The following assessment assignment must be completed without help from anyone else. You may refer to your notes and the solutions to worksheets and assignments. It is due on Tuesday, Feb 14th at 9:30 am.

Part I

1. You are throwing a ball straight up in the air. At the highest point, the ball's
   (a) velocity and acceleration are zero.
   (b) velocity is not zero but its acceleration is zero.
   (c) acceleration is not zero, but its velocity is zero.
   (d) velocity and acceleration are both not zero

2. An accelerated body must at all times
   (a) have positive velocity.
   (b) have an increasing velocity.
   (c) have a changing direction.
   (d) have a changing velocity.

3. A constant force is exerted for a short time interval on a cart that is initially at rest on frictionless track. The same force is exerted for the same length of time on another cart, also initially at rest, that has twice the mass of the first one. The final speed of the heavier cart is
   (a) one-fourth that of the lighter cart
   (b) half that of the lighter cart
   (c) the same as that of the lighter cart
   (d) double that of the lighter cart

4. A coin is tossed vertically up in the air. It first rises and then falls. As the coin passes through its highest point the net force on it
   (a) becomes zero.
   (b) acts downwards and reaches a maximum value.
   (c) acts downwards and reaches a minimum value.
   (d) acts downwards and remains constant.

5. A low intensity beam of electrons is incident on a pair of narrow slits. Those electrons that pass through the slits strike a screen. After some time the distribution of electrons which strike the screen resembles an interference pattern. If you alter the experiment by trying to detect which slit each electron passes through
   (a) you will not be able to detect any electrons. It is only possible to detect particles and in this experiment the electrons are behaving like waves.
   (b) you will detect electrons, but you will disturb them so that they will no longer pass through the slits.
   (c) you will detect electrons, but the distribution pattern on the screen will not resemble an interference pattern.
   (d) you will detect electrons, and the interference pattern on the screen will remain unchanged.

Part II

1. Sketch graphs of position vs. time, velocity vs. time and acceleration vs. time for each of the following situations.

   (a) A ball is thrown upwards in the positive direction and then falls back down to the ground.

   (b) A car moves backwards (in the negative direction) with uniform motion and then applies its brakes and gradually comes to a stop.

2. In two or three paragraphs explain the meaning of classical determinism in the context of Newton's Laws. In your response carefully distinguish between determinism, free will and predictability. What are the origins of uncertainty in classical mechanics and what are the implications for predictability, free will and determinism (if any)? Also describe the ways in which quantum theory and chaos theory change our notions of predictability and determinism.

3. 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.

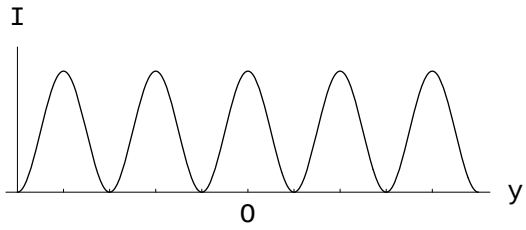
   (c) What would be the speed of a wave traveling down this string.

   (d) An identical string but at a different tension vibrates at 444 Hz

      (i) If both strings vibrate together beats are heard. Describe what beats are and how they are formed.

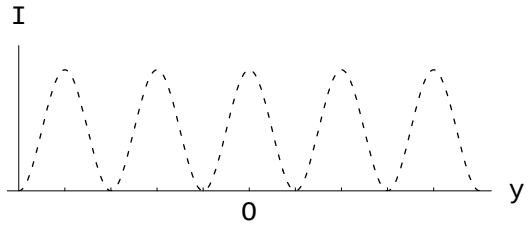
      (ii) What is the frequency of the beats?

4. Light from a double-slit experiment shines on a screen. A graph of intensity (or brightness) vs position along the screen is shown below

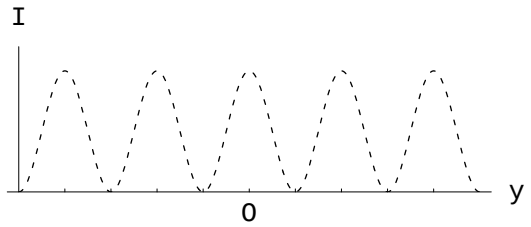


In each part below a single change has been made to the original apparatus. Draw the new graph of intensity vs position on top of the old graph which is given. Explain your reasoning.

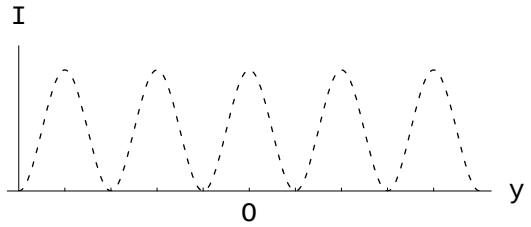
(a) The distance between the slits is increased.



(b) The wavelength of the original light is increased.



(c) The distance from the slits to the screen is increased.



(d) The slits are made narrower, but the distance between them is kept the same.