Unit 1 - Motion

Review for Motion and Projectiles

1) Understand three types of motion. What is the difference between velocity and acceleration. What are the units for velocity? What are the units for acceleration? How does a meter/sec of velocity compare to a mile/hour?

motionless - Not moving at all
constant velocity (steady speed) - Have one velocity and keep it
} Forces are zero or balanced (equilibrium)

acceleration - Speed up or slow down

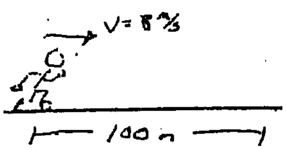
Units
velocity = m/sec
$accel = \frac{m/sec}{sec} = m/sec^2$

2) What is the constant velocity, or steady speed equation. If you are traveling at constant velocity what is your number (or magnitude of) for your acceleration.

Watch out for steady speed problems that involve the speed of sound, or speed of light (Remember you can use v=d/t on traveling waves also).

Watch out for v=d/t problems where the object goes around a circle.

i -

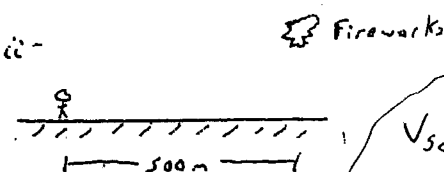


$V = \frac{d}{t}$

$8\,m/s = \frac{100\,m}{t}$

$t = 12.5\,sec$

ii -

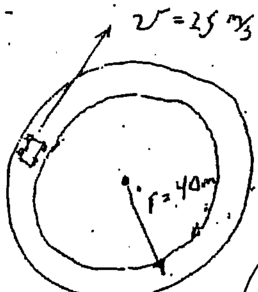


$V_{sound} = \frac{d}{t}$

$331\,m/s = \frac{500\,m}{t}$

$t = 1.51\,sec$

iii -

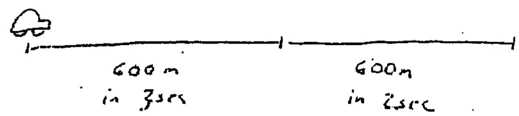


$V = \frac{d}{t} = \frac{2\pi r}{t}$

$25\,m/s = \frac{2(3.14)(40\,m)}{t}$

$t = 10.48\,sec$

Watch out for steady speed problems where car is going different speeds over different parts of trip.



$$V_{\text{whole Trip}} = \frac{d_{\text{whole Trip}}}{\text{time}}$$

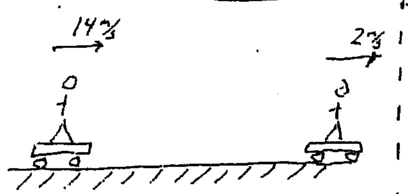
$$V_{\text{whole}} = \frac{600m + 600m}{3sec + 2sec} = 240 \, m/sec$$

3) What is the basic acceleration formula ($a=\Delta v/t$). Be able to apply in simple situations given 2 of the three quantities. Understand the unit m/s^2 Watch out for objects slowing down. Watch out for objects changing direction.

i

t = 2sec

$$a = \frac{\Delta v}{t} \qquad a = \frac{12\, m/s}{2sec} = 6\, m/s^2$$



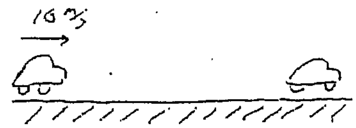
t=6sec

$$a = \frac{\Delta v}{t} = \frac{-12\, m/s}{6sec} = -2\, m/s^2$$

To the left

ii

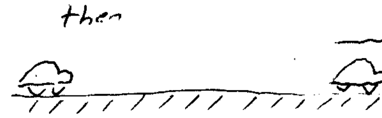
$a = 2\, m/s^2$ for 6sec



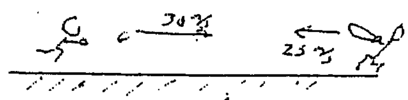
$$a = \frac{\Delta v}{t} \qquad 2\, m/s^2 = \frac{\Delta v}{6sec} \qquad \Delta v = 12\, m/s$$

then

$10\, m/s + 12\, m/s = 22\, m/s$

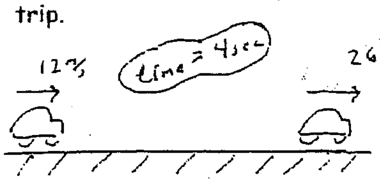


t = .1sec



$$a = \frac{\Delta v}{t} = \frac{55\, m/s}{.1sec} = 550\, m/s^2$$

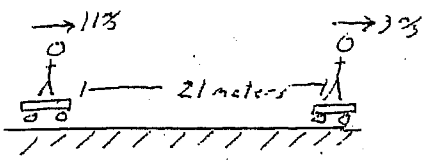
4) UnWritten simple formula for average velo. $\bar{v} = \frac{v_i + v_f}{2}$ Always remember average velocity is like the middle velocity for a speed up or slow down trip.



