Name: ______________________ DISC: ____________ Score: _____ / 20

Instructions:

- Do your own work.
- Answer the questions below in the space provided.
- Make sure you show all your work and any equations that you use.
- Please place a box around your answers.
- Remember to give the correct units with all numerical answers.

Q1	Q2	Q3	Q4
5	5	5	5

1. You have just arrived on a new planet and wish to find its acceleration of gravity. You throw a ball vertically upward with an initial velocity, $v_0 = 12\ m/s$. The ball takes $5s$ to reach its maximum height. **(Lecture 5, p. 8)**

   a. What happens to the *velocity* of the ball at its maximum height?

   Answer (2pts):

   When the ball reaches its maximum height, it will have $v(h_{max}) = 0\ m/s$.

   b. Of the following expressions, which would you use to find g_{new} the acceleration of gravity on the new planet:

   Expression (1 pt):

   i. $v = v_0 + at$ (circled)
   ii. $y(t) = y_0 + v_0 t + \frac{1}{2}at^2$
   iii. $v^2 = v_0^2 + 2\,a\,\Delta y$

   c. Use your result in part a) and your chosen expression in part b) to find g_{new} :

   g_{new} (2 pts):

$$v = v_0 + at$$

$$v = 0,$$

$$a = -\frac{v_0}{t} = -\frac{12m/s}{5s} = -2.4\ m/s^2$$

2. A train leaves a station and undergoes constant acceleration from rest. After traveling 1.2 km in a straight line, the train reached a final speed of 35 m/s **(Lecture 4, p. 7)**

   a. Select the equation you would use to find the acceleration of the train?

   Choice (2 pts):

   i. $x(t) = x_0 + v_0 t + \frac{1}{2}at^2$
   ii. $v^2 = v_0^2 + 2\,a\,\Delta x$ (circled)

   b. Use your chosen equation to find the acceleration (remember acceleration is a vector):

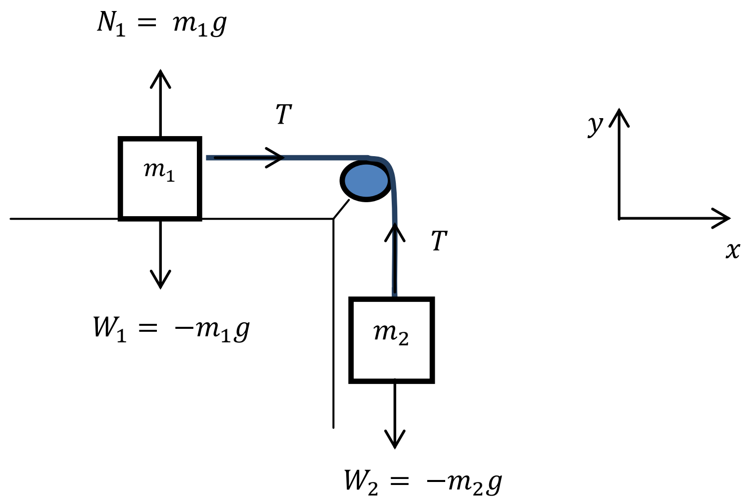
   Information:
   Solution (2 pts):

   i. Do you have all the information you need (yes/no)? (yes circled)
   ii. Solve for $\vec{a}$.

$$v^2 = v_0^2 + 2\,a\,\Delta x$$
$$v^2 - v_0^2 = 2\,a\,\Delta x$$

$$a = \frac{(v^2 - v_0^2)}{(2\Delta x)} = \frac{((35\ m/s)^2 - (0\ \ m/s)^2\ )}{(2 \times 1200m)} = \frac{1225}{2400}\frac{m}{s^2} = 0.51\ m/s^2$$

3. Two blocks are attached to each other by a massless cord as shown in the diagram below. Both the table and pulley are *frictionless*: **(Lecture 2; Lecture 4 pp. 8-14)**



Coord. System (1 pt.):
Forces (2 pts):

a. Finish the free-body diagram by including all of the forces which can act on the blocks. *Include a coordinate system*.

b. Can this system be in equilibrium? Explain your reasoning.

Answer (1 pt):
Reasoning (1 pt):

This system cannot be in equilibrium.

Because the table is frictionless, there is no force which can oppose the tension in the string attached to block m_1. The tension is caused by the block m_2 which experiences the force of gravity pulling it down. Thus the two masses must accelerate with constant acceleration as block m_2 is pulled down.

4. You are standing on a scale in an elevator. You read the weight on the scale. **(Lecture 5, pp. 11-14)**

a. The scale reads the same as your weight outside the elevator. Which of the following is true:

Answer (2 pts):

i. The elevator is slowing down.
ii. The elevator is speeding up.
iii. Neither of these is true.
iv. Both of these are true.

b. You look at the scale again. The reading is *less* than your weight outside the elevator. Explain in your own words what has happened.

Explanation (3 pts.):

If the scale reads a different value from my "true weight" then the elevator must be accelerating.

While the elevator accelerates, the normal force N I experience is not the usual $N = mg$. It is altered by the acceleration of the elevator. Recall Newton's Law: $ma = N - mg$ or the sum of the forces I experience, the normal force and the force of gravity, is the force I experience from the elevator.

The normal force then is: $N = m(a + g)$ where the acceleration will have a sign I must find to answer the question.

The question tells me that the normal force I experience makes the scale read *less* than my "true weight". Thus the sign of the acceleration must be negative: $N = m(g - a)$. So, the elevator is either accelerating downward or moving upward but slowing down.