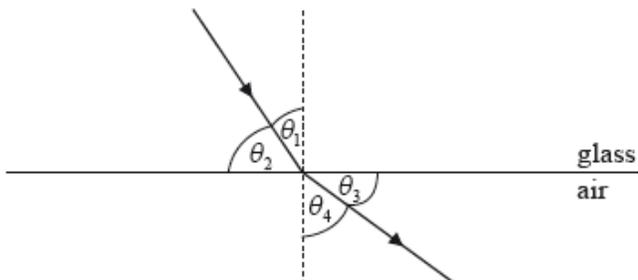# Waves Review FEB 2020   Name: _____

Paper 1 Problems: [1 mark each]
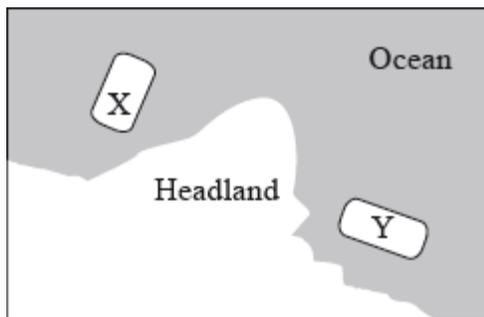
1. A ray of light is incident on a boundary between glass and air.

Which of the following is the refractive index of glass?

A. $\dfrac{\sin \theta_1}{\sin \theta_3}$ B. $\dfrac{\sin \theta_1}{\sin \theta_4}$

C. $\dfrac{\sin \theta_3}{\sin \theta_2}$ D. $\dfrac{\sin \theta_4}{\sin \theta_1}$

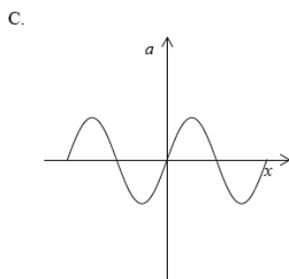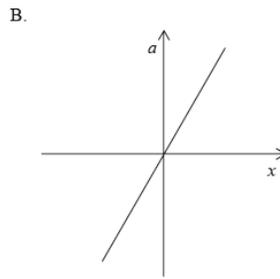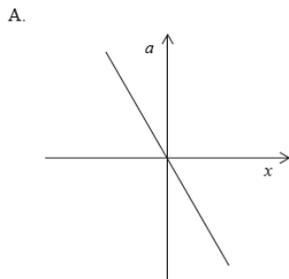2. An orchestra playing on boat X can be heard by tourists on boat Y, which is situated out of sight of boat X around a headland.

The sound from X can be heard on Y due to

A. refraction.

B. reflection.

C. diffraction.

D. transmission.

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

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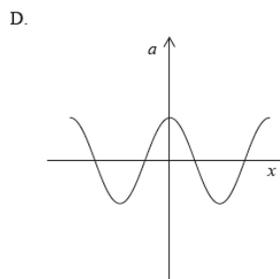
4. In which of the following regions of the electromagnetic spectrum is radiation of wavelength 600 nm located?

A. microwaves   B. radio waves   C. visible light   D. X-rays

5. What is the best estimate for the refractive index of a medium in which light travels at a speed of $2.7 \times 10^8 \text{ m s}^{-1}$?

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

6. One end of a horizontal string is fixed to a wall. A transverse pulse moves along the string as shown.
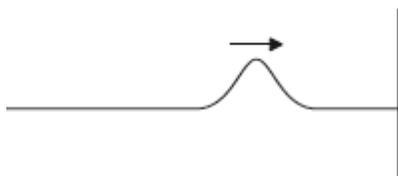
Which of the following statements are correct for the reflected pulse compared to the forward pulse?

I. *It moves more slowly.*

II. *It has less energy.*

III. *It is inverted.*

A. I and II only   B. I and III only   C. II and III only   D. I, II and III

7. Monochromatic light travels from air into water. Which of the following describes the changes in wavelength and speed?

