

# PH 221 Week 8

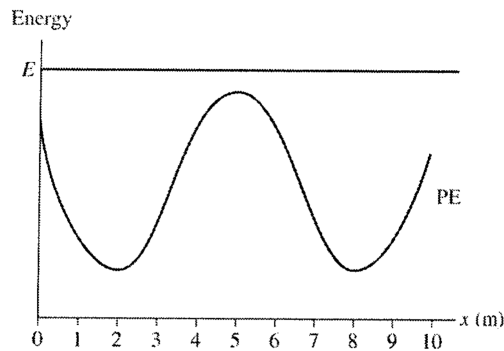
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This material is borrowed/adapted from Chapter 10 of the *Student Workbook for Physics for Scientists and Engineers*.

## R8-1: Interpreting a Potential Energy Graph

A particle with the potential energy shown in the graph is moving to the right at  $x = 0$  m with total energy  $E$ .



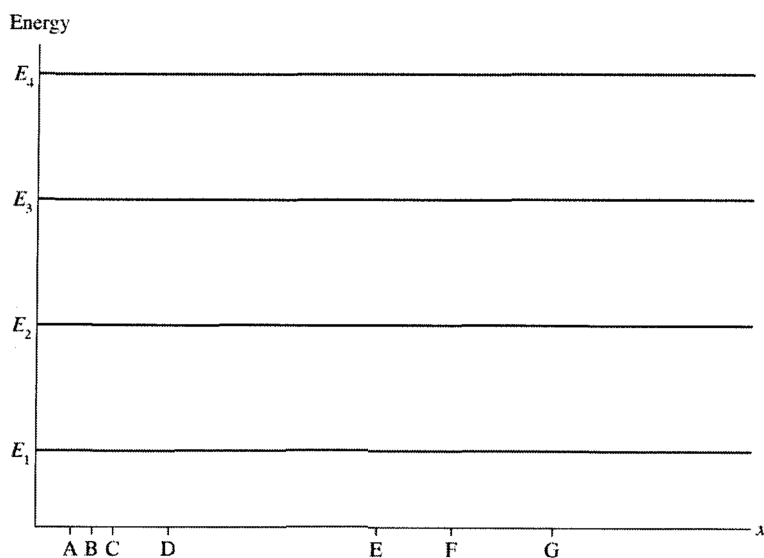
- (a) At what value or values of  $x$  is the particle's speed a maximum?
- (b) At what value or values of  $x$  is the particle's speed a minimum?
- (c) At what value or values of  $x$  is the potential energy a maximum?
- (d) Does this particle have a turning point in the range of  $x$  covered by the graph? If so, where?
- (e) In which intervals of  $x$  is the force on the particle to the right?
- (f) In which intervals of  $x$  is the force on the particle to the left?
- (g) At what value or values of  $x$  is the magnitude of the force a maximum?
- (h) At what value or values of  $x$  are positions of stable equilibrium?
- (i) At what value or values of  $x$  are positions of unstable equilibrium?
- (j) If the particle is released from rest at  $x = 0$  m, will it reach  $x = 10$  m? Explain.

## R8-2: Producing a Potential Energy Graph

Below is a set of axes on which you are going to draw a potential energy curve. By doing experiments, you find the following information:

- A particle with energy  $E_1$  oscillates between positions D and E.
- A particle with energy  $E_2$  oscillates between positions C and F.
- A particle with energy  $E_3$  oscillates between positions B and G.
- A particle with energy  $E_4$  enters from the right, bounces at A, then never returns.

Draw a potential energy curve that is consistent with this information.

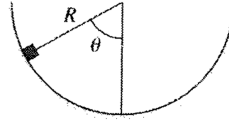


## R8-3: Potential versus Change in Potential

- (a) If the force on a particle at some point in space is zero, must its potential energy also be zero at that point? Explain.
- (b) If the potential energy of a particle at some point in space is zero, must the force on it also be zero at that point? Explain.

## R8-4: Sliding Cube in a Bowl

A small cube of mass  $m$  slides back and forth in a frictionless, hemispherical bowl of radius  $R$ . Suppose the cube is released at angle  $\theta$ . What is the cube's speed at the bottom of the bowl?



- (a) Begin by drawing a before-and-after pictorial representation. Let the cube's initial position and speed be  $y_i$  and  $v_i$ . Use a similar notation for the final position and speed.
- (b) At the initial position, are either  $K_i$  or  $U_{Gi}$  zero? If so, which?
- (c) At the final position, are either  $K_f$  or  $U_{Gf}$  zero? If so, which?
- (d) Does thermal energy need to be considered in this situation? Why or why not?
- (e) Write the conservation of energy equation in terms of position and speed variables, omitting any terms that are zero.
- (f) You're given not the initial position but the initial angle. Do the geometry and trigonometry to find  $y_i$  in terms of  $R$  and  $\theta$ .
- (g) Use your result of part (f) in the energy conservation equation, and then finish solving the problem.