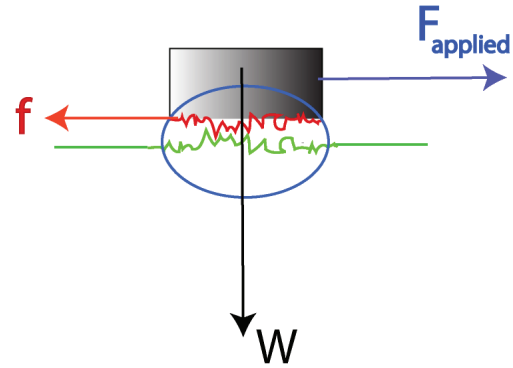
LECTURE 7 PHY 2004

FRICTION

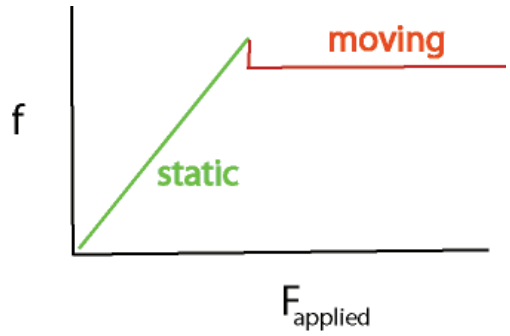


Force of friction proportional to force NORMAL to motion

μ = coefficient of friction $f=\mu W$

Rubber on concrete	**$\mu \approx 0.8$**
Steel on steel	**0.07**
Skater on ice	**0.02**