	Wavelength	Speed
A.	increases	decreases
B.	increases	increases
C.	decreases	increases
D.	decreases	decreases

2

8. The graph shows how the velocity v of an object undergoing simple harmonic motion varies with time t for one complete period of oscillation.
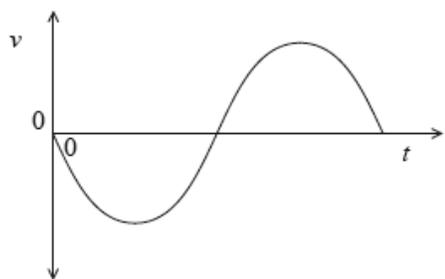
Which of the following sketch graphs best shows how the total energy E of the object varies with t?

A.

B.

C.

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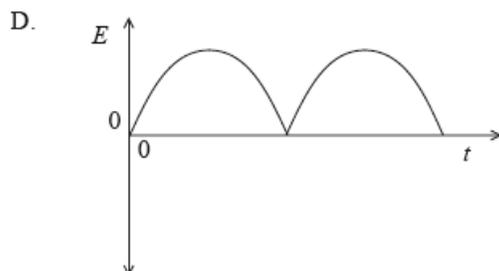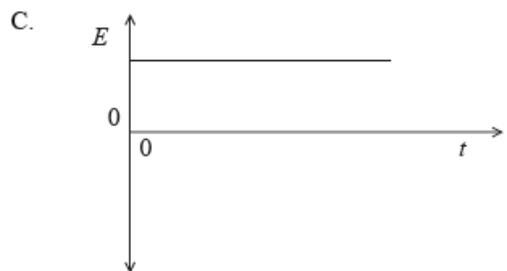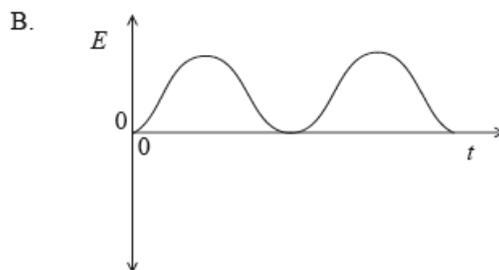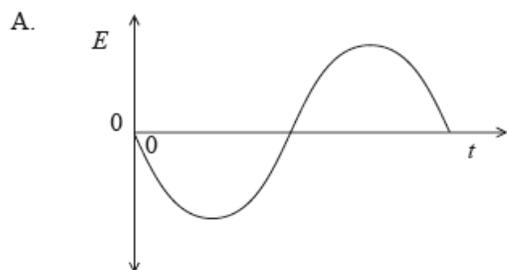
9. Which of the following is a value of wavelength that is found in the visible region of the electromagnetic spectrum?

A. 4×10^{-5} m   B. 4×10^{-7} m   C. 4×10^{-9} m   D. 4×10^{-11} m

10. Two waves meet at a point in space. Which of the following properties always add together?

A. Displacement   B. Amplitude   C. Speed   D. Frequency

11. The diagram shows the variation of velocity v with time t for an object performing simple harmonic motion.
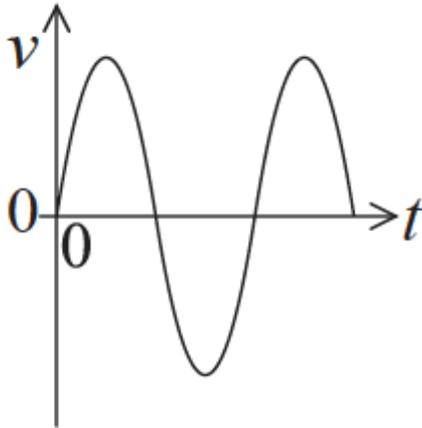
Which of the following shows how the acceleration a varies with t?

A.

B.

C.

D.
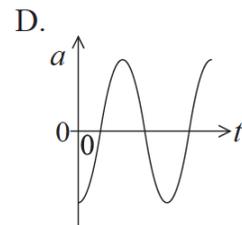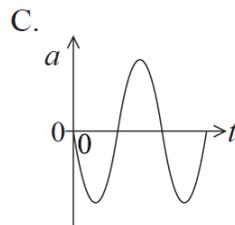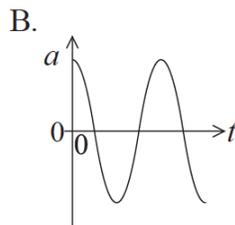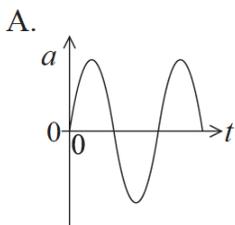
12. Which of the following gives regions of the electromagnetic spectrum in the order of **decreasing** frequency?

