August 2011

DIAGNOSTIC TEST: WHAT DID WE LEARN IN 121?

Please Print Your Name: SOLUTION

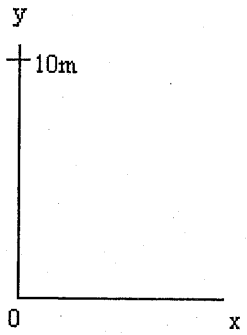
PLEASE ANSWER AS MANY QUESTIONS AS YOU CAN. PERFORMANCE ON THIS TEST HAS NO EFFECT ON YOUR GRADE. ITS PURPOSE IS TO INTRODUCE US TO ONE ANOTHER. Take care, God Bless You!

HINT: YOU DONOT NEED TO DO ANY CALCULATIONS.

1. Starting at y=0, a ball is thrown straight up (y-axis) and goes to a height of 10m before returning to earth. What is a) its velocity b) its acceleration at y=10m? (Acceleration and velocity are both vectors). Neglect air friction.

$\vec{V}$ at 10m is zero. That is why it stops rising.

$\vec{a} = -9.8\,m/s^2\,\hat{y}$ (Fixed by Earth)

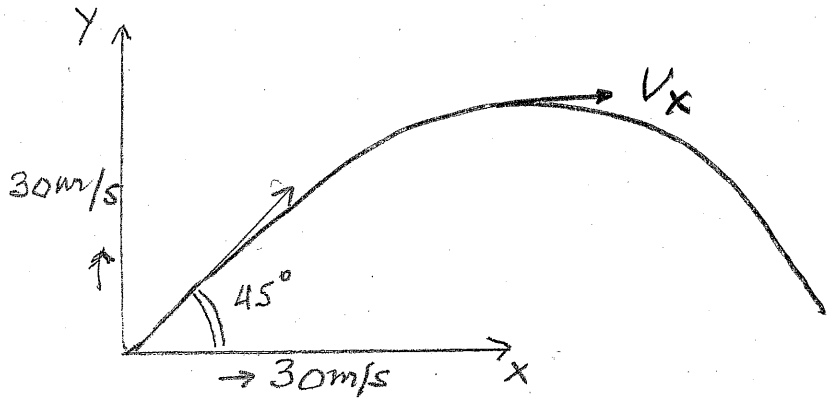


2. Next, the ball is launched as a projectile with an initial velocity of $\underset{\sim}{v} = (30\,m/s\,\hat{x} + 30\,m/s\,\hat{y})$. What is (i) its velocity and (ii) its acceleration at the highest point?

$V_y = 0$

$V_x = 30\,m/s$

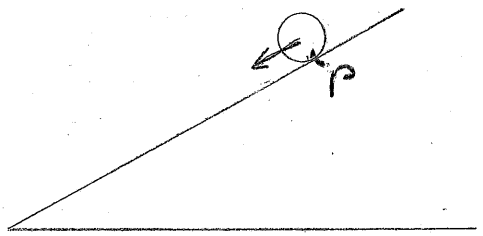
$\vec{a} = -9.8\,m/s^2\,\hat{y}$ (fixed by Earth)



3. A ball of mass 10kg rolls down an inclined plane, <u>without slipping</u>. Do you need a frictional force for this to happen? If so, how much work is done by friction if the ball moves by 1 meter? Justify your answers. (without slip, velocity at point of contact is zero at all times).

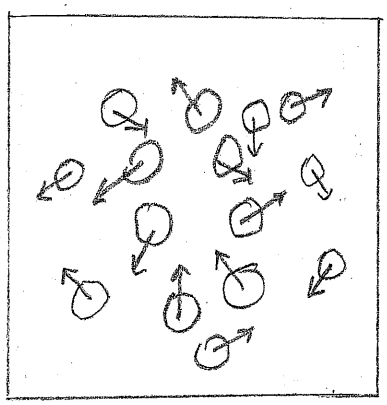
Yes, you need friction (static) to make $V_P = 0$ at all times.

No work is done by f_s because displacement at P is ZERO!



