Read 6.4-6.5

Exam 2

Monday 7:30 AM - 9:20 A.M

HERE, chapters 4-5 only

same format as before

wait outside room

seat # on exam

16 Questions (1 free)

ex) Jupiter is 5.2 times as far from the sun as earth. What is the length of Jupiter's year?

$$T_E^2 = \text{const } r_E^3$$
$$T_J^2 = \text{const } r_J^3$$

$$\frac{T_E^2}{T_J^2} = \frac{r_E^3}{r_J^3}$$

$$\frac{(1 \text{ year})^2}{T_J^2} = \frac{\cancel{r_E^3}}{(5.2\cancel{r_E})^3}$$

$$T_J^2 = (5.2)^3 (1 \text{ year})^2$$

$$\boxed{T_J = 12 \text{ years}}$$

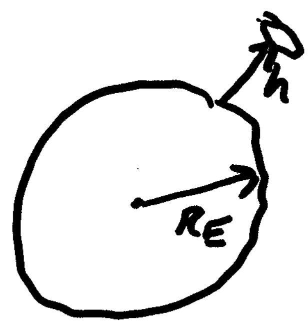
Artificial Gravity

what is the value of "g" for a person in space station?

weightless → $g = 0$?

$$F = \frac{G m_E m_p}{r^2} = \text{weight}$$

$$\frac{W_{orbit}}{W_{earth}} = \frac{\dfrac{G m_E m_p}{(R_E + h)^2}}{\dfrac{G m_E m_p}{(R_E)^2}}$$



$h \approx 600\,km$

$R_E \approx 6400\,km$

$$\frac{W_{orbit}}{W_{earth}} = \frac{(R_E)^2}{(R_E + h)^2} = \frac{(6400\,km)^2}{(7000\,km)^2} = .84$$

"g" ≠ 0!

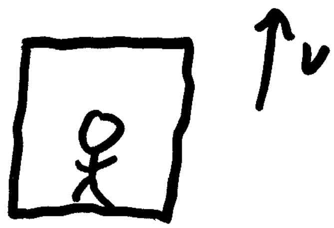
astronaut has $\underline{\underline{.84\,g}}$

so why is astronaut "weightless"

apparant weight

elevator moving at const velocity

person on
scale

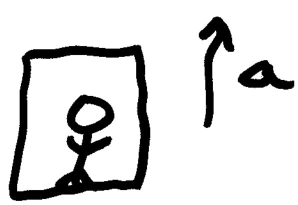


F.B.D
Person

$F_N - w = 0$

$F_N = w$ Reading on scale $= F_N$ $=$ weight

Now have elevator accelerating upward

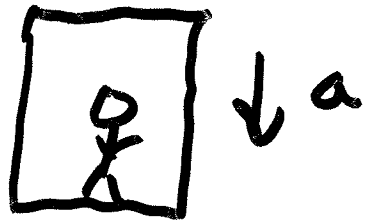


$F_N - w = ma$

$F_N = w + ma = mg + ma = m(g+a)$

scale reading $m(g+a)$ <u>larger</u>

accelerating downward



$F_N - w = -ma$

$F_N = -ma + w = -ma + mg = m(g-a)$

scale reading $m(g-a)$ smaller

so if accelerating downward at "g" (cable snaps)

scale reading $m(g-g) = 0$

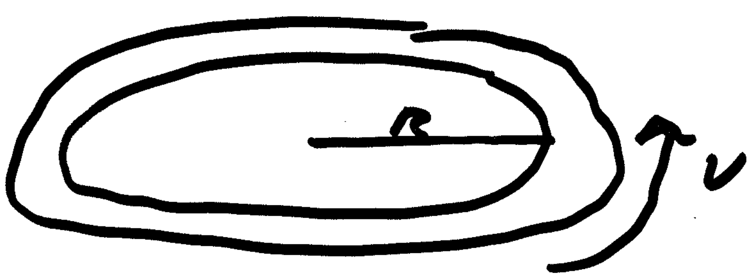
weightless

we see that acceleration acts similar to gravity → weight

so if in deep space very far from earth $g \approx 0$

Can make artificial gravity using acceleration

Easiest is to use centripetal acceleration



$a_c = \frac{v^2}{R}$

For earth gravity

$\frac{v^2}{R} = 9.8\,m/s^2$

Chapter 6
Energy

First talk about money

DEFINE money

CASH

CREDIT

LAND

STOCKS

⋮

Total amount of money Does not change. Can be transferred from one type to another

Energy

Hard to define energy

Total amount of energy never changes

It is <u>conserved</u>

But it can be <u>transferred</u> from one system to another mechanical Energy

E = Kinetic Energy + Potential Energy

System

- Energy of motion
= kinetic energy
(K) = $\frac{1}{2}mv^2$
- stored energy
= potential energy
(U)

WORK

Energy transfer

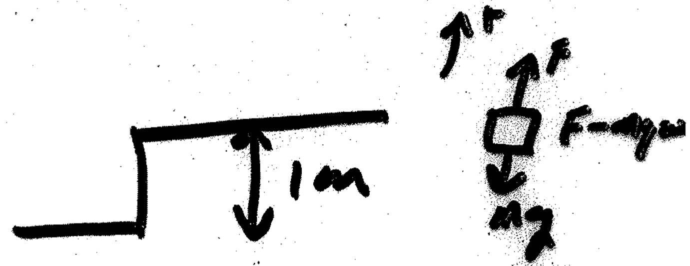
environment

Energy → ability to do work

→ DEFINE work

Lift a box of mass m at a constant velocity

1^{st} lift straight up



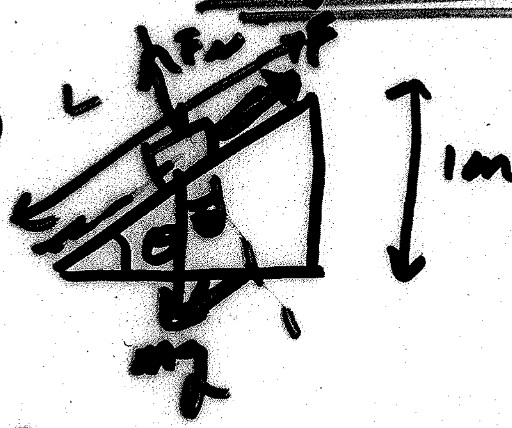
$F = mg$

Force needed? mg

Distance $= 1\,m$

force x distance $= \underline{(mg)(1m)}$

Now use ramp (Frictionless)



$F - mg\sin\theta = 0$

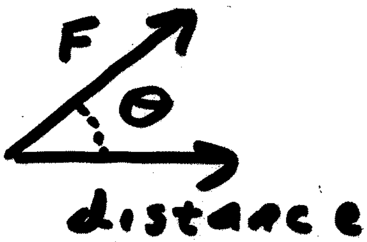
$F = mg\sin\theta$

Force $= mg\sin\theta$

Distance $= L$ $\quad \sin\theta = \frac{1m}{L} \Rightarrow L = \frac{1m}{\sin\theta}$

force x distance $= (mg\cancel{\sin\theta})\frac{1m}{\cancel{\sin\theta}} = \underline{(mg)(1m)}$

Work is product of component of force along direction of displacement times magnitude of distance



Work

$$\boxed{W = F d \cos \theta}$$

θ = angle between direction of force and direction of motion