      A. gamma-ray, microwave, visible   B. radio wave, infrared, microwave

      C. ultraviolet, infrared, microwave   D. visible, gamma-ray, radio wave

13. A transverse wave travels from left to right. The diagram below shows how, at a particular instant of time, the displacement of particles in the medium varies with position. Which arrow represents the direction of the velocity of the particle marked P?

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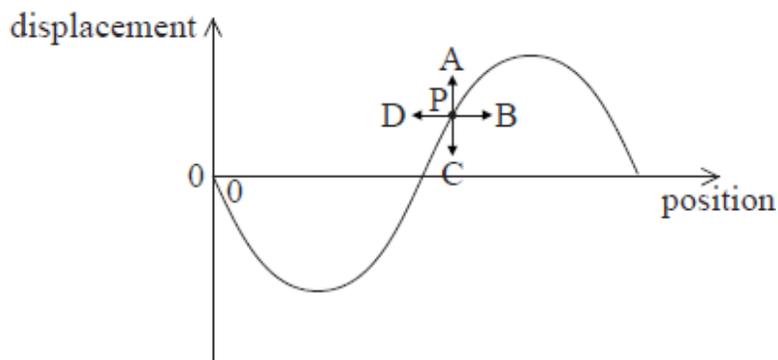
14. Which of the following electromagnetic waves has a frequency **greater** than that of visible light?

    A. Ultraviolet   B. Radio   C. Microwaves   D. Infrared

15. The graph shows measurements of the height h of sea level at different times t in the Bay of Fundy.
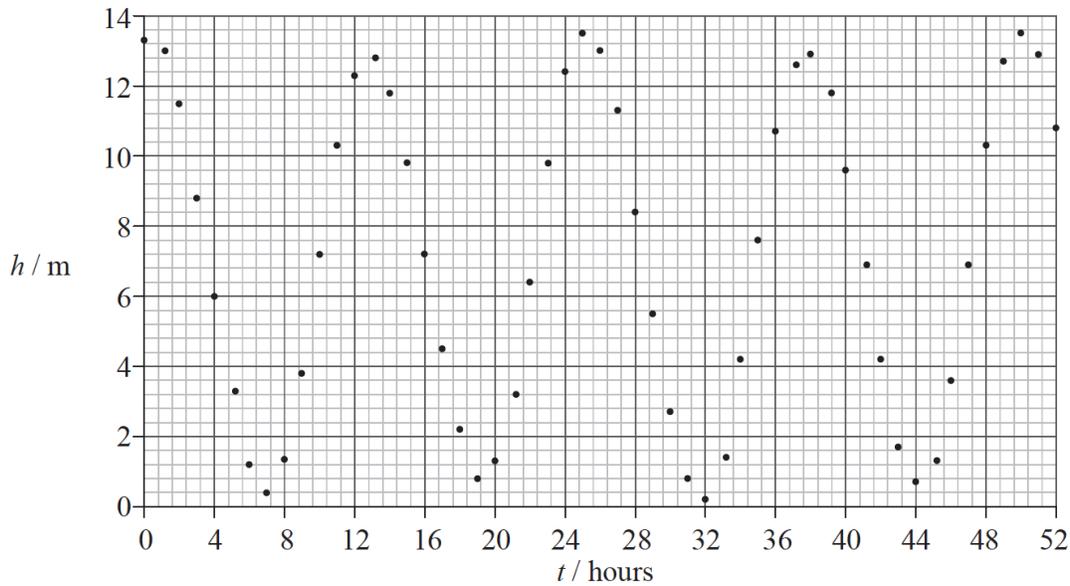
Which of the following gives the approximate amplitude and period of the tides?

	Amplitude	**Period**
A.	6.5 m	6 hours
B.	13 m	12 hours
C.	6.5 m	12 hours
D.	13 m	6 hours

16. Waves emitted from sources X and Y have equal wavelengths and are initially in phase. The waves interfere destructively at point P, where the path difference is 0.60m.