$\bar{v} =$

$d =$

$a =$



$\bar{v} =$

$t =$

$a =$

5) Working with the four motion equations for accelerating objects.

You can almost always use these instead

(You need to remember the ins and outs of these)

i- A car having an initial speed of 16 meters per second is uniformly brought to rest in 4.0 seconds. How far does the car travel during this 4.0-second interval?

(1) 32 m
(2) 82 m
(3) 96 m
(4) 4.0 m

$V_i = 16 \text{ m/s}$

$t = 4 \text{sec}$

$V_F = 0 \text{ m/s}$

$d = ?$

$d = \frac{1}{2}(V_i + V_f)t$

$= \frac{1}{2}(0 \text{ m/s} + 16 \text{ m/s})\, 4 \text{sec}$

$= 32 \text{ m}$

ii- A car moving at a speed of 8.0 meters per second enters a highway and accelerates at 3.0 meters per second². How fast will the car be moving after it has accelerated for 56 meters?

(1) 24 m/s
(2) 20. m/s
(3) 16 m/s
(4) 4.0 m/s

$V_F = ?$

$V_i = 8 \text{ m/s}$

$a = 3 \text{ m/s}^2$

$d = 56 \text{ m}$

$V_F^2 = V_i^2 + 2ad$

$V_F^2 = (8 \text{ m/s})^2 + 2(3 \text{ m/s}^2)(56 \text{ m})$

$V_F = 20 \text{ m/s}$

iii- A boat initially traveling at 10. meters per second accelerates uniformly at the rate of 5.0 meters per second² for 10. seconds. How far does the boat travel during this time?

(1) 50. m
(2) 250 m
(3) 350 m
(4) 500 m

$V_i = 10 \text{ m/s}$

$a = 5 \text{ m/s}^2$

$t = 10 \text{sec}$

$d = ?$

$d = V_i t + \frac{1}{2} a t^2$

$d = 10 \text{ m/s}(10 \text{sec}) + \frac{1}{2}(5 \text{ m/s}^2)(10 \text{sec})^2$

$d = 350 \text{ m}$

$V_F = V_i + at$

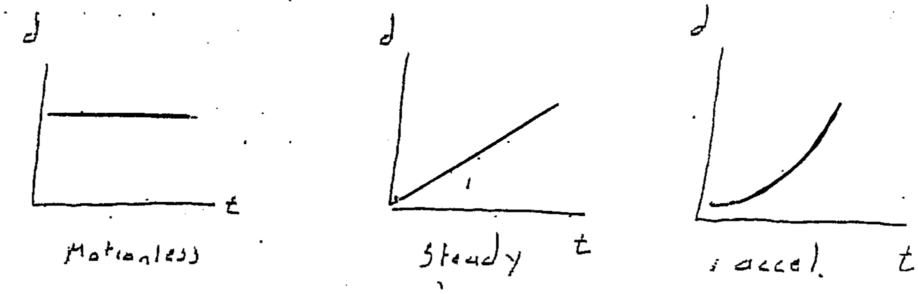
$d = V_i t + \frac{1}{2} a t^2$

$V_F^2 = V_i^2 + 2ad$

$* \; d = \frac{1}{2}(V_i + V_F)t$

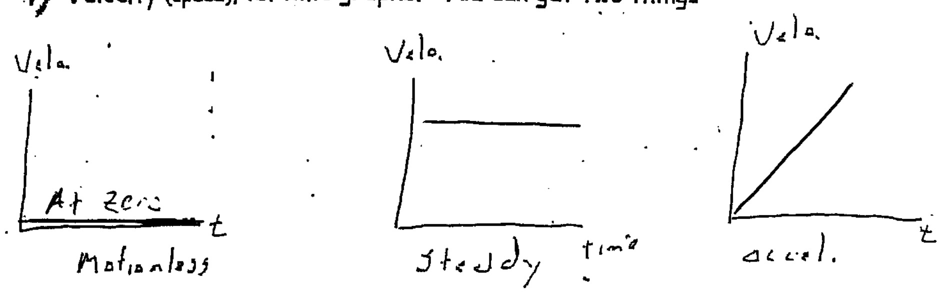
Graphing Motion

6) Distance (displacement), vs. Time graphs. What one thing can you get



Slope = $\frac{\Delta d}{t}$ = Velo.