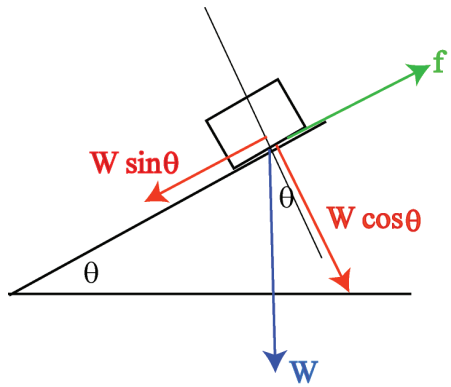
Static versus sliding friction



Object does not move until

$F_{applied}$ overcomes static friction

Inclined plane



Force normal to plane

$F = W\cos\theta$

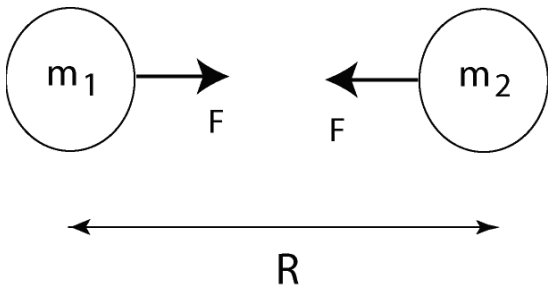
Friction $f = \mu W\cos\theta$

SLIDES when $W\sin\theta = f$

OR $\tan\theta = \mu$

LECTURE 6 PHY 2004

Gravity



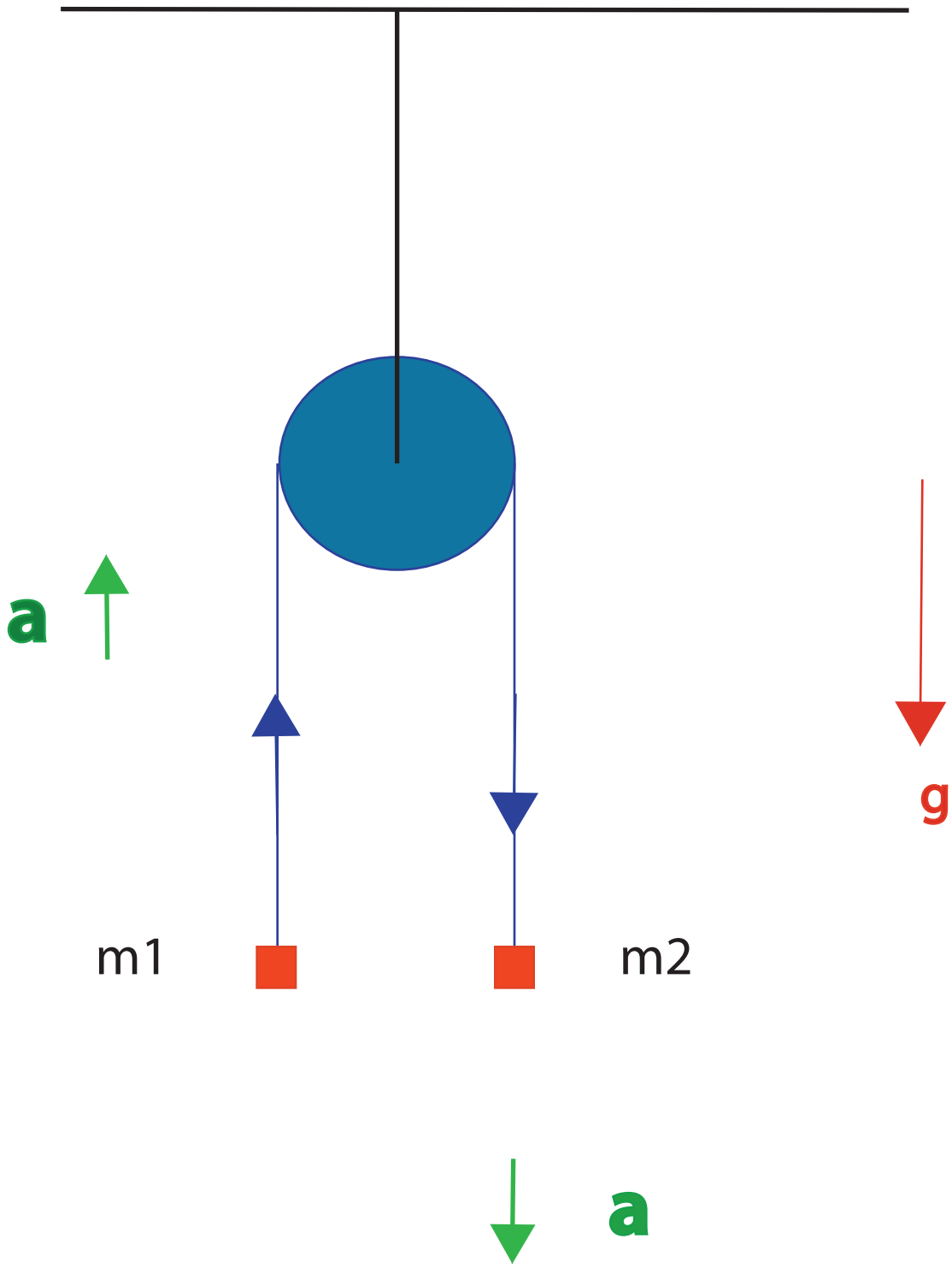
Force

$$F = \frac{Gm_1m_2}{R^2}$$

G is universal constant

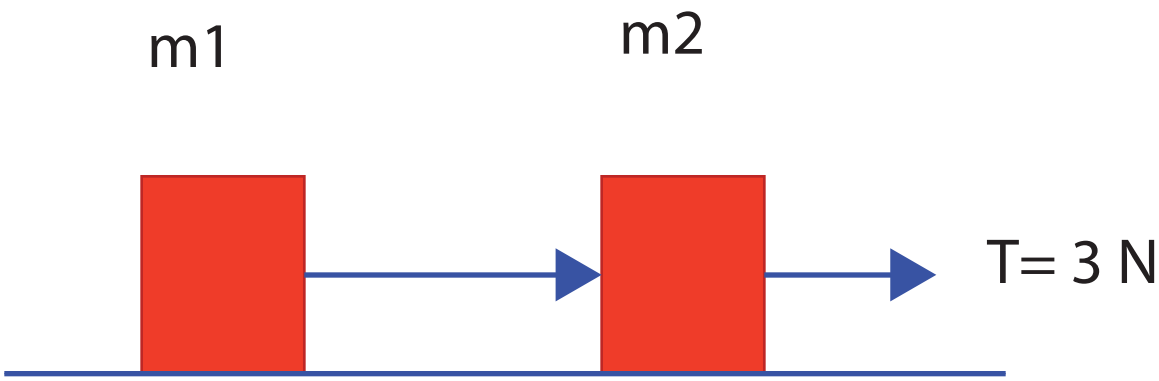
(same everywhere)

Atwood's machine



Find acceleration a in terms of m1, m2 and g.