X •

• P   What is a possible value for the wavelength of the waves?

A. 0.20 m

B. 0.30 m

C. 0.40 m

Y •

D. 0.60 m

17. What region of the electromagnetic spectrum includes waves of wavelength 5×10^{-8} m?

A. X-ray   B. Ultraviolet   C. Infrared   D. Microwave

18. A pendulum swings back and forth in a circular arc between X and Y.
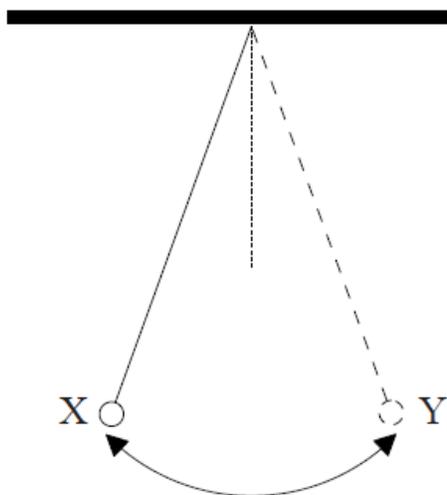
The pendulum bob is

A. always in equilibrium.

B. only in equilibrium at X and Y.

C. in equilibrium as it passes through the central position.

D. never in equilibrium.

X   Y

19. Two wave pulses travel along a string towards each other. The diagram shows their positions at a moment in time.

Which of the following shows a possible configuration of the pulses at a later time?

A.

B.

C.

D.
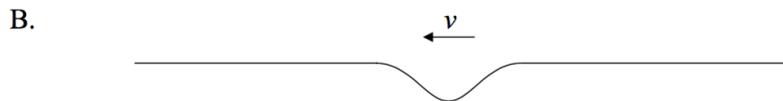
Paper 2 Problems:

20a. State what is meant by the terms ray and wavefront and state the relationship between them.   [3]

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20b. The diagram shows three wavefronts, A, B and C, of a wave at a particular instant in time incident on a boundary between media X and Y. Wavefront B is also shown in medium Y.
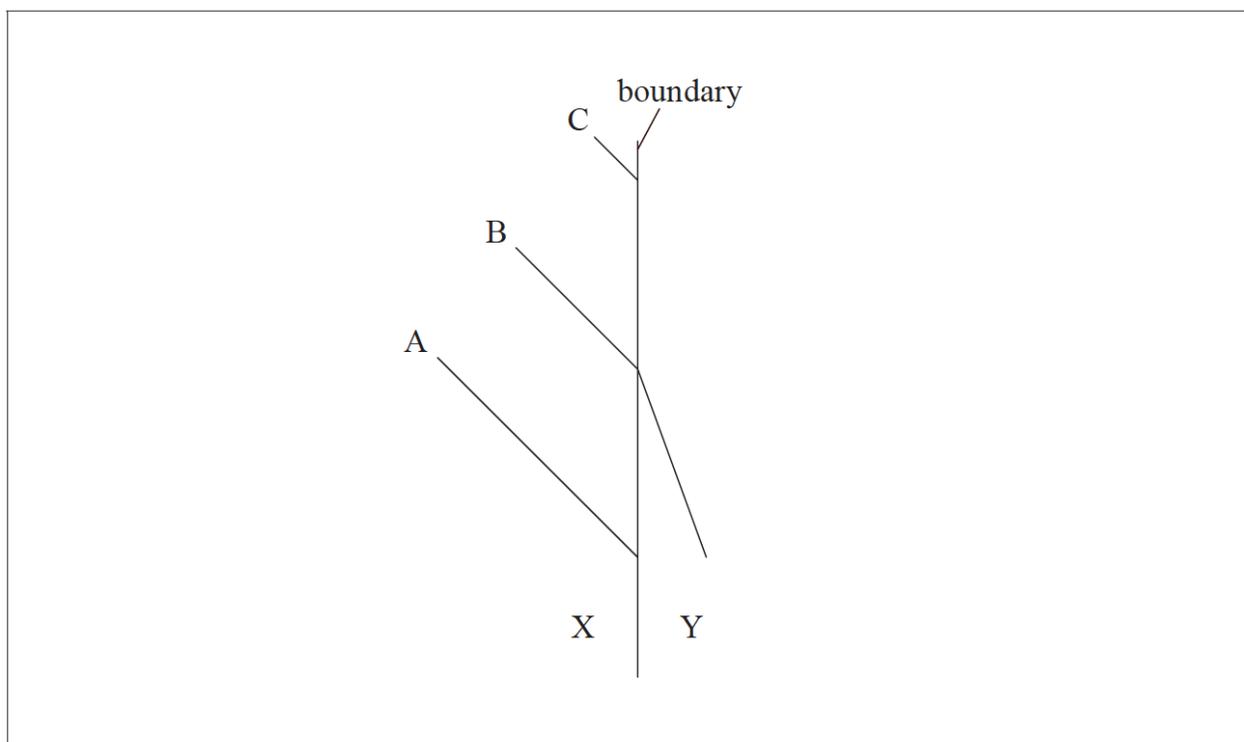
(i) Draw a line to show wavefront C in medium Y.   [1]