7) Velocity (speed), vs. time graphs. You can get two things

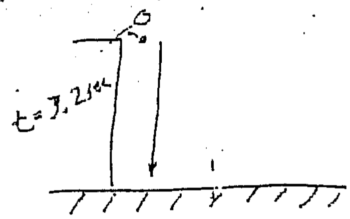


Slope = $\frac{\Delta V}{t}$ = accel

Area Under = distance traveled

Falling Bodies

8) Easy falling body problems, and accel. of gravity. (If they give time of fall, or velocity it has just befor it hits *its easy*)



Find V_{Final} + d (height)

IF you times time by 10 you get velo.

IF you have velo. & divide by 10 you get time

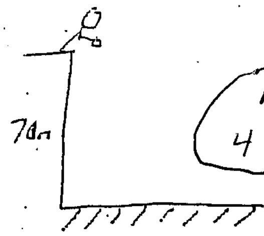
$a = \frac{\Delta V}{t}$ $\quad 10\,m/s^2 = \frac{\Delta V}{3.2\,sec}$ $\quad \Delta V = 32\,m/s$

OR

$V_i = 0\,m/s$
$a = 10\,m/s^2$
$V_F = ?$
$t = 3.2\,sec$

$V_F = V_i + at$
$V_F = 0\,m/s + 10\,m/s^2(3.2\,sec)$
$V_F = 32\,m/s$

9) Harder falling body problems. (If they only give distance of fall)



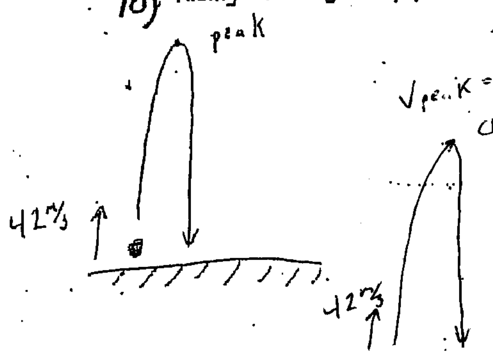
Find time and V_{Final}

Must do with 4 motion $t \neq 7\,sec$

$d = 70m$
$V_i = 0\,m/s$
$a = 10\,m/s^2$
$t = ?$

$d = V_i t + \frac{1}{2}at^2$
$70m = 0 + \frac{1}{2}(10\,m/s^2)t^2$
$70 = 5t^2$
$14 = t^2$
$t = 3.74\,sec$

10) Rising - Falling Body problems.



Find t_{rise}, and d (height)

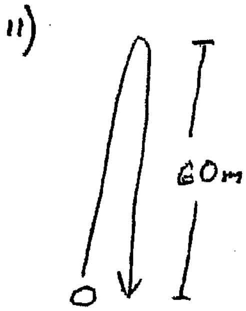
$V_{peak} = 0\,m/s$
$a = 10\,m/s^2$ down

rise

$V_i = 42\,m/s$
$V_F = 0\,m/s$
$a = -10\,m/s^2$
$t = ?$

$V_f = V_i + at$
$0\,m/s = 42\,m/s + (-10)t$
$-42 = -10(t)$
$t = 4.2\,sec$

11)



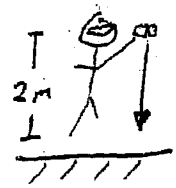
Find $V_{Initial}$, t_{rise}

rise

$d = 60m$
$a = -10\,m/s^2$
$V_F = 0\,m/s$
$V_i = ?$

$V_F^2 = V_i^2 + 2ad$
$(0\,m/s)^2 = V_i^2 + 2(-10\,m/s^2)(60m)$
$-V_i^2 = -1200$
$V_i = 34.6\,m/s$

12) An object on planet Alpha is dropped from an astronauts hand and falls 2 meters, in 1.2 seconds. Find the acceleration of gravity on planet Alpha.



$V_i = 0\ m/s$

$d = 2m$

$a = ?$

$t = 1.2\ sec$

$d = v_i t + \frac{1}{2} a t^2$

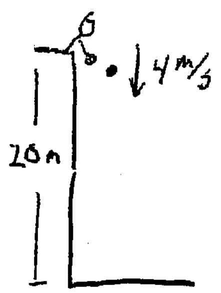
$2m = 0 + \frac{1}{2}(a)(1.2sec)^2$

$2 = .72(a)$

$a = 2.77\ m/sec^2$

13) An object is thrown down wards from a height of 20 meters with an initial velocity of 4 m/s. Explain why this object will be in the air a shorter time than if it were just dropped. Find the objects final velocity and time of fall.

V_i is not $0\ m/s$



$V_i = 4\ m/s$

$a = 10\ m/s^2$

$V_f = ?$

$d = 20m$

$V_f^2 = V_i^2 + 2ad$

$V_f^2 = (4\ m/s)^2 + 2(10\ m/s^2)(20m)$

$V_f^2 = 416$

$V_f = 20.4\ m/s$

14) What affect does air resistance have on falling objects ?