7: Work and Energy Review

Name: Key

Multiple Choice: Choose the best answer for each question and place the answer on the answer sheet provided. Each question is worth one point.

1. The area under the force versus displacement (F vs. d) curve represents
   a) momentum
   b) impulse
   c) work
   d) kinetic energy

2. Can work be done on a system if there is no motion?
   a) Yes, an outside force is provided
   b) Yes, since motion is only relative
   c) No, since a system that is not moving has no energy
   d) No, because of the way work is defined

3. You throw a ball straight up. Compare the sign of the work done **by gravity** while the ball goes up with the sign of the work done by gravity on the way down.
   a) Work is + on the way up and + on the way down
   b) Work is + on the way up and - on the way down
   c) Work is - on the way up and + on the way down
   d) Work is - on the way up and - on the way down

up: d, F, −W, $\theta = 180$ | down: F, d, +W, $\theta = 0$ | $W = Fd\cos\theta$

4. If it takes 50 m to stop a car that is initially moving at 25 m/s, What distance is required if to stop the car if it is moving under the same conditions at 50 m/s?
   a) 50 m
   b) 100 m
   c) 200 m
   d) 400 m

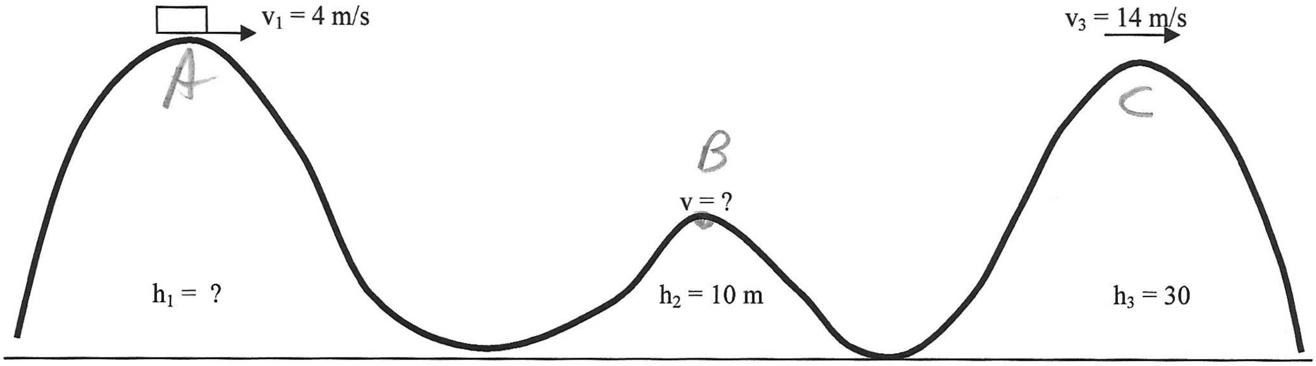
$W = \Delta K$
$2v \rightarrow 4K$
$4K \rightarrow 4W \rightarrow 4d$

5. The total mechanical energy of a system
   a) Is equally divided between potential and kinetic energy
   b) Is either all potential or all kinetic at one instant
   c) Is constant if only conservative forces act on the system

6. A ball falls from the top of a building, through the air (do not ignore air resistance), and lands on the ground below. How does the kinetic energy K just before striking the ground compare to the gravitational potential energy U_g at the top of the building?
   a) $K = U_g$
   b) $K > U_g$
   c) $K < U_g$
   d) Cannot determine from the information given

Some energy is lost due to friction (air resistance) to heat

7. The roller coaster designers need the roller coaster shown below to have a velocity of 14 m/s as it goes over the third hill.



a. How high would the first hill have to be in order for the roller coaster car to be going 14 m/s at the top of the third hill?

$E_A = E_C$

$U_{gA} + K_A = U_{gC} + K_C$

$\frac{1}{2}mv_A^2 + mgh_A = \frac{1}{2}mv_C^2 + mgh_C$

$\frac{1}{2}(4)^2 + 9.8h_A = \frac{1}{2}(14)^2 + 9.8(30)$

$9.8h_A = 384$

$h_A = 39.2\,m$

b. How fast will the roller coaster car be going at the top of the second hill?

$E_A = E_B$ or $E_B = E_C$

$\frac{1}{2}mv_B^2 + mgh_B = \frac{1}{2}mv_C^2 + mgh_C$

$\frac{1}{2}v_B^2 + 9.8(10) = \frac{1}{2}(14)^2 + 9.8(30)$

$\frac{1}{2}v_B^2 = 294$

$v_B^2 = 588$

$v_B = 24.2$ m/s

c. If the effects of friction were included into this problem, how would the height of the first hill have to change in order make sure that the car has a speed of 14 m/s at the top of the third hill? Explain.

the height of the first hill would need to be higher, since some energy would be lost due to friction becoming heat