(ii) The refractive index of X is n_X and the refractive index of Y is n_Y. By making appropriate measurements, calculate $\dfrac{n_X}{n_Y}$.   [3]

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20c. Describe the difference between transverse waves and longitudinal waves. [2]

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20d. The graph below shows the variation of the velocity v with time t for one oscillating particle of a medium.
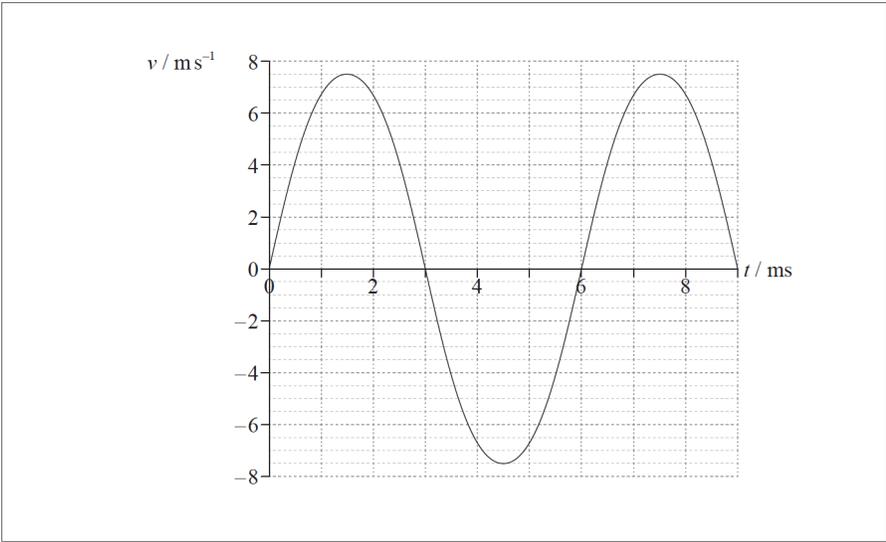
(i) Calculate the frequency of oscillation of the particle. [2]

(ii) Identify on the graph, with the letter M, a time at which the displacement of the particle is a maximum. 1

9

21a. An object of mass m is placed on a frictionless surface and attached to a light horizontal spring. The other end of the spring is fixed.

The equilibrium position is at B. The direction B to C is taken to be positive. The object is released from position A and executes simple harmonic motion between positions A and C.

