Practice Test

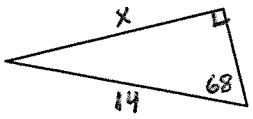
Trigonometry and Projectile Motion

You must include the correct unit of measure with each of your answers. All decimals can be rounded to the nearest tenth. You may neglect air resistance for all questions.

1. List the three main equations that will useful to you on the test – one relating height to time, one relating distance to velocity and time, and one relating velocity to acceleration and time.

$h = -16t^2 + v_v t + h_i$ $\quad d = v_h t$ $\quad v_f = at + v_i$

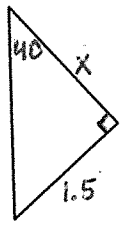
Find each unknown.

2. 

$\sin(68) = \frac{x}{14}$

$x = 14\sin(68)$

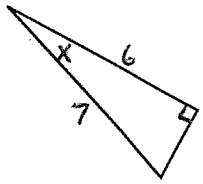
$x = 13.0$

3. 

$\tan(40) = \frac{1.5}{x}$

$x = \frac{1.5}{\tan(40)}$

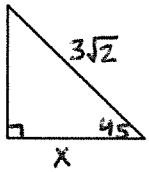
$x = 1.8$

4. 

$\cos(x) = \frac{6}{7}$

$x = \cos^{-1}\left(\frac{6}{7}\right)$

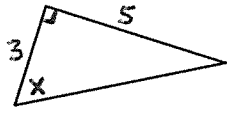
$x = 31.0°$

5. 

$\cos(45) = \frac{x}{3\sqrt{2}}$

$x = 3\sqrt{2}\cos(45)$

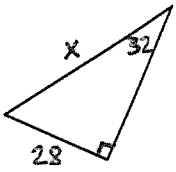
$x = 3$

6. 

$\tan(x) = \frac{5}{3}$

$x = \tan^{-1}\left(\frac{5}{3}\right)$

$x = 59.0°$

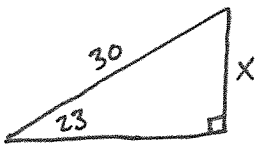
7. 

$\sin(32) = \frac{28}{x}$

$x = \frac{28}{\sin(32)}$

$x = 52.8$

8. A 30 foot long ramp make an angle of 23 degrees with the ground. How high above the ground is the end of the ramp?

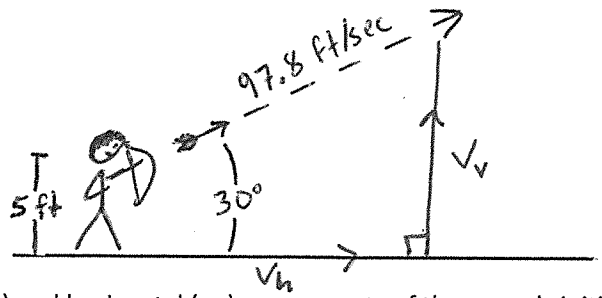


$\sin(23) = \frac{x}{30}$

$x = 30\sin(23)$

$x = 11.7$ ft

Use the picture below to answer questions 9 – 14.



9. What are the vertical (v_v) and horizontal (v_h) components of the arrow's initial velocity?

$V_v = 97.8\sin(30) =$ **48.9 ft/sec** $\quad V_h = 97.8\cos(30) =$ **84.7 ft/sec**

10. Write an equation that relates the height of the arrow in feet, h, to the time since the arrow was fired in seconds, t.

$$h = -16t^2 + 48.9t + 5$$

11. Write an equation that relates the horizontal distance of the arrow from the shooter in feet, d, to the time since the arrow was fired in seconds, t.

$$d = 84.7t$$

12. The shooter is aiming at a circular target that is 260 feet away. How long will it take for the arrow to reach the target?

$260 = 84.7t \quad$ **$t = 3.07$ seconds**

13. The bottom of the target is 3 feet above the ground, and the diameter of the target is 2 feet. Will the arrow hit the target assuming it isn't aimed too far left or right?

$h = -16(3.07)^2 + 48.9(3.07) + 5 = 4.3$ ft

Yes, because $3 < 4.3 < 5$.

14. At its highest point, what is the arrow's acceleration, vertical velocity, horizontal velocity, and overall velocity?

acceleration: -32 ft/sec^2

vertical velocity: 0 ft/sec

horizontal velocity: 84.7 ft/sec

overall velocity: 84.7 ft/sec

16. a) In order to escape a bunch of bandits, you have to run and jump over a river of lava. If your vertical velocity as you leave the ground is 18 feet per second, how long will you be in the air before coming back down to ground-level?

$0 = -16t^2 + 18t$

$0 = -t(16t - 18)$

$16t - 18 = 0$

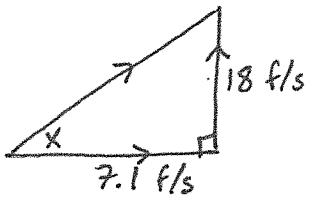
$t = 1.125$ seconds

b) The river of lava is 8 feet wide. What is the largest angle your trajectory could make with the ground in order to guarantee that you make it across safely?

$d = v_h t$

$8 = v_h(1.125)$

$v_h = 7.1$ ft/sec

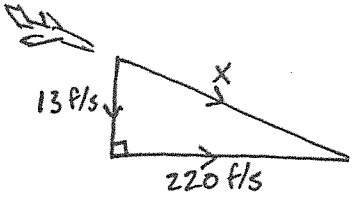


$\tan(x) = \frac{18}{7.1}$

$x = \tan^{-1}\left(\frac{18}{7.1}\right)$

$x = 68.5°$

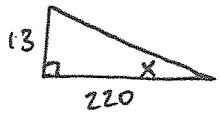
17. a) A plane is coming in for a landing with a downward vertical velocity of 13 feet/second, and a horizontal velocity of 220 feet/second. What is the plane's actual velocity?



$13^2 + 220^2 = x^2$

$x = \sqrt{13^2 + 220^2} = 220.4$ ft/sec

b) What angle does the plane's trajectory make with the ground?



$\tan(x) = \frac{13}{220}$

$x = \tan^{-1}\left(\frac{13}{220}\right) = 3.38°$

Something to think about: Try using a scientific calculator to solve for x in the equation $\sin(x) = \frac{11}{5}$. What does your calculator say? Why do you think it says this? (Drawing a picture may help.)

Think, think, think!