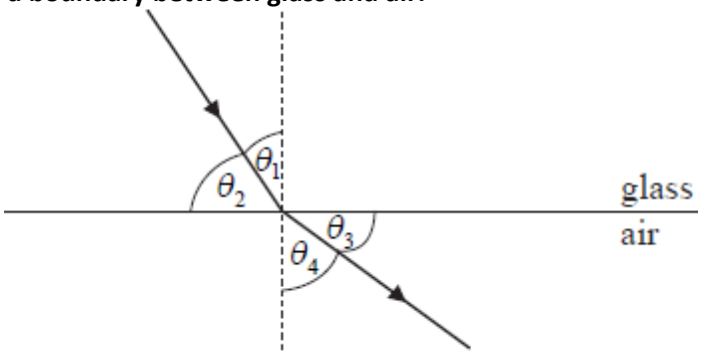
IB Physics SL Y2 – Paper 1 and Paper 2 Review – Topic 4 Assignment (23 Marks)

Name: _____ Date: _____ Period: _____

Objectives:
4.1 Kinematics of simple harmonic motion (SHM)
4.2 Energy changes during simple harmonic motion (SHM)
4.3 Forced oscillations and resonance
4.4 Wave characteristics
4.5 Wave properties

1. A ray of light is incident on a boundary between glass and air.



Which of the following is the refractive index of glass?

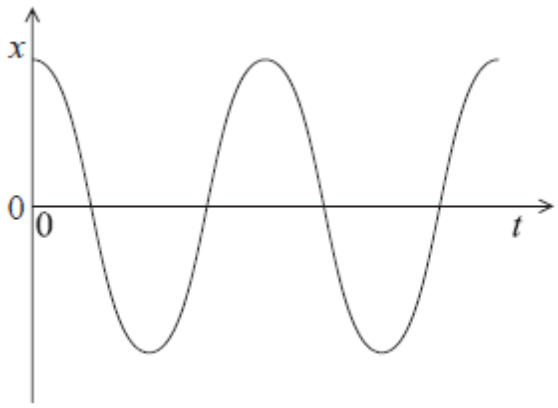
A. $\frac{\sin\theta_1}{\sin\theta_3}$

B. $\frac{\sin\theta_1}{\sin\theta_4}$

C. $\frac{\sin\theta_3}{\sin\theta_2}$

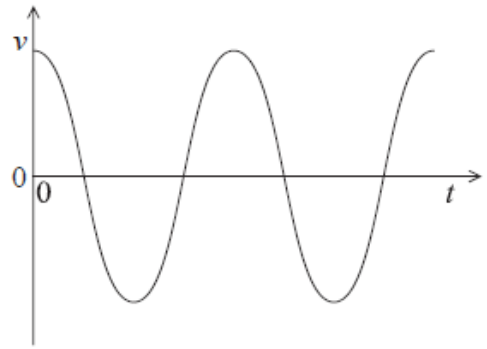
D. $\frac{\sin\theta_4}{\sin\theta_1}$

The following graph refers to questions 2 and 3.
The graph below shows how the displacement x of a particle undergoing simple harmonic motion varies with time t. The motion is undamped.

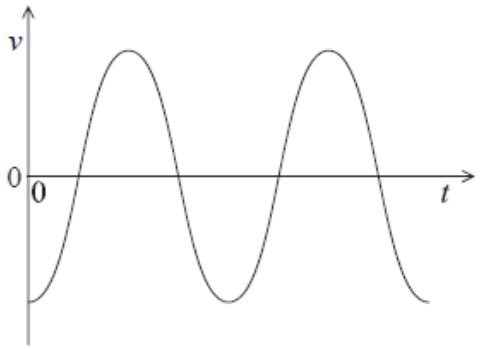


2. Which of the following graphs correctly shows how the velocity v of the particle varies with t?

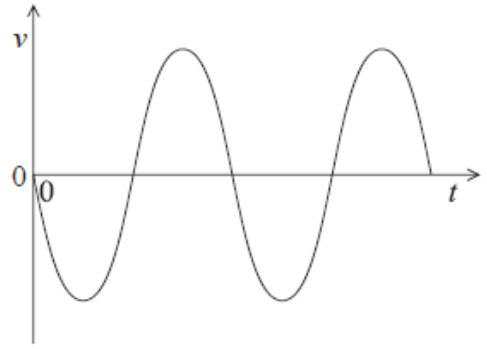
A.



