Gravity and constant acceleration

If an object is thrown up and falls down then:

Time up = Time down = half entire time.
Dis at bottom is 0.
V at top = 0
Vi up = -Vf down

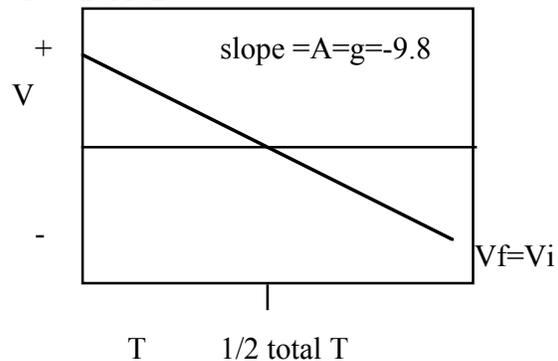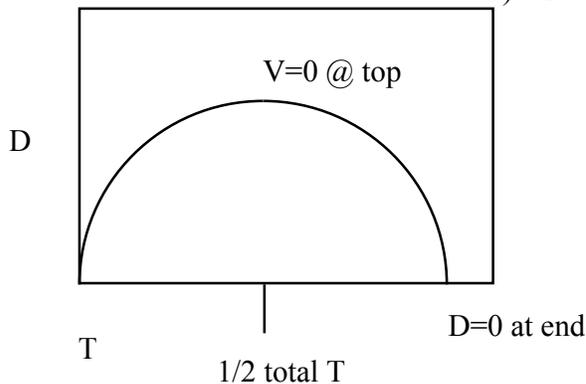1) $D = \frac{(Vi+Vf)}{2} * T$ 3) $Vf = Vi + A*T$

2) $Vavg = \frac{(Vi+Vf)}{2}$ 4) $D = Vi*T + \frac{1}{2}*A*T^2$

                                5) $Vf^2 = Vi^2 + 2*A*D$

G Problems:

1) If I throw up a baseball straight into the air at 8 m/s, (assume g=-9.8)
    a)what is its velocity at the top of its journey?
    Vf = 0 at top
    b) How much time does it take to go all the way up?
    Vf=0, Vi=8, A = -9.8
    Vf=Vi+AT   0=8-9.8T   9.8T=8   T=8/9.8=.81632 seconds

    c) How much time does it take to go down?
    Same amount of time T= .81632 seconds
    Total time up and down, D=0, Vi=8, A=-9.8
    D=ViT + ½*AT²
    0=8T+ ½*-9.8 T²
    0=8-4.9T   T=8/4.9 =1.632 seconds for whole trip, ½ = .81632 seconds

    d) What is its final velocity when it hits the ground?
    Vf=Vi+AT
    Vf=8+(-9.8)(1.632) = 8-16 = -8 m/s

Or $Vf^2=Vi^2 +2AD$
$= 8^2+2(-9.8)(0)$
so Vf=+/- 8 m/s

2)   A pebble is dropped down a well and hits the ground 1.5 seconds later. What is the displacement from the edge of the well to the waters surface?
Vi=0 (dropped)
A= -9.8
T=1.5
D=???

$D=ViT + ½*AT^2$
$D=0*1.5+ ½*-9.8 1.5^2$
*D= -4.9*2.25 = -11.025 m (downwards)*

3) A gymnast is practicing a dismount from the high bar that is 4 meters off the ground, and swings up with a velocity of + 4 m/s . How fast will she be going when she hits the ground?
Vi=4, A = -9.8 , D= -4 m (because up is positive, and she's ending up below the start)

$Vf^2=Vi^2 +2AD$
$Vf^2= 4^2+2(-9.8)(-4)$
$Vf^2=16+78.4=94.4$
so Vf=+/- 9.7 m/s or -9.7 m/s downwards

4) I drop a meterstick and catch it at the 32 cm mark. What is my reaction time?
Vi=0, A = - 9.8 , D = -32 cm = - .32 m, T= ???
$D= ½*g*T^2$
$.32 = ½*9.8*T^2$
T= SQRT (2.32/9.8) = SQRT (.0653) = .256 seconds*

5) I jump straight up and hit the ground 3 seconds later.
How fast was I going when I started?
Vi=????, T=3, D=0 (hit ground), A = -9.8
$D=ViT + ½*AT^2$
$0=Vi*3+ ½*-9.8 3^2$
*0=3Vi -4.9 * 9*
44.1 = 3Vi   Vi=14.7 m/s, Vf = -14.7 m/s

or at top of journey, Vf=0, T=1/2 total t= 1.5, A = -9.8

*Vf=Vi + A T   0=Vi -9.8*1.5 Vi= 14.7 m/s*

What is the total DISTANCE I traveled (not displacement)
Total distance equals distance up plus distance down, or twice distance down.
Starting at top T =1.5, Vi=0, A = -9.8, D=??

$$D=ViT + \tfrac{1}{2}*AT^2$$
$$D=0T+ \tfrac{1}{2}*-9.8*1.5^2$$
D=11.025m so total distance = 22.05 m

Or use #5 for first half of journey, Vi=14.7, Vf=0, A= -9.8, T=1.5

$$0^2=14.7^2 +2(-9.8)D$$
$$0^2= 216.09+ - 19.6D$$

216.09=19.6D   D=11.025m up, so total D is 2*11.025 = 22.05 m

6) A robot probe drops a camera off the rim of a 24 km deep crater on Mars, where the free fall acceration is -3.7 m/s^2 .
Find the time required for the camera to reach the crater floor and the velocity with which it hits.

D= -24 km = -24000 m, Vi=0, A = - 3.7 T =???

$$D=ViT + \tfrac{1}{2}*AT^2$$
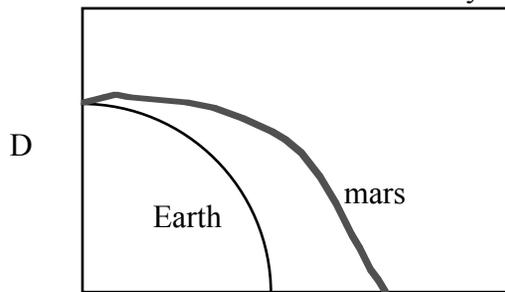$$-24000=0T+ \tfrac{1}{2}*-3.7*T^2$$
$$-24000= -1.85\,T^2$$
$$T^2 = 24000/1.85 \text{ so } T= 113 \text{ seconds or } 1.89 \text{ minutes}$$
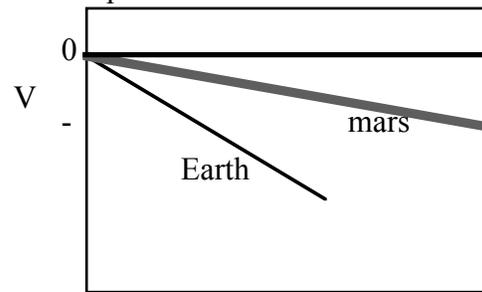
$$Vf^2=0^2 +2(-3.7)(-24000)$$
$$Vf^2=177600$$
$$Vf=421.4 \text{ m/s}$$

Sketch the distance time and velocity time graph as compared to Earth.