

Physics 3AB

Waves, Particles and Quanta Unit Test 2012

Name:

Mark: / 56

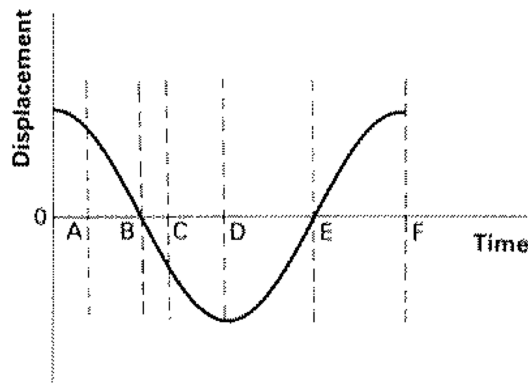
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Notes to Students:

- You must include **all** working to be awarded full marks for a question.
- Marks will be deducted for incorrect or absent units and answers stated to an incorrect number of significant figures.
- **No** graphics calculators are permitted – scientific calculators only.

Question 1**(4 marks)**

The diagram below shows the displacement-time graph of an oscillator.



- (a) How does the velocity at time B compare with that at time E? (1 mark)
- (b) How does the velocity at time D compare with that at time F? (1 mark)
- (c) State two points that are 90° out of phase. (1 mark)
- (d) If the wave is moving to the left, in which direction is point C moving? (1 mark)

Question 2**(1 mark)**

What is the electric charge of an antiproton?

Question 3**(8 marks)**

A laser used to weld detached retinas emits light with a wavelength of 652 nm in pulses that are 20.0 ms in duration. The average power during each pulse is 0.600 W.

(a) How much energy is in each pulse?

(3 marks)

(b) What is the energy of one photon?

(3 marks)

(c) How many photons are there in each pulse?

(2 marks)

Question 4**(3 marks)**

If we see someone's clock running slow due to relative motion, how will they see our clocks running? Explain your reasoning.

Question 5**(3 marks)**

If a bell is ringing inside a bell jar, we can no longer hear it when the air is pumped out, but we can still see it. What differences in the properties of propagation of sound and light waves does this indicate?



Question 6**(6 marks)**

Two speakers of a stereo system are separated by 6.00 m. They are connected to a single frequency generator and are set up so that they are facing each other. Assume the speed of sound in air is 344 ms^{-1} .

- (a) If a person stands in the exact middle of the two speakers, what would they hear? Explain your reasoning.

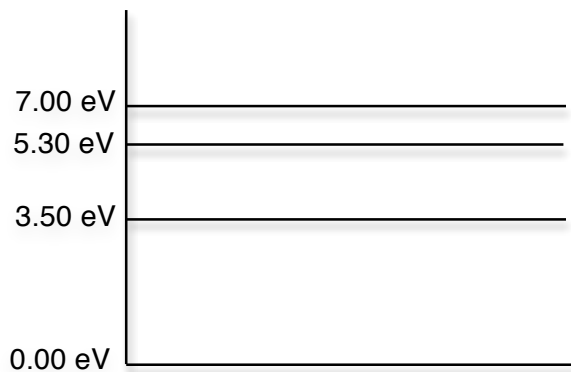
(3 marks)

- (b) If the person now stands 2.00 m closer to the left hand speaker and the frequency from the generator is 43.0 Hz, what will they hear?

(4 marks)

Question 7**(10 marks)**

Consider the four energy levels shown in the diagram below.



- (a) How many spectral lines will result from all possible decay transitions among these levels? (1 mark)
- (b) State which transition (i.e $n = ?$ to $n = ?$) corresponds to the highest frequency light emitted and calculate the frequency of this photon. (4 marks)
- (c) State which transition corresponds to the longest wavelength light emitted and calculate the wavelength of this photon. (4 marks)
- (d) How many absorption lines would be present if white light were shone through the cold atoms? (1 mark)

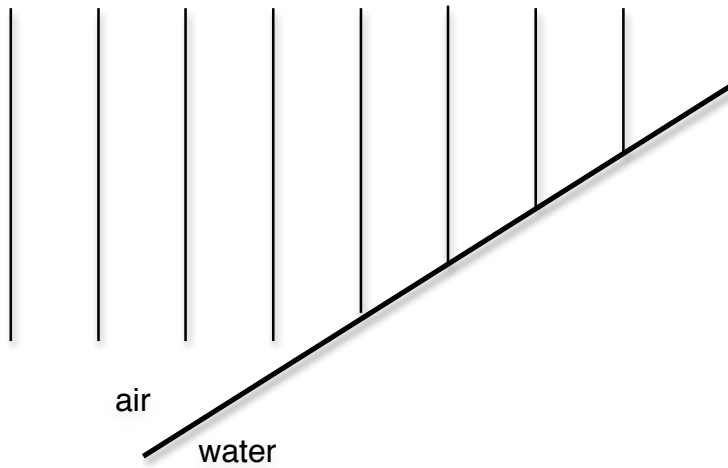
Question 8

(5 marks)

A sound wave travels from air to water as shown in the diagram below. The speed of the wave in air is 346 ms^{-1} and its frequency is 500 Hz .

- (a) Complete the diagram to show how the wave moves after entering the water.

(2 marks)



- (b) If the speed of sound in water is 1480 ms^{-1} , calculate the wavelength of the sound wave in water.

(3 marks)

Question 9**(3 marks)**

Describe the spectra that would be produced by each of these sources, when viewed through a spectroscope;

(a) A tungsten filament lamp.

(1 mark)

(b) A discharge tube filled with one type of gas

(1 mark)

(c) White light is shone through a solution of a molecular substance

(1 mark)

Question 10**(3 marks)**

Sometimes a tone from an instrument or an audio device will cause another object in the room to begin vibrating loudly. Name this phenomenon and explain its occurrence.

Question 11**(8 marks)**

Blowing across the open mouth of an empty test tube produces the fundamental resonant mode of the air column inside the test tube.

- (a) If the length of the air column in the test tube is 14.0 cm, what is the frequency of the standing wave?
(3 marks)
- (b) What will be the frequencies of the 2nd and 3rd overtones of the air column inside the test tube?
(2 marks)
- (c) What will happen to the frequency of the fundamental resonant mode as the test tube is filled with water? Explain your reasoning.
(3 marks)

Question 12**(2 marks)**

State the differences between hadrons and leptons