Part I

1. When a horse pulls a wagon, the force that causes the horse to move forward is
   (a) the force he exerts on the ground.
   (b) the force he exerts on the wagon.
   (c) the force the ground exerts on him.
   (d) the force the wagon exerts on him.

2. 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.

3. A helicopter flies horizontally with constant velocity. The net force acting on it is
   (a) parallel to the velocity.
   (b) vertically upward.
   (c) vertically downward.
   (d) zero.

4. A constant force is exerted on a cart that is initially at rest on a track. Friction between the cart and the track is negligible. The force acts for a short time interval and gives the cart a certain final speed. To reach the same final speed with a force that is only half as big, the force must be exerted on the cart for a time interval
   (a) four times as long as for the stronger force
   (b) twice as long as for the stronger force
   (c) half as long as for the stronger force
   (d) a quarter as long as for the stronger force

5. A constant force is exerted for a short time interval on a cart that is initially at rest on frictionless track. This force gives the cart a certain final speed. 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

6. A rocket of mass 10000 kg on the surface of the earth accelerates upward at a rate of 4 m/s^2. The force provided by the rocket engines must be

   (a) 40000 N (b) 100000 N (c) 140000 N (d) 160000 N

7. A big ship crashes into a small canoe. During the collision the force that the ship exerts on the canoe is

   (a) greater than the force the canoe exerts on the ship.

   (b) equal to the force the canoe exerts on the ship.

   (c) less than the force the canoe exerts on the ship.

   (d) is related to the force on the canoe in a way that depends on the nature of the collision.

8. A mass of 30kg on a smooth horizontal table is tied to a cord running along the table over a frictionless pulley mounted at the edge of the table. A 10kg mass is attached to the other end of the cord. When the two masses are allowed to move freely the tension in the cord is

   (a) 300 N. (b) 150 N. (c) 100 N. (d) 75 N.

9. A stationary book sits on a table. Newton's third law is often stated as "To every *action* there is an equal and opposite *reaction*". The reaction to the weight of the book is the force that the

   (a) earth exerts on the book.

   (b) book exerts on the table.

   (c) table exerts on the book.

   (d) book exerts on the earth.

Part II

1. A basketball player is jumping vertically upward in order to land a shot. Her legs are flexed and pushing on the floor so that her body is accelerated upward.

   (a) Draw a free-body diagram of the player. Show the relative magnitudes of the various forces and describe each in words .

   (b) Repeat this exercise for the situation immediately after the player's body breaks contact with the floor.

   (c) Finally, consider, in the same manner, the situation at the top of the jump.

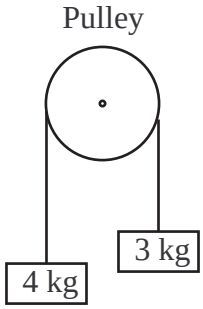
2. A toy is dragged along a rough floor by a child.

   (a) When the child applies a force of 0.50N horizontally the velocity is constant at 1.0 m/s. What is the force of friction on the toy?

   (b) When the child pulls harder so that the applied force is 1.00 N the velocity of the toy increases uniformly to 2.0 m/s in 5.0 seconds. Calculate the acceleration of the block

   (c) Find the mass of the toy.

3. Atwood's Machine.



The set up illustrated in the diagram on the left consists of two blocks connected by a string which passes over a frictionless (and massless) pulley. (The string, by the way, is massless too – you can get these in the same place you buy the pulley above.)

(a) The 3 kg weight is initially held still so that the system is stationary. What is the tension in the string at this time.

(b) The weight is then released. Does the tension in the string stay the same, get smaller or get larger?

(c) To answer the question in part (b) quantitatively, draw free body diagrams for each block separately. Then write down an expression for the net force on each assuming tension is an unknown quantity T. Apply Newton's second law in each case. Hence find the acceleration of the blocks and the tension in the string.