Part I

1. Consider two blocks stacked one above the other on a table. Someone pulls the bottom block to the right with a rope in such a way that both blocks accelerate to the right but no slipping occurs at the interface between the top and bottom blocks. Friction at the interface between the two blocks does
   (a) no work on the top block
   (b) positive work on the top block.
   (c) negative work on the top block
   (d) first positive then negative work on the top block.

2. A force of 10 N is applied to a 2.0 kg mass at rest on which the force of friction is 4.0 N. The net work done on the mass after two seconds will be:
   (a) 36 J (b) 60 J (c) 72 J (d) 100 J

3. A cart on an air track is moving at 0.5 m/s when the air is suddenly turned off so that friction between the cart and the track now acts. The cart comes to rest after traveling 1 m. The experiment is repeated, but now the cart is moving at 1 m/s when the air is turned off. How far does the cart travel before coming to rest?
   (a) 1 m (b) 2 m (c) 3 m (d) 4 m

4. Compared to the amount of energy required to accelerate a car from rest to 10 miles per hour, the amount of energy required to accelerate the same car from 10 mph to 20 mph is
   (a) the same. (b) twice as much. (c)three times as much. (d) four times as much.

5. A crate is moving to the right on a conveyor belt without slipping. The conveyor belt maintains a constant speed. The net work done on the crate is
   (a) positive
   (b) negative
   (c) zero
   (d) first to the right then to the left.

6. A trolley makes two separate runs down an inclined plane. It is released first from Y, halfway up the slope and then from X at the top of the slope.

   Which of the following statements is/are true?

   (i) The trolley takes twice as long to run from X to Z as it take to run from Y to Z.

   (ii) At Z the trolley is going twice as fast when released at X as it is when it is released at Y.

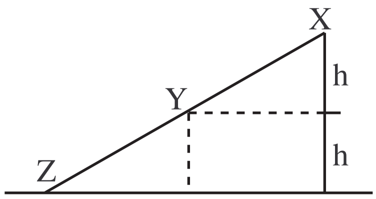
   (iii) At Z the trolley has twice as much kinetic energy when released at X as it has when released at Y.

   (a) (iii) only

   (b) (i) and (iii) only

   (c) (i) and (ii) only

   (d) (i), (ii) and (iii)



7. A spring-loaded toy dart gun is used to shoot a dart straight up in the air, and the dart reaches a maximum height of 24 m. The same dart is shot straight up a second time from the same gun, but this time the spring is compressed only half as far as before firing. How far up does the dart go this time, neglecting friction and assuming an ideal spring?

   (a) 24 m (b) 17 m (c) 12 m (d) 6 m

8. A marble is dropped from the top of a skyscraper. The work done by the earth's gravitational force on the marble is

   (a) equal to the work done by the marble's gravitational force on the earth

   (b) smaller than the work done by the marble's gravitational force on the earth

   (c) larger than work done by the marbles gravitational force on earth

   (d) more information is needed.

9. King Kong falls from the top of the Empire State Building, through the air (air friction is present), to the ground below. How does his kinetic energy (K) just before striking the ground compare to his potential energy (U) at the top of the building?

   (a) K is greater than U.

   (b) K is equal to U.

   (c) K is less than U.

   (d) It is impossible to tell

Part II

1. A 100 g puck is shot with a horizontal spring which has a spring constant of 200 N/m.

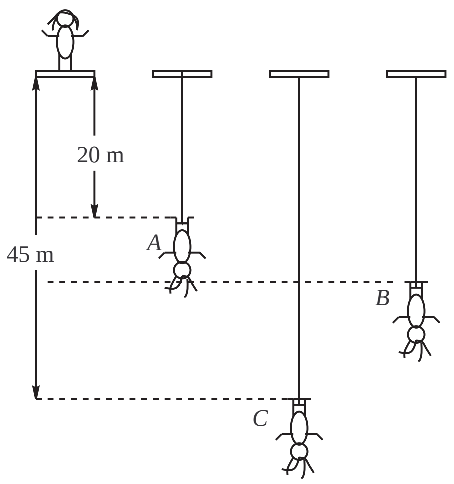
   (a) If the puck leaves the spring with speed 4 m/s, by how much was the spring compressed?

   (b) If the puck slides up a ramp angled at 30^o above the horizontal, how far will it travel along the ramp, assuming negligible friction.

   (c) If instead of sliding up the ball it slides along a floor and travels 10 m before stopping, what is the coefficient of friction between the floor and the puck?

2.

In the sport of Bungee Jumping people stand on a high platform and allow themselves to fall while tied to the platform by an elastic cord attached to their ankles. Johanna does a bungee jump. The unstretched length of the bungee cord is 20.0 m. Johanna's centre of mass is 1.0 m above her feet when she is standing and her mass is 54.0 kg. In her initial drop the lowest point she reaches is when her feet are 45.0 m below the platform (Since she is upside down while she is falling her centre of mass is 47.0 m below its initial position).



   (a) As Johanna drops, describe the energy changes taking place. Do this by writing **increasing, decreasing** or **constant** under the headings gravitational potential energy, kinetic energy and elastic potential energy in the table below. The top row refers to energy changes between her initial position on the platform and position A – the point where the bungee cord just starts to stretch; the middle row as she falls from point A through point B – the final equilibrium position; and the bottom row as she falls from point B to position C the lowest point of her initial drop.

	gravitational potential energy	kinetic energy	elastic potential energy
From platform to A			
From A through B			
From B to C			

(b) Using conservation of energy find Johanna's speed at point A just before the bungee starts to stretch.

(c) Again by using conservation of energy find how much energy is stored in the bungee cord at point C when Johanna is momentarily at rest at her lowest position?

(d) From your answer to (c) find the magnitude of the spring constant of the bungee assuming it obeys Hooke's Law.

(e) Calculate the net force acting on Johanna at C and hence find her acceleration as she bounces back up again.

(f) After bouncing up and down a number of times she loses energy and comes to rest at B hanging by her angles. By how much is the cord stretched at B.

(g) What problems could arise if the spring constant of the bungee were too small? too large?