

## AP PHYSICS REVIEW SHEET: Motion

AP Physics is a college level course. This means it will be fast paced and challenging. To make sure that you are adequately prepared I am requiring all prospective AP students to complete this summer review sheet. By completing this review you will reinforce your understanding of important concepts problem solving methods. This activity will be collected on the first day of class...don't wait until the last day of summer vacation to begin!!

You are welcome to contact me by email ([jamalhafza@att.net](mailto:jamalhafza@att.net)) over the summer if you have get stumped or have questions about how to proceed.

### **PART 1 PHYSICAL QUANTITIES –**

*Give the formula that can be used to calculate each of the following. Indicate the units of each.*

| <u>QUANTITY</u>                    | <u>FORMULA</u> | <u>UNITS</u> |
|------------------------------------|----------------|--------------|
| 1. Force of gravity (on earth)     |                |              |
| 2. Force of gravity (in space)     |                |              |
| 3. Coefficient of Friction         |                |              |
| 4. Density                         |                |              |
| 5. Acceleration                    |                |              |
| 6. Momentum                        |                |              |
| 7. Impulse                         |                |              |
| 8. Work                            |                |              |
| 9. Power                           |                |              |
| 10. Efficiency                     |                |              |
| 11. Kinetic energy                 |                |              |
| 12. Gravitational Potential Energy |                |              |
| 13. Centripetal Acceleration       |                |              |

*Explain the difference between vector and scalar quantities by completing the statements below.*

A \_\_\_\_\_ quantity has both \_\_\_\_\_ and direction. \_\_\_\_\_ quantities only have magnitude. Some examples of \_\_\_\_\_ quantities are displacement, force, \_\_\_\_\_, \_\_\_\_\_, & \_\_\_\_\_. Some examples of \_\_\_\_\_ quantities are energy, speed, \_\_\_\_\_, \_\_\_\_\_, & \_\_\_\_\_.

### **Kinematics and Motion—**

*There are kinematics formulas. Write down each one.*

- 1.
- 2.
- 3.
- 4.
- 5.

*Solve the following problems in the space provided. Remember to list knowns and unknowns, write down the formula used, substitute and solve, box answer with units.*

1. You are traveling to grandma's house for Thanksgiving. If grandma lives 180 miles away and you drive at 60 mph, how long does the trip take?
2. If you walk at 2.0 m/s for 10 minutes, how far have you gone?
3. What is the acceleration of a racing car if it's velocity is decreased uniformly from 66 m/s to 44 m/s during an 11 second time period?
4. How far does the car in the previous problem travel?

5. An apple is thrown straight up in the air with an initial speed of 25 m/s.
- At its very highest point what is its velocity?
  - At its very highest point what is its acceleration?
  - How long does it take to reach this point?
  - How high above where it was thrown does the apple go?
  - How fast is the apple moving when it returns to the level where it was thrown?
6. Wily Coyote plummets from a cliff. He hits the ground 3.0 seconds later
- How fast is he moving just before he hits the ground—assume that real physics apply (as opposed to cartoon physics)
  - How high is the cliff?
  - If he has a mass of 40.0 kg, what is his kinetic energy just before he hits? What is his momentum just before he hits?

## **PROJECTILE MOTION**

Review notes. Remember that:

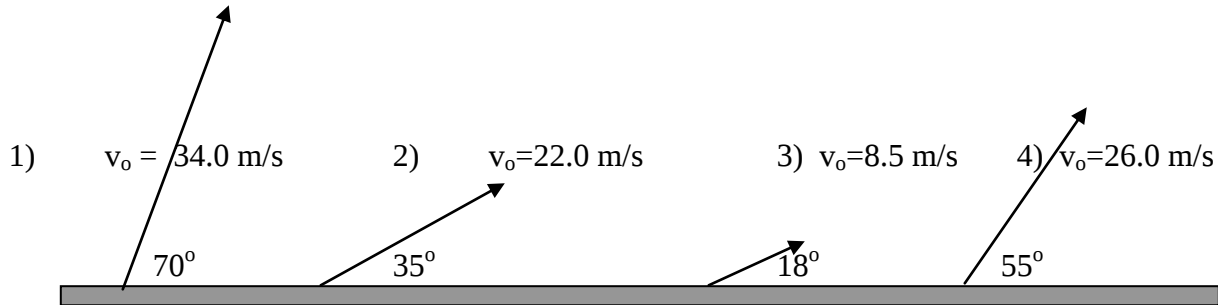
- Vectors can be split into horizontal and vertical components
- Projectiles move at **CONSTANT SPEED** in the **HORIZONTAL** direction
- The **VERTICAL MOTION** of a projectile is exactly the same as **FREE FALL MOTION**
- The acceleration due to gravity ( $g=9.8 \text{ m/s}^2$ ) only affects the **VERTICAL MOTION!!**
- The acceleration in the **HORIZONTAL DIRECTION** is **ZERO!!**
- The **TRAJECTORY** of a projectile follows a **PARABOLIC** path
- At the **TOP OF THE MOTION** the **VERTICAL VELOCITY IS ZERO**, but the **HORIZONTAL VELOCITY** is the same throughout the motion

Review problems. The two types of projectile problems that you absolutely must be able to solve are:

- 1) Projectiles launched at an angle from a flat surface
- 2) Projectiles launched horizontally from a cliff or building.