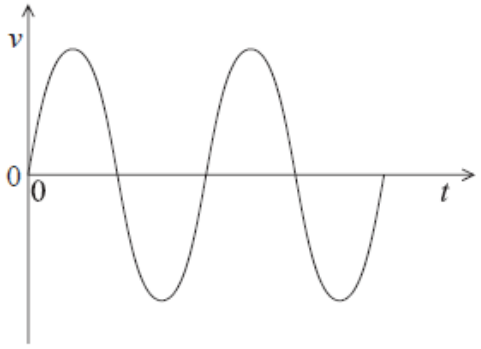
B.



C.

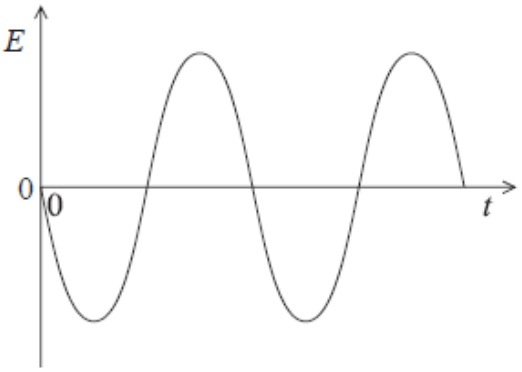


D.

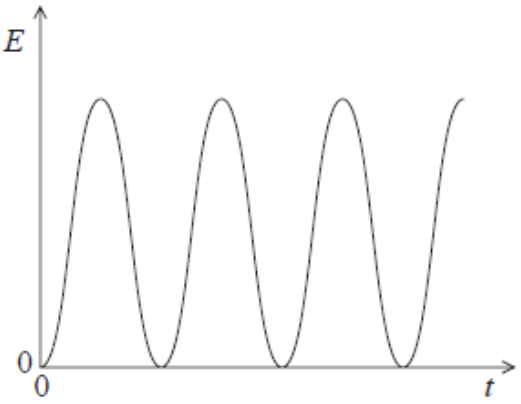


3. Which of the following graphs shows how the total energy E of the particle varies with time t?

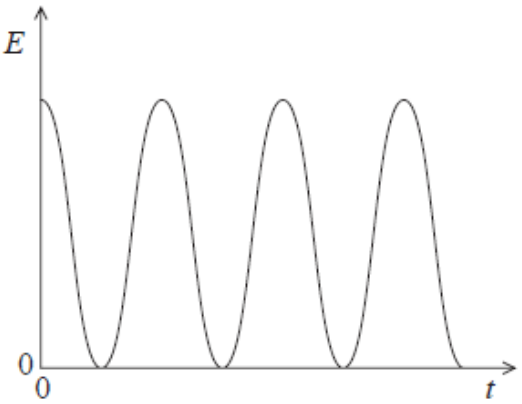
A.



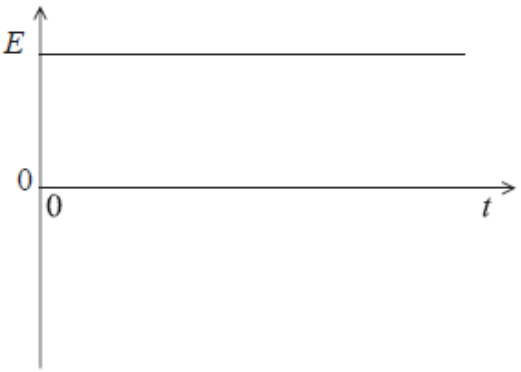
B.



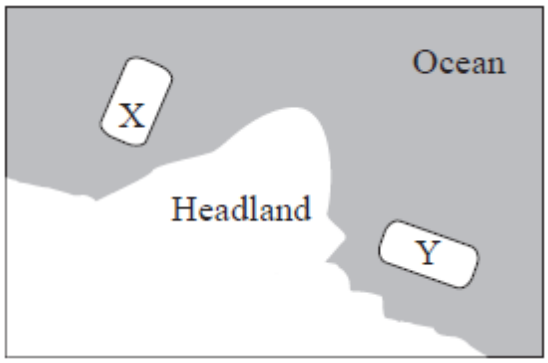
C.



D.



4. An orchestra playing on boat X can be heard by tourists on boat Y, which is situated out of sight of boat X around a headland.