Define *simple harmonic motion*.   [2]
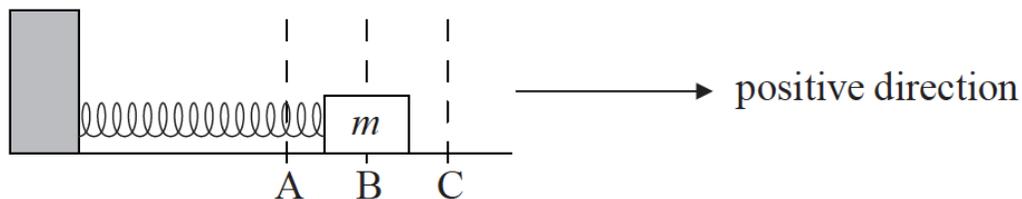
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21b. (i) On the axes below, sketch a graph to show how the acceleration of the mass varies with displacement from the equilibrium position B.   [2]
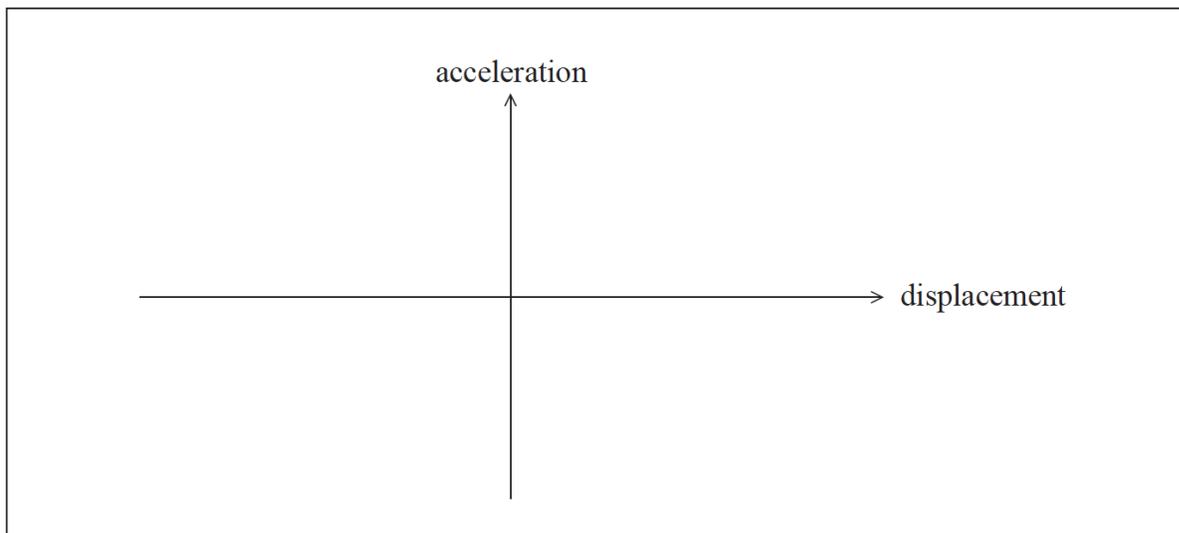
(ii) On your graph, label the points that correspond to the positions A, B and C.   [1]

21c. (i) On the axes below, sketch a graph to show how the velocity of the mass varies with time from the moment of release from A until the mass returns to A for the first time. [2]

velocity ↑

→ time

(ii) On your graph, label the points that correspond to the positions A, B and C.   [1]

21d. The period of oscillation is 0.20s and the distance from A to B is 0.040m. Determine the maximum speed of the mass.   [3]

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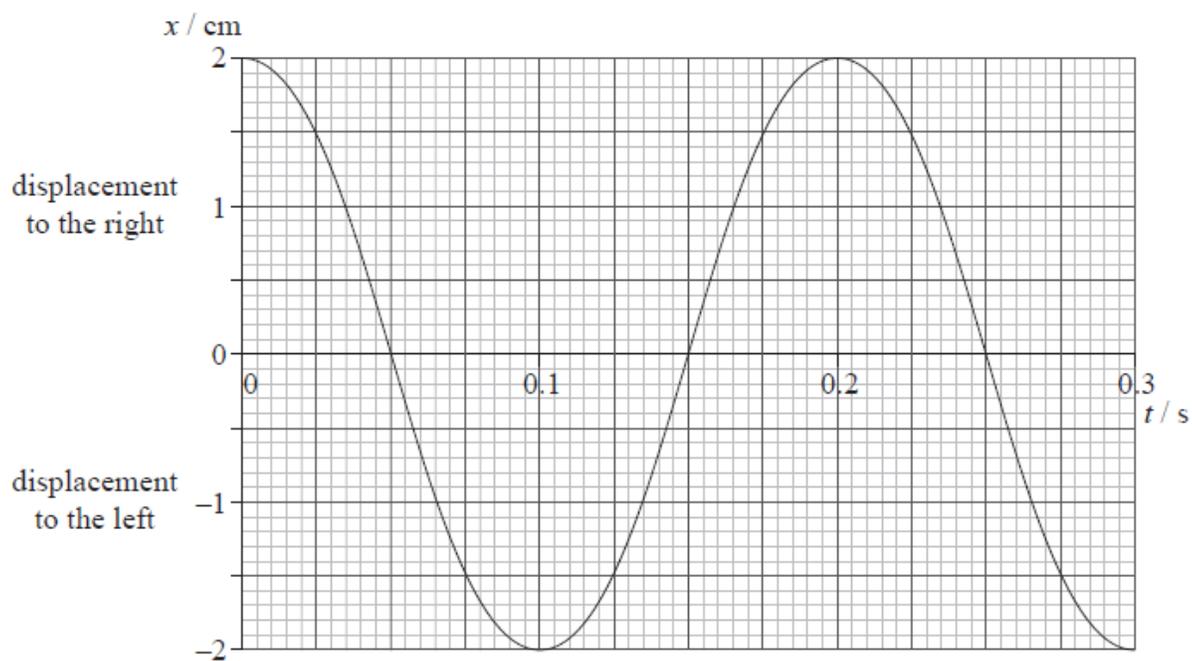..