On the following pages are some exercises for you to practice these kinds of problems.

The following arrows show the launch velocity of projectiles fired from level surface.



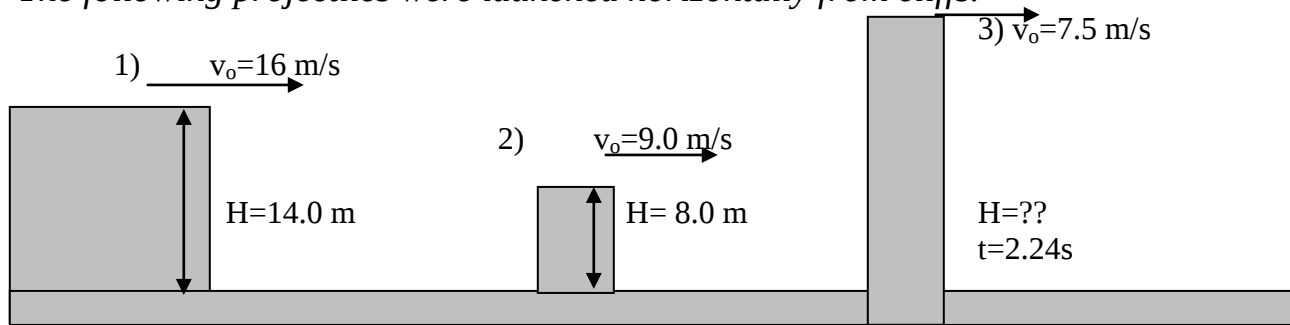
**Step 1.** Find the horizontal and vertical component of the initial velocity in each case. The first problem is done for you.

|                                           |            |            |            |
|-------------------------------------------|------------|------------|------------|
| 1. $v_x = 34 \cos 70 = 11.63 \text{ m/s}$ | 2. $v_x =$ | 3. $v_x =$ | 4. $v_x =$ |
| $v_y = 34 \sin 70 = 31.95 \text{ m/s}$    | $v_y =$    | $v_y =$    | $v_y =$    |

**Step 2.** Divide problem into horizontal and vertical parts. Follow the example (problem 1) to find the time of flight, range, and maximum height of each projectile.

| 1. | Horizontal                                                                                                                                                           | Vertical                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | $v_x = 11.63 \text{ m/s}$<br><i>(constant horiz. speed!!)</i><br>$d_x = v_x t$<br>$= (11.63)(6.52) \text{ (total time)}$<br><div><math>= 75.8 \text{ m}</math></div> | $v_{oy} = 31.95 \text{ m/s}$<br>$v_y = 0.0 \text{ m/s}$ <i>(vert. velocity is zero at top of flight)</i><br>$a = -9.8 \text{ m/s}^2$<br>$v = v_o + at \rightarrow t = -v_{oy}/9.8 = 3.26 \text{ s}$<br><br>Time of flight = $2t$ <i>(time up plus time down)</i><br><div><math>= 6.52 \text{ s}</math></div><br><br>Max height = $d_y = \frac{1}{2} (v_{oy} + v_y) t$<br>$= \frac{1}{2} (31.95 + 0) 3.26$<br><div><math>= 52.1 \text{ m}</math></div> |
| 2. | Horizontal                                                                                                                                                           | Vertical                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|    | Now it is your turn...                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 3. | Horizontal                                                                                                                                                           | Vertical                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|    |                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 4. | Horizontal                                                                                                                                                           | Vertical                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|    | Could you explain this method to classmate??                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

The following projectiles were launched horizontally from cliffs.



- How far from the base of the first cliff does the projectile land? .

#### HORIZONTAL

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

$$d_x = v_x t$$

$$= (16)(1.69)$$

$$= 27.0 \text{ m}$$

#### VERTICAL

$$v_{oy} = 0.0 \text{ m/s}$$

$$a = 9.8 \text{ m/s}^2$$

$$H = d_y = \frac{1}{2} a t^2$$

$$t = (2H/9.8)^{1/2}$$

$$= 1.69 \text{ s}$$

**(horizontal launch means NO vertical component to  $v_o$ !!)**

- How far from the base of the cliff does the second projectile land. (Your turn to solve...)

#### HORIZONTAL

#### VERTICAL

- In the third diagram the height of the cliff is not given, but we know that the projectile lands 2.24 seconds after being launched.

- How far from the base of the cliff does the third projectile land? (Hint: you don't need to know the height of the cliff to answer!!)
- How high is the cliff?
- What is the speed and direction of the projectile immediately prior to impact?.

#### HORIZONTAL

#### VERTICAL