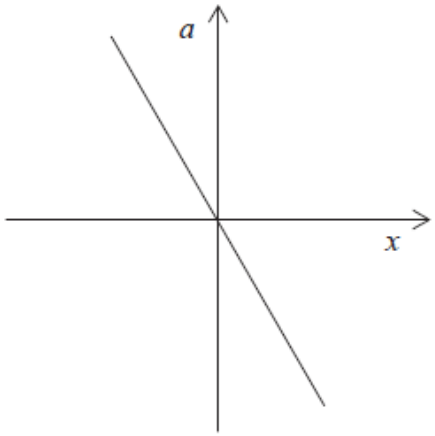


The sound from X can be heard on Y due to

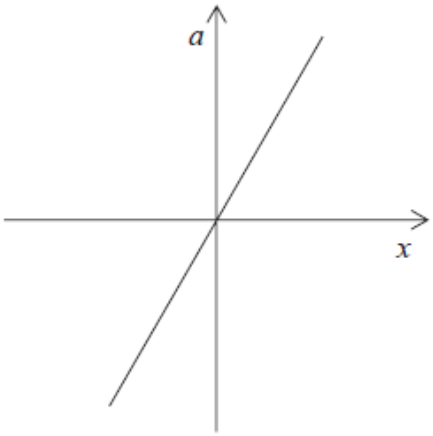
A. refraction.
B. reflection.
C. diffraction.
D. transmission.

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

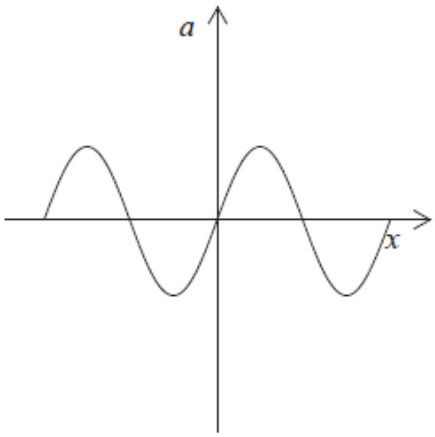
A.



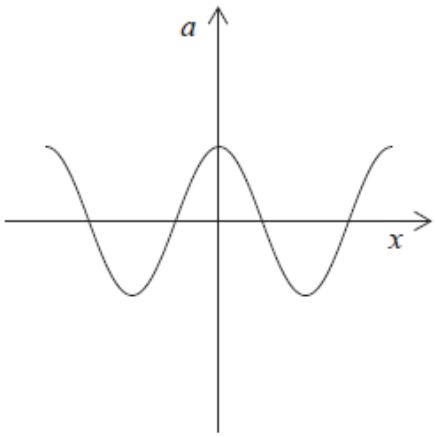
B.



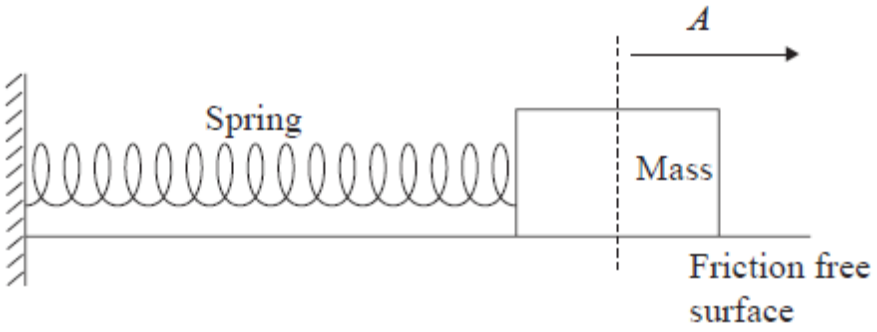
C.



D.



6. 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 2A. 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.	$\sqrt{2}T$	$2E$

7. 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

8. What is the best estimate for the refractive index of a medium in which light travels at a speed of 2.7×10^8 ms^{-1}?

A. 0.9
B. 1.0
C. 1.1
D. 2.7

Part 1 Simple harmonic motion and waves

(a) A particle of mass m that is attached to a light spring is executing simple harmonic motion in a **horizontal direction**.

