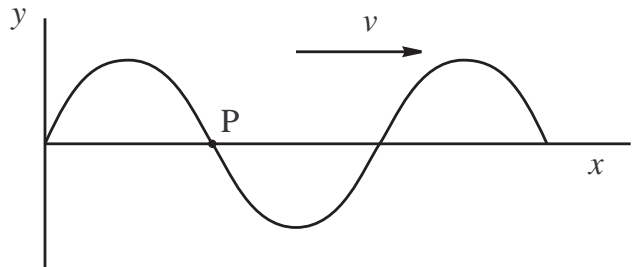
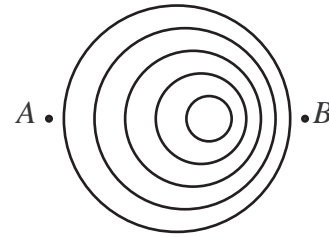


## Part I

1. A block vibrates on the end of a spring. In order to double the period of oscillation the block should be replaced with one which has
  - (a) twice the mass.
  - (b) half the mass.
  - (c) quadruple the mass.
  - (d) one quarter the mass.
2. A string which is fixed at both ends vibrates at its fundamental frequency. The tension of the string is now increased and the string is again made to vibrate at its fundamental frequency. Which one of the following statements about the change in the properties of the wave is correct
  - (a) The wave speed increases and the wavelength increases.
  - (b) The wave speed increases and the frequency increases.
  - (c) The wave speed decreases and the wavelength decreases.
  - (d) The wave speed decreases and the frequency decreases.
3. A grandfather clock has a weight at the end of a pendulum that can be moved up or down. If the clock is running slow what should you do to adjust the time
  - (a) move the weight up
  - (b) move the weight down
  - (c) moving the weight will not help
  - (d) call the repair man
4. Two air columns are identical except that one is open at both ends while the other is closed at one end. When they oscillate at their fundamental frequency, which one of the following quantities is the same for the sound wave associated with each column.
  - (a) Wavelength
  - (b) Frequency
  - (c) Wave speed
  - (d) Number of antinodes.
5. The diagram below shows a wave at a particular moment in time as it travels to the right along a rope in the direction shown. Which one of the following statements is true about the point P on the rope?
  - (a) It is moving upwards.
  - (b) It is moving downwards.
  - (c) It is moving to the right.
  - (d) It is momentarily at rest.



6. Two observers  $A$  and  $B$  listen to sound from a moving source. The diagram on the right shows the wave fronts of crest of a wave. Which of the following statements is true



- (a) The wavefronts move faster at  $A$  than at  $B$
  - (b) The wavefronts move faster at  $B$  than at  $A$
  - (c) The frequency of the sound is highest at  $A$
  - (d) The frequency of the sound is highest at  $B$
7. A quiet radio has an intensity level of 40 dB and a busy street has a level of about 70 dB. How much greater is the intensity of the street compared to the intensity of the radio
- (a) about the same
  - (b) about 30 times
  - (c) about 100 times
  - (d) about 1000 times
8. You blow into an open pipe and produce a tone. What happens to the frequency of the tone if you close the end of the pipe and blow into it again?
- (a) it depends on the speed of sound in the pipe.
  - (b) you hear the same frequency.
  - (c) you hear a lower frequency.
  - (d) you hear a higher frequency.
9. You hear a fire truck with a certain intensity and you are about 1 mile away. How far away will the truck be approximately when the intensity is 10 times less?
- (a) about 3 miles away
  - (b) about 10 miles away
  - (c) about 30 miles away
  - (d) about 100 miles away
10. A rescue vehicle rapidly approaches a casualty who has had a mishap at the base of a cliff. The casualty observes that the frequency of the siren has shifted higher due to the Doppler effect. The sound of the siren reflects off the cliff and is heard as an echo by the rescuers. The frequency of the echo that they hear is
- (a) is the same as the sound the casualty hears.
  - (b) is higher than the sound the casualty hears.
  - (c) is lower than the sound the casualty hears, but higher than the sound of the siren.
  - (d) is identical to the sound of the siren.

## Part II

1. A guitar string of length 80 cm oscillates in its fundamental mode with a frequency of 440 Hz.

- (a) Describe how standing waves in a string are formed.
- (b) Draw pictures showing the shape of the modes of vibration for the first three harmonics and indicate the value of their wavelengths.
- (c) What would be the speed of a wave traveling down this string.
- (d) An identical string but at a different tension vibrates at 444 Hz
  - (i) What is the ratio of the tension in the first string to the tension in the second string?
  - (ii) If both strings vibrate together beats are heard. Describe what beats are and how they are formed.
  - (iii) What is the frequency of the beats?

2. (a) Sound travels faster in warm and moist air than in cold dry air. Explain why.
- (b) After a long hot day in the Australian outback cool air floats above a layer of hot air near the ground. Are distant dingos likely to be easier or harder to hear? Draw a diagram showing the path of the sound waves to explain your answer.
- (c) On a plain in Spain you see rain clouds just above you. Are distant howling wolves likely to be easier or harder to hear? Draw a diagram showing the path of the sound waves to explain your answer.
3. When a 60 kg person gets into a 300 kg boat the boat sinks about 5 cm lower in the water.
- (a) Assuming the buoyant force of the water on the boat behaves like a Hookian spring find the effective spring constant of the boat water system.
- (b) The boat and person gently bob up and down in simple harmonic motion. Find the natural frequency of bobbing.

- (c) When the person looks over the side of the boat she notices that the bobbing produces ripples whose crests have a height of 2 cm and are separated by a distance of 1.2 m. The ripples leave the boat towards the shore which is 100 m away.
- (i) What is the speed of these waves?
  - (ii) Approximately how long do they take to reach the shore?
  - (iii) As the waves approach the shore the water gets shallower and the waves slow down. How does this affect the frequency and wavelength of the waves? Explain.
  - (iv) As the waves approach the shore they bend so that the incoming wave fronts become parallel to the shoreline – regardless of their original direction. Explain why this happens using a diagram. What wave phenomena is this an example of?
- (d) Suppose the boat now moves off at a speed of 2.0 m/s producing a wake behind it (analogous to the shock wave of a supersonic jet).
- (i) Explain how this wake forms using a diagram.
  - (ii) At what angle does the wake leave the side of the boat?