal plate. The detector records a sequence of equally spaced maxima and minima of intensity.

(a) Explain how these maxima and minima are formed.

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**(4)**

(b) The microwave detector is moved through 130 mm from one point of minimum intensity to another point of minimum intensity. On the way it passes through nine points of maximum intensity. Calculate the

(i) wavelength of the microwaves.

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**(2)**

(ii) frequency of the microwaves.

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**(2)**

(c) Describe and explain how it could be demonstrated that the microwaves are polarized. *(blank space below is allowed for a diagram)*

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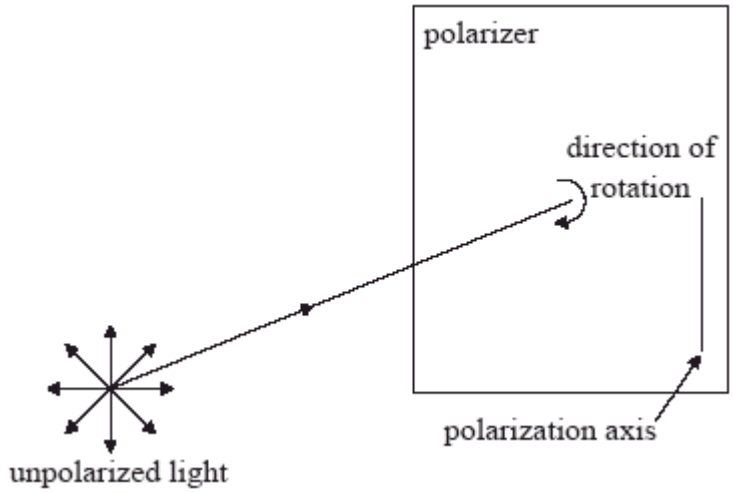
**(3)**

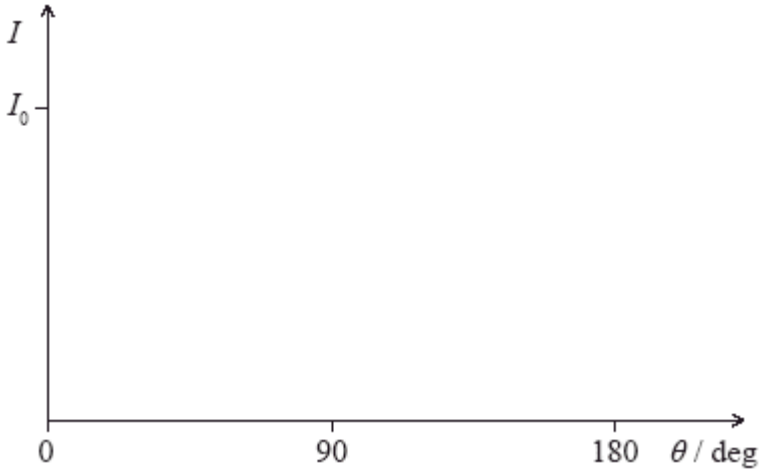
**(Total 11 marks)**

**22.** This question is about polarization.

(a) A beam of unpolarized light of intensity $I_0$ is incident on a polarizer. The polarization axis of the polarizer is initially vertical as shown.

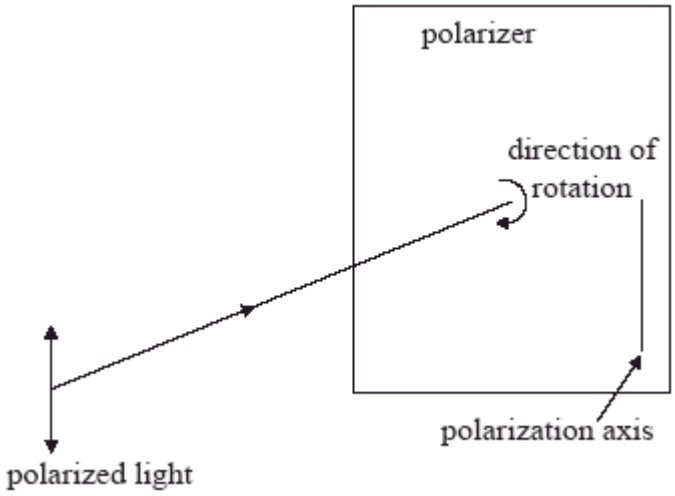



The polarizer is then rotated by 180° in the direction shown. On the axes below, sketch a graph to show the variation with the rotation angle $\theta$, of the transmitted light intensity $I$, as $\theta$ varies from 0° to 180°. Label your sketch-graph with the letter U.




**(2)**

(b) The beam in (a) is now replaced with a polarized beam of light of the same intensity.
The plane of polarization of the light is initially parallel to the polarization axis of the polarizer.




The polarizer is then rotated by 180° in the direction shown. On the same axes in (a), sketch a graph to show the variation with the rotation angle $\theta$, of the transmitted light intensity $I$, as $\theta$ varies from 0° to 180°. Label your sketch-graph with the letter P.

**(2)**

**(Total 4 marks)**

**23.** This question is about polarization.

(a) State what is meant by polarized light.

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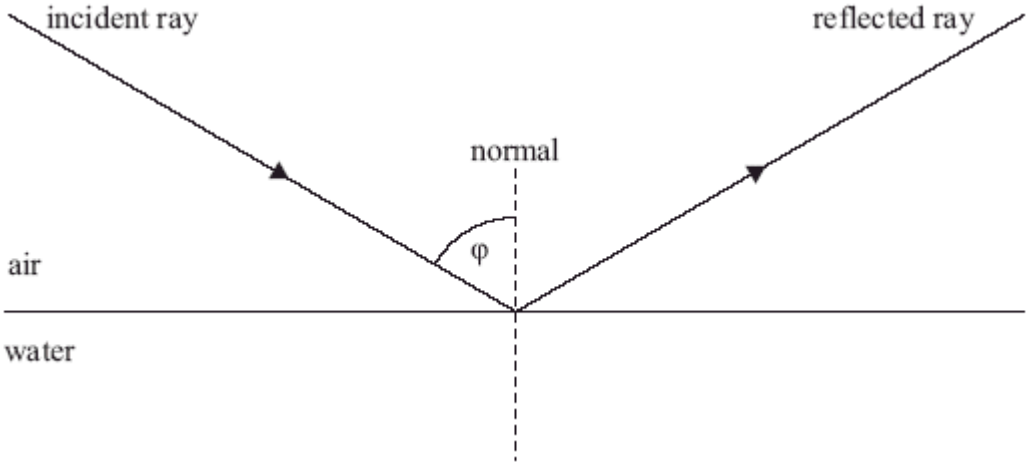
**(1)**

(b) A ray of light is incident on the surface of a lake. The angle of incidence is φ.




The reflected light is completely polarized horizontally.
The refractive index of water is $n$.

(i) On the diagram above draw the refracted ray.

**(1)**

(ii) Use the diagram to deduce the relationship between $\varphi$ and $n$.

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**(3)**

(iii) The refractive index of the water is 1.3. Calculate the value of φ.

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**(1)**

**24.** This question is about polarization.

(a) State what is meant by unpolarized light.

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**(1)**

(b) A beam of unpolarized light of intensity 1.0 W $m^{-2}$ is incident on an ideal polarizing filter. State the value of the intensity of the transmitted light. Explain your answer.

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**(2)**

(c) Outline how polarized light may be used to measure the concentration of a sugar solution.

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**(2)**