State the condition relating to the net force acting on the particle that is necessary for it to execute simple harmonic motion. *[2]*

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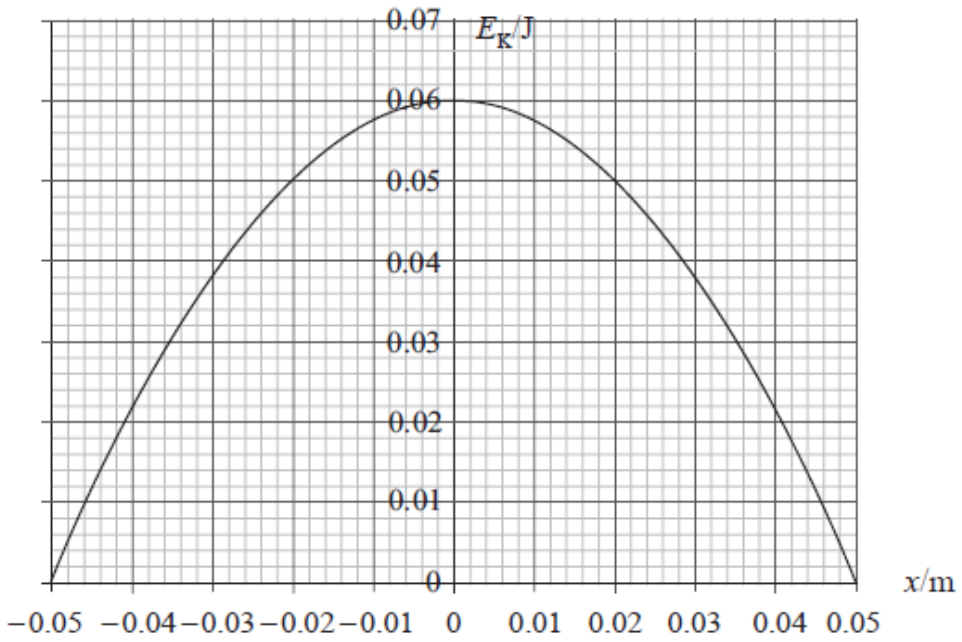
(b) The graph shows how the kinetic energy E_K of the particle in (a) varies with the displacement x of the particle from equilibrium.



(i) Using the axes above, sketch a graph to show how the potential energy of the particle varies with the displacement x. *[2]*

(ii) The mass of the particle is 0.30 kg. Use data from the graph to show that the frequency f of oscillation of the particle is 2.0 Hz. *[4]*

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(c) The particles of a medium M_1 through which a transverse wave is travelling, oscillate with the same frequency and amplitude as that of the particle in (b).

(i) Describe, with reference to the propagation of energy through the medium, what is meant by a transverse wave. *[2]*

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(ii) The speed of the wave is 0.80 m s^{-1}. Calculate the wavelength of the wave. *[1]*

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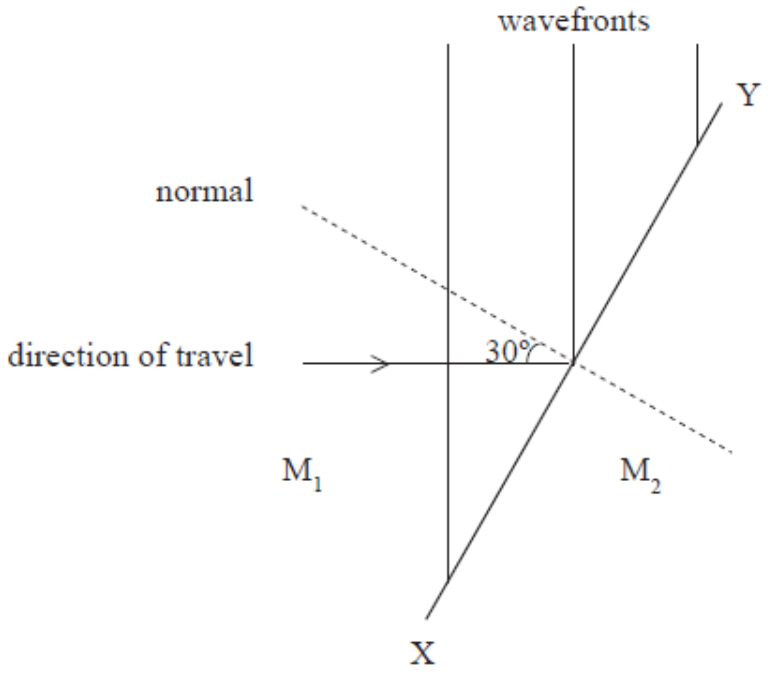
(d) The diagram shows wavefronts of the waves in (c) incident on a boundary XY between medium M_1 and another medium M_2.



The angle between the normal, and the direction of travel of the wavefronts is 30°.

(i) The speed of the wave in M_1 is $0.80\,m\,s^{-1}$. The speed of the waves in M_2 is $1.2\,m\,s^{-1}$. Calculate the angle between the direction of travel of the wavefronts in M_2 and the normal. *[3]*

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(ii) On the diagram, sketch the wavefronts in M_2. *[1]*