22a. A longitudinal wave travels through a medium from left to right.

Graph 1 shows the variation with time t of the displacement x of a particle P in the medium.

Graph 1

For particle P,

(i) state how graph 1 shows that its oscillations are not damped. [1]

(ii) calculate the magnitude of its maximum acceleration. [2]

(iii) calculate its speed at $t=0.12$ s. [2]

(iv) state its direction of motion at $t=0.12$ s. [1]

12

22b. Graph 2 shows the variation with position *d* of the displacement *x* of particles in the medium at a particular instant of time.

Graph 2

x / cm

displacement to the right

displacement to the left

d / cm
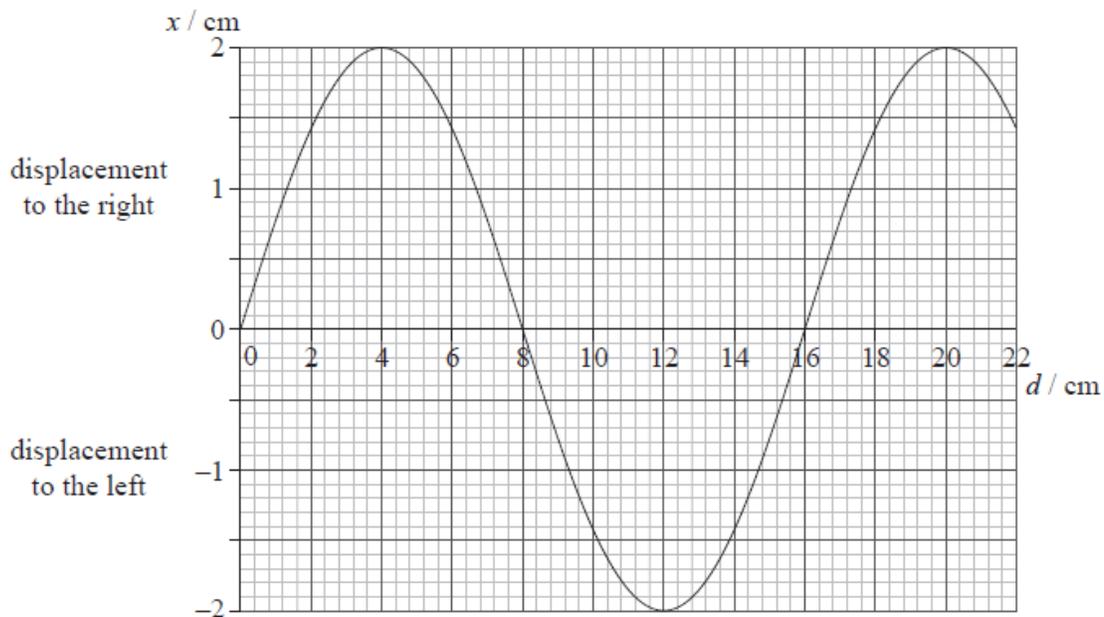
Determine for the longitudinal wave, using graph 1 and graph 2,

(i) the frequency. [2]

(ii) the speed. [2]

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