Problem 3.27



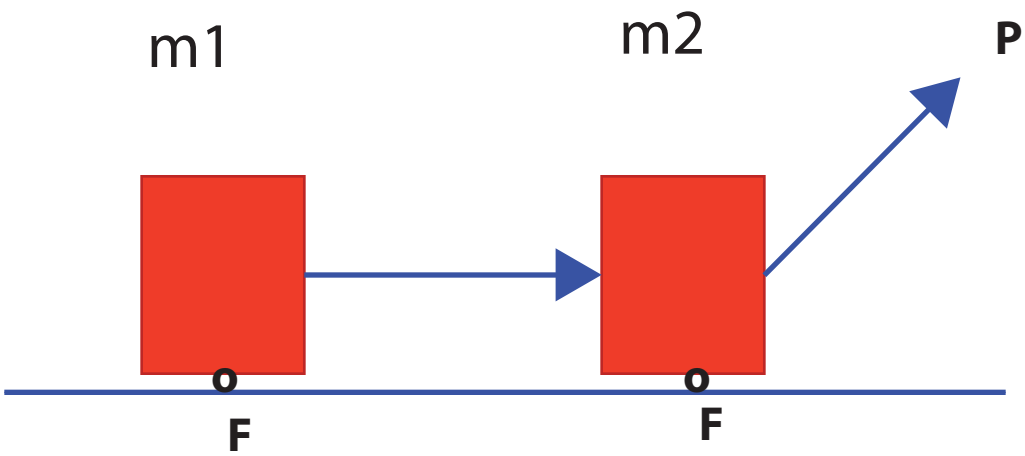
m1 and m2 tied together m1=m2=0.7 kg

m2 is pulled with a force of 3N

Assume there is negligible friction

Find the acceleration and the value of T_2 ?

Problem 3.30



m1 and m2 tied together m1=m2=4 kg

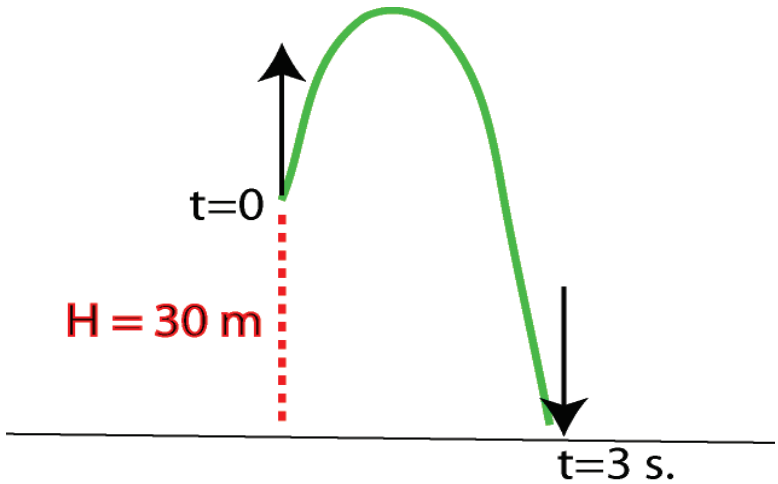
m2 is pulled with a force P inclined at 37 deg.

The horizontal force of friction at each wheel is 10 N.

Find the acceleration and the values of P and T_2 .

LECTURE 5 PHY 2004

Chap. 2 #43



$Y = V_i t + (1/2)at^2$ ..... (1)

At end Y = -30 m (below origin)

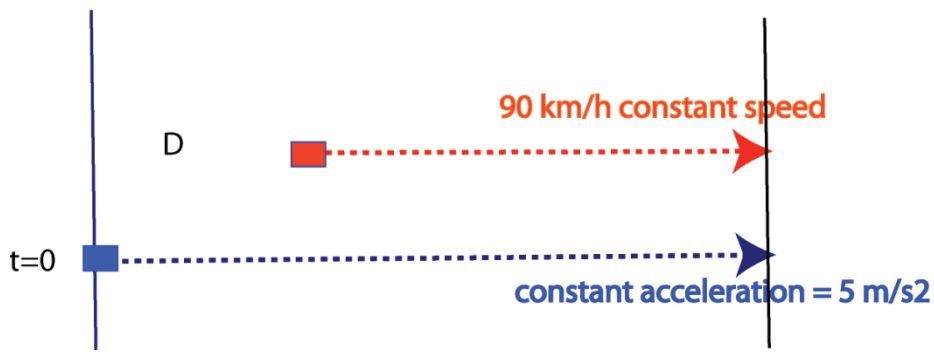
acceleration a = -g= -9.8m/s2

Put in Eq'n (1)