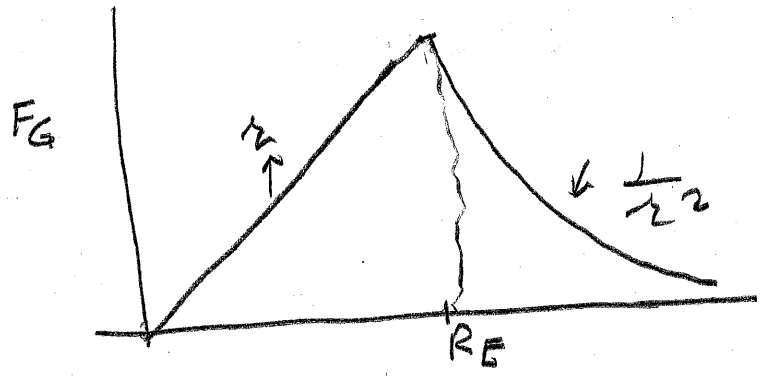
4. A gas is in a container <u>at rest</u> at a temperature of 600 K. What is the average velocity of the atoms in the gas? Why?

Average velocity is zero because motion is random and container is at rest.



5. If you were located at the center of the earth, what would your weight be? Why? (Assume that the earth is a uniform sphere)

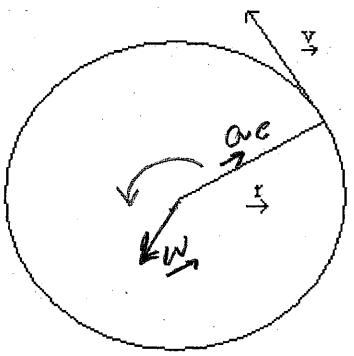
Your weight would be zero. The Earth pulls you toward its CTR. If you are already there, force vanishes.



6. In uniform circular motion which of the following vectors rotates as a function of time: a) acceleration b) angular velocity c) position? Why?

Position and acceleration vectors rotate

Angular velocity, perpendicular to circle's axis.



7. What does the second law of thermodynamics tell you about change of entropy in any adiabatic process? [IN AN ADIABATIC PROCESS NO HEAT ENTERS OR LEAVES THE SYSTEM]

Entropy increases

$dS \geq 0$

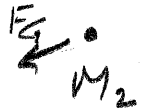
= applies to REVERSIBLE ADIABATIC

8. The gravitational force between two point masses is written as

$$\vec{F_G} = \frac{-GM_1M_2}{r^2}\hat{r}$$

where r is the distance between them. Why is there a negative sign on the right hand side of this equation?

The force is Attractive



M_1 & M_2 are being pulled toward one another

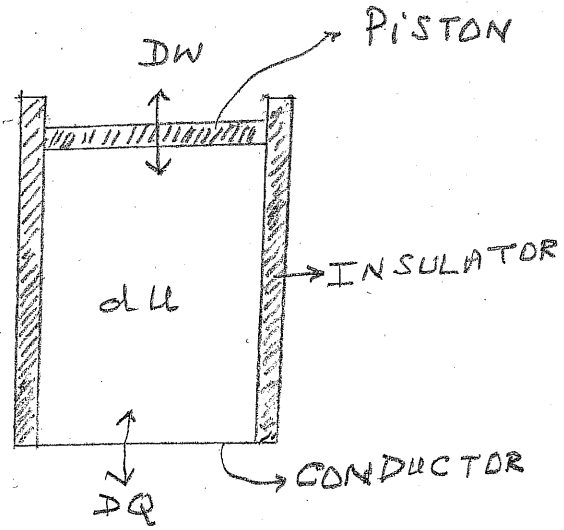
9. What is a conservative force? [Hint: To define Potential Energy, the system must be assembled in the presence of a conservative force]

IN A CONSERVATIVE FORCE, WORK DONE IS INDEPENDENT OF PATH. Determined only by End points.

10. The first law of thermodynamics is written as $\pm dU \pm DQ \pm DW = 0$. Why do we need two different "dees" to express these changes? [dU = Change in Internal Energy, DQ = Heat Exchange, DW = Thermodynamic Work]

DQ, DW are path dependent both involve exchanges with outside

dU is path Independent, It is an Intrinsic change



11. What is the difference between FORCE [$\underline{F}$] and TORQUE [$\underline{r} \times \underline{F}$]?

FORCE CAUSES TRANSLATION (LINEAR ACCELERATION)

TORQUE CAUSES ROTATION, (ANGULAR ACCELERATION)

TO HAVE TORQUE YOU MUST APPLY FORCE AT SOME DISTANCE ($\underline{r}$) FROM THE AXIS ABOUT WHICH ROTATION IS DESIRED.