Aug/ Sept 2009

DIAGNOSTIC TEST: WHAT DID WE LEARN IN 121?

Please Print Your Name: SOLUTION

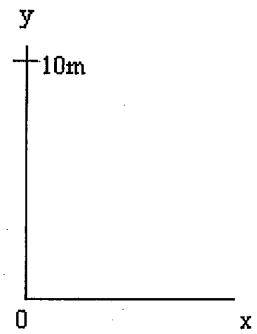
PLEASE ANSWER AS MANY QUESTIONS AS YOU CAN. PERFORMANCE ON THIS TEST HAS NO EFFECT ON YOUR GRADE. ITS PURPOSE IS TO INTRODUCE US TO ONE ANOTHER. Take care, God Bless You!

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.

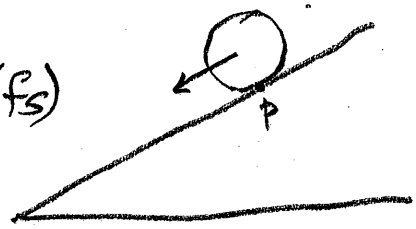
$\vec{V}(10m) = 0$
That is why it stops rising

$\vec{a}(10m) = -9.8 m/s^2 \hat{y}$
All unsupported objects near Earth have constant acceleration.



2. A ball of mass 10kg rolls down an inclined plane, without slipping. 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).

To prevent slip
Static friction (f_s)
is needed.



Since vel. is
zero at P.
No Displacement where f_s acts
So No WORK IS DONE by f_s.

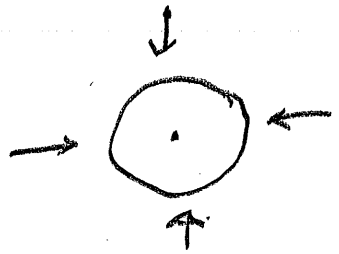
3. A gas is in a container at rest at a temperature of 600 K. What is the average velocity of the atoms in the gas? Why?

MOTION OF ATOMS IS TOTALLY
RANDOM SO AVERAGE VELOCITY
IS "ZERO"

$$\langle \vec{V} \rangle = 0$$

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

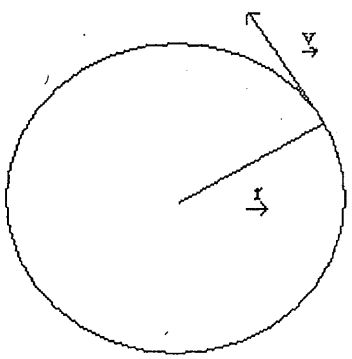
At the center weight is zero. Earth wants to pull you to its ctr. If you are already there, "pull" vanishes.



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

acceleration and position vectors rotate as a function time.

$\vec{\omega}$ is fixed b/c it is perpendicular to plane of circle



6. 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]

ADIABATIC PROCESS $DQ \equiv 0$.

2nd law says

$$\boxed{dS \geq 0}$$

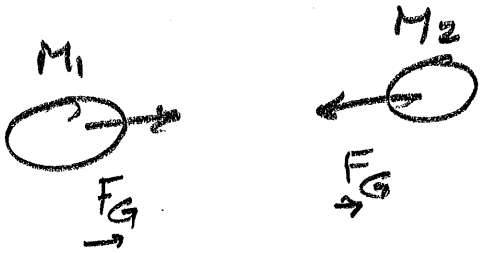
Entropy always increases except when process is reversible (= sign) when change is zero.

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

$$\underline{F}_G = \frac{-GM_1M_2}{r^2}\hat{r}$$

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

"−" sign ensures that the forces are attractive



8. What is a conservative force? [Hint: It is needed to define Potential Energy]

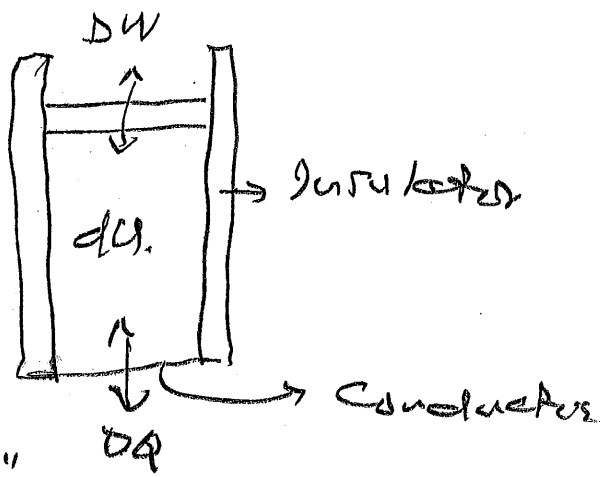
FOR A CONSERVATIVE FORCE WORK DONE IS INDEPENDENT OF THE PATH. WORK DONE ON A CLOSED LOOP IS "ZERO".

9. 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? [U = Internal Energy, DQ = Heat Exchange, DW = Thermodynamic Work]

DQ = HEAT EXCHANGE WITH SORROUNDINGS DUE TO TEMPERATURE DIFFERENCE

DW: WORK DONE ON OR BY GAS.

→ BOTH DEPEND ON THERMODYNAMIC "PATH"



dU: Intrinsic change, Independent of Path.

10. What is the difference between FORCE [$\underset{\rightarrow}{F}$] and TORQUE [$\underset{\rightarrow}{r} \times \underset{\rightarrow}{F}$]?

FORCE CAUSES TRANSLATION, LINEAR ACCELERATION

TORQUE CAUSES ROTATION: ANGULAR ACCELERATION

TO HAVE TORQUE FORCE MUST BE APPLIED AT A DISTANCE $\underset{\rightarrow}{r}$ FROM THE AXIS ABOUT WHICH ROTATION IS DESIRED.