Please complete the following homework assignment in the space provided. It is due on Tuesday, January 24$^{\text{th}}$ at 9:30 am.

1. Hobson Ch 4 Ex 26,27,34,35,45,46,47

   26 At rest in your hand: Net force is zero, gravity is balanced out by the normal force your hand exerts on the apple holding it. The apple is falling to the ground: The force acting on it is gravity, hence f= ma = 2N. The apple is moving upward just after you threw it: It is the same as when it is dropping, gravity is the only force working on it.

   27 The upper force the hand must be greater, or else it would not accelerate upwards. If you accelerate the apple downwards while it is in your hand then you are pulling it in the same direction as gravity, thus the two forces will be working together. It is tricky if you lift the apple at an unchanging velocity. Initially, you will have to apply a force greater than gravity's pull downwards to get the apple moving once it is moving the hand need only apply an equal and opposite force to gravity. This then cancels out the force of gravity leaving a net force of 0, and hence the apple will continue on at a constant velocity. Likewise, to lower the apple at a constant velocity you must at first lesson your hold on it to allow gravity to pull it down, once it is moving you again must apply an equal and opposite force than gravity in order for the net force to be 0 and for the apple to continue at a constant velocity.

   34 Yes the car does exert a force on the truck. The truck exerts an equal and opposite force on the car. This is the force pair law

   45 The Earth's force is what gives the apple it's weight, hence it is 1 Newton.

   46 The apple also exerts a 1 N force on the earth

   47 The apples acceleration is that given by gravity which is a constant 9.8 m/s^2. Let's find the acceleration of the earth. Well, a = f/m = 1 N / 6 x 10^{2}4 kg = 1/6 x 10^{-24} m/s^2. So it is very small, as expected.

2. For each of the following describe the other member of the force pair.

   (a) The force of a bat hitting a ball.
   force of the ball hitting the bat.

   (b) The force of a rope pulling forward on a water skier.
   The force of the water skier pulling on the rope.

   (c) The weight of an apple pulling it down?
   The force of the apple pulling up on the earth.

   (d) The force of your arms as you pull a box across the floor?
   The force of the box pulling back on your arms.

3. (a) A 12 N book rest on the palm of your hand. What two forces act on the book? How strong is each force and in what direction do they act? Do these two forces form part of a third law force pair?
   The two forces are the force of gravity pulling it down and the normal force of the hand pushing it up. Both forces are 12 N, but do no form a third law force pair since they act on the same object.

(b) Suppose you accelerate the book upwards. Describe the individual forces acting on the book now. What can you say about the strengths of each of the two forces. Are they equal and opposite to each other?
The upward normal force is now larger than the downward force of gravity, which remains constant at 12 N.

4. Your friend (mass 100 kg) and you (mass 50 kg) are both wearing frictionless roller skates. You are at rest behind your friend who is also at rest. You push your friend on his back with a force of 40 N. What is your friend's acceleration? Do you accelerate? If so what is your acceleration?
Using Newton's second law $F = ma$, or $a = F/m$ we see that $a = 40/100 = 0.4\ \mathrm{m/s^2}$. You will also accelerated. By Newton's third law you feel a force of 40 N pushing you back. Your acceleration will be $a = 40/50 = 0.8\ \mathrm{m/s^2}$.

5. A person stands on a set of scales inside a closed elevator. The scales register the magnitude of the force applied to whatever rests upon them. The mass the of the person is 50.0 kg

(a) Explain the terms mass and weight.
Mass is the property of matter that resits changes in motion. Weight is the force of gravity acting on an object.

(b) (i) Draw a free body diagram of the person labeling all the forces acting on her when the elevator is stationary. If any of the forces are equal indicate that and explain why.
Since the person is at rest, the normal force and weight are equal and opposite. Weight acts down and the normal force acts up.

(ii) Determine the scale reading when the elevator is stationary.
The reading on the scale is the normal force. As stated above since the elevator remains stationary the normal force equals the weight. The weight is $W = mg = 50.0 \times 9.8 = 490$ N. Thus the scale reads 490 N.

(c) For each of the situations below draw a free body diagram of the person labeling all the forces acting on her and showing their relative magnitudes. Also determine the reading on the scale in the elevator

(i) moving downward at a constant speed of 2.00 m/s.
If she is moving downward at 2.0 m/s, then her velocity is not changing. This means that the forces balance. Thus the normal force equals the weight, which is 490 N.

(ii) accelerating upward at a constant acceleration of $2.00\ \mathrm{m/s^2}$.
Since she is accelerating upwards at $2.0\ \mathrm{m/s^2}$, the normal force must be greater than the weight. The net force is $N - W$ and according to Newton's second law $F_{\text{net}} = ma = 50(2) = 100N$. Hence $N - W = 100 \;\Rightarrow\; N = 100 + W = 590$ N.

(iii) free falling, since the cable has broken.
In free-fall the women accelerates downward with acceleration $9.8\ \mathrm{m/s^2}$. Hence the weight exceeds the normal force by this much. Now the net force is $W - N$ acting down, and from Newton's second law $F_{\text{net}} = ma = 50(9.8) = 490$ N. Hence $W - N = 490 \;\Rightarrow\; N = 490 - W = 0$ Hence the normal force is zero – she feels weightless.