AP/Honors Homework: Forces 1

Full Name, Period, AP/Honors: **due: 11/18**

Instructions: For short answer questions, work must be shown to receive credit. If you ever feel like you need a calculator, you are doing it wrong. AP only problems need to be completed by AP students and will be graded on correctness. Honors students are not required to do them, but will not be penalized for trying.

1 Many paths, but only one option

1. An object moves with a constant velocity of $v_0\hat{\text{x}}$ across a table on Earth. The object has a mass of M and is acted on by friction, gravity, a normal force, and an applied force of F_A. What is the net force on the object?

   A. $Mg(1 - \mu_k) + F_a$

   B. $Mg(1 + \mu_k) - F_a$

   C. 0

   D. There is not enough information to determine the answer.

2. An object with mass m is sitting in an elevator which is moving with a constant acceleration of $a\hat{\text{z}}$. The velocity of the object is $v_0\hat{\text{z}}$. If the acceleration due to gravity is $-g\hat{\text{z}}$, which of these gives the normal force the elevator applies on the object?

   A. $\frac{Mv_0^2}{ag}\hat{z}$

   B. $\frac{-Mv_0^2}{ag}\hat{z}$

   C. $M(g + a)\hat{\text{z}}$

   D. $M(g - a)\hat{\text{z}}$

3. Derive a formula that gives the weight of a person on a different planet in terms of the weight on Earth. Use the variables F_e for the weight on Earth, F_x for the weight on the other planet, g_e for Earth's gravity, and g_x for the other planet's gravity.

   A. $F_x = \frac{g_e}{g_x}F_e$

   B. $F_x = \frac{g_x}{g_e}F_e$

   C. $F_x = \frac{g_e^2}{g_x^2}F_e$

   D. $F_x = \frac{g_x^2}{g_e}F_e$

4. Two objects collide with each other. The first has mass M_1 and is moving with velocity $v_1\hat{x}$ before the collision. The second has unknown mass and is moving with velocity $-v_2\hat{x}$ before the collision. If the acceleration of object 1 is a_1 and the acceleration of object 2 is a_2, what is the second mass?

   A. $M_2 = \frac{a_1 v_1}{a_2 v_2}M_1$

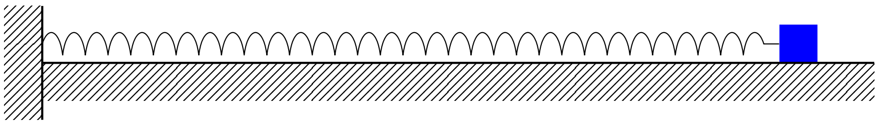
   B. $M_2 = \frac{v_1}{v_2}M_1$

   C. $M_2 = \frac{a_2}{a_1}M_1$

   D. $M_2 = \frac{a_1}{a_2}M_1$

5. Calculate the average number of points per second that your grade improves by during the time in which you are writing your name, period, and AP/Honors status on the top of this paper. You may assume that your grade will be 0 if you don't do this. This assignment is worth 10 points.

6. (AP Only) We have a very long spring. At one is we attach a mass and we attach the other end to a wall. The mass is then set on a horizontal frictionless surface. We will take the equilibrium position $\vec{r}_0 = 0$. The maximum position of the mass is $\vec{r}_{max}$ and the minimum position of the mass is $-\vec{r}_{max}$. The force on the mass from the spring is given by $\vec{F} = -k\vec{r}$.



(a) When the spring is very close to $\vec{r}_{max}$ how will the velocity change with time?

A. Approximately constant with time.

B. Approximately as $\sqrt{t}$

C. Approximately as t

D. Approximately as t^2

(b) When the mass is very close to $\vec{r}_0$ how will the velocity change as a function of time?

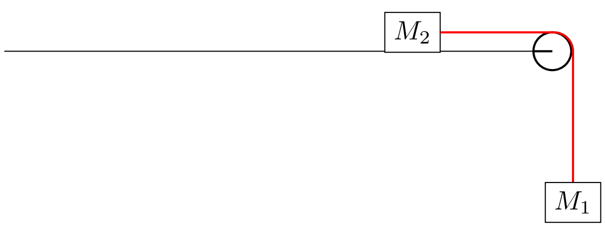
A. Approximately constant with time.

B. Approximately as $\sqrt{t}$

C. Approximately as t

D. Approximately as t^2

7. (AP only) You are visiting another planet where the gravitational acceleration g_p has not been measured. You have a system consisting of two objects with known mass, as shown. You want to measure the gravity of the planet with this system. Which of these methods would give all information you need to calculate it? **Select all that apply**.



A. Ensure that the friction coefficient between M_2 and the surface is very low. Measure the height of M_1 from the ground and the time it takes M_1 to hit the ground.

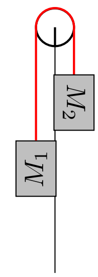
B. Ensure that the friction coefficient between M_2 and the surface is high then measure the maximum static friction coefficient. Keep adding mass to M_1 until M_2 begins to move, then measure the final value of M_1.

C. Ensure that the friction coefficient between M_2 and the surface is high, then measure the static friction coefficient. Remove M_1 from the device and replace it with a hand scale. Pull on the scale until M_2 begins to move and record the force required.

D. Remove the masses from the setup and slide them across a surface with known frictional coefficient. Measure the initial velocity and the time it takes for them to stop on that surface.

2 Answer me!

1. Two massive objects are placed so that each hangs from one side of a string held up in the middle by a rod with a pulley. The objects have mass M_1 and M_2. No friction exists anywhere and $M_2 > M_1$. A diagram is provided.



   (a) Draw free body diagrams for each mass.

   (b) What will be the acceleration of the system?

   (c) What will be the tension in the rope connecting them?

2. Use your knowledge of kinematics and newtons laws to find the stopping time for a car with mass M when the brakes are applied. The car is initially moving with a velocity $v_0\ \hat{x}$. You may assume that the car travels in a straight line while stopping and that the force the brakes apply is a constant $\vec{F}_b = -F_b\hat{x}$.

3. (AP Only) You build the apparatus shown below. If the apparatus is put in an elevator accelerating upwards at $a\hat{z}$ near Earth's surface, find the acceleration vector for M_3 in the Earth's reference frame. The ropes have no slack and friction is negligible.