$-30 = V_i\, 3 - (1/2)(9.8)\, 9$

$V_i = (4.9)3 = 4.7$ m/s

Chap 2. # 35



Red speed constant = 90 km/h = 25 m/s

Blue does not start until 5 seconds after red passes, D=(5)(250)=125 m

Need to find t, then calculate distances

NOTE: $X_{blue} = X_{red} + 125$ .....Eq'n (1)

$X_{red} = 25\ t$

$X_{blue} = (1/2)\ at^2 = (1/2)5t^2 = 2.5t^2$

Use Eq'n (1)

$2.5\ t^2 = 25t + 125$, or

$t^2 = 10t + 50$,

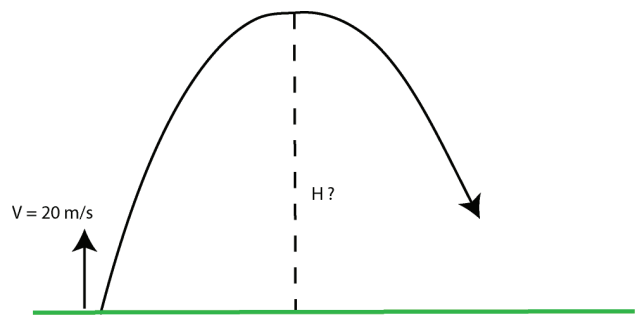
or $t=5 \pm\sqrt{(75)}$ (-ve sign non-physical)=5 +8.7 = 13.7s

$X_{red} = 25\ t = 341.5$ m

$X_{blue} = 466.5$ m

LECTURE 3 PHY 2004

Gravity constant at Earth's surface (always "down")



Typical problem

Throw ball up at 20 m/s. How high will it go?

$V_F^2 = V_i^2 + 2aH$

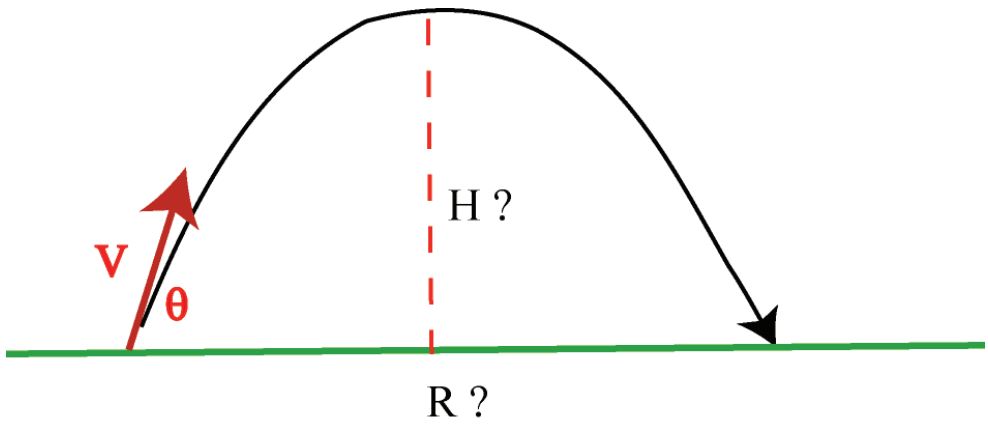
$a = -9.8\ m/s^2$ (gravity DOWN deceleration)

$V_F = 0$

$0 = 202 - 2(9.8)H$

$H = 400/19.6 = 20.4\ m$

Projectile Motion



Initial velocity V at angle θ to horizontal

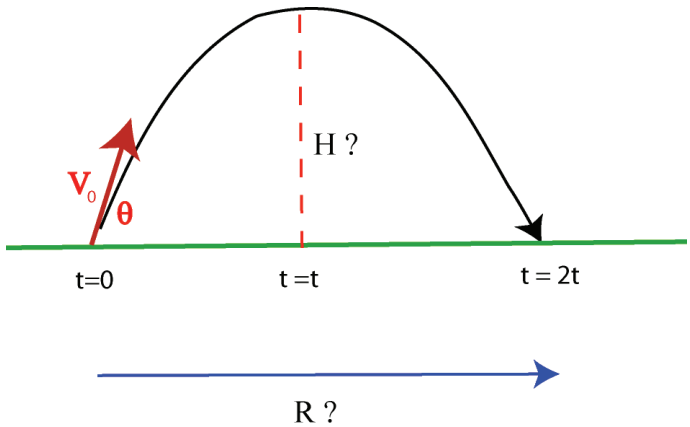
Calculate R

Calculate θ

_____

LECTURE 4 PHY 2004

Continuing the above problem from lecture 3.



Key point to remember, the x and y motions are independent.

Resolve V into x and y motions

$V_X = V_0 \cos\theta$

$V_Y = V_0 \sin\theta$

Consider vertical motion. V_y =0 at top where y =H

V_{avg} **(y-direction) = (1/2) $V_0 \sin\theta$**

At top use $V_F = V_i + at$, or $0 = V_0\sin\theta - gt$ which gives $t = (V_0\sin\theta)/g$

$H = V_{avg}.t = (1/2)V_0 \sin\theta.(V_0\sin\theta/g)$ **No need to memorize this formulae,**

just remember simple red equations

R= (total time) $V_x = 2t\, V_0\cos\theta$

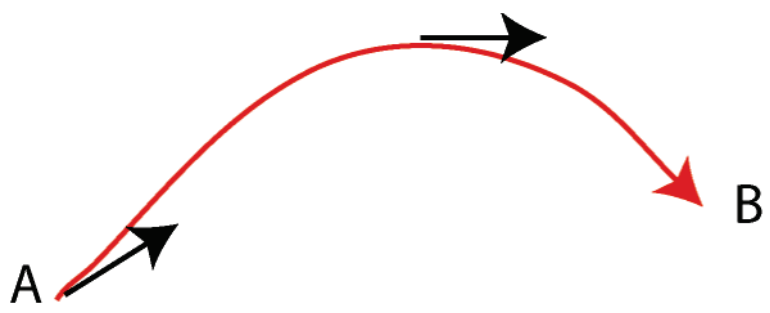
Lectures 1-2

PHY 2004

MOTION

Speed (scalar) distance per unit time meters/sec

Velocity (vector) speed + direction



Direction different at different points

Average velocity = displacement vector AB/time

Acceleration (vector)

Rate of change of velocity

$a = (V_F - V_I)/t$ OR $V_F = V_I + at$

Uniform acceleration (typical in this class)

e.g. gravity, rockets

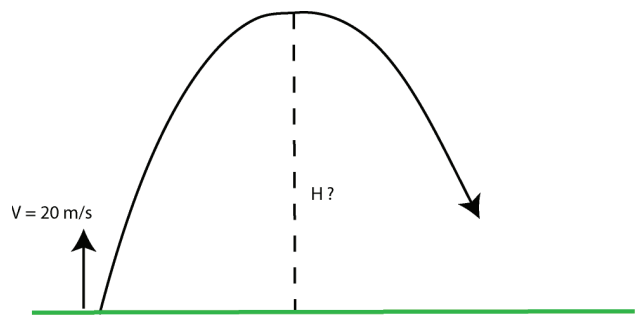
$X = V_{avg}\, t$ where V_{avg} is average velocity $V_{avg} = (V_I + V_F)/2$

THUS $X = (V_F^2 - V_I^2/2a)$ OR $V_F^2 = V_I^2 + 2aX$

ALSO $X = V_{avg}\, t$ OR $X = V_I t + (1/2)at^2$

LECTURE 3 PHY 2004

Gravity constant at Earth's surface (always "down")



Typical problem

Throw ball up at 20 m/s. How high will it go?

$V_F^2 = V_i^2 + 2aH$

$a = -9.8\ m/s^2$ (gravity DOWN deceleration)

$V_F = 0$

$0 = 202 - 2(9.8)H$

$H = 400/19.6 = 20.4\ m$