ABRHS PHYSICS (H)

NAME: KEY

~Test: *Projectiles*

2011

Equations and Constants:

$\bar{v} = \frac{\Delta x}{\Delta t}$ $\quad v = \frac{dx}{dt}$ $\quad \bar{a} = \frac{\Delta v}{\Delta t}$ $\quad a = \frac{dv}{dt}$ $\quad \bar{v} = \frac{1}{2}(v_i + v_f)$ $\quad |g| = 10\ m/s^2$

$x = \frac{1}{2}at^2 + v_i t + x_i$ $\quad v = at + v_i$ $\quad v_f^2 = v_i^2 + 2a\Delta x$ $\quad R = \frac{v^2 \sin 2\theta}{g}$ $\quad a_c = \frac{v^2}{r}$

$2\sin\theta\cos\theta = \sin 2\theta$

Multiple Choice: *Choose the letter of the best answer. 3 points each.*

Questions 1 to 5 refer to the following:
A projectile is launched from the ground with an initial velocity of 30i + 40j m/s across a level field.

1. C While in the air, what is its slowest speed?
a. 50 m/s. b. 40 m/s. c. 30 m/s. d. 10 m/s. e. 0 m/s.

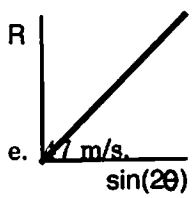
2. D How many seconds was it in the air?
a. 4 s. b. 5 s. c. 6 s. d. 8 s. e. 10 s.

3. D What was the acceleration, in m/s^2, of the projectile at its maximum height?
a. 10i + 0j. b. 0i + 10j. c. –10i + 0j. d. 0i – 10j. e. 10i + 10j.

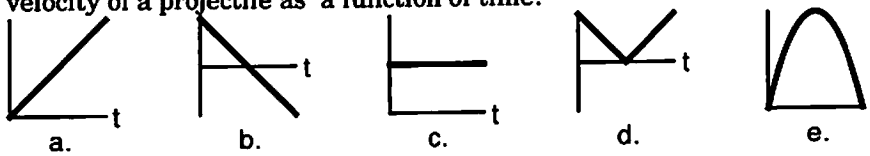
3. A Which of the following initial velocities would let a second projectile land in the same spot as the first (assuming it was fired from the same initial position)?
a. 40i + 30j. b. –30i + 40j. c. –30i – 40j. d. 40i – 30j. e. 30i – 40j.

5. E Assuming the initial speed of the projectile remains the same, what is the maximum distance across the field the projectile could be launched?
a. 90 m. b. 160 m. c. 200 m. d. 240 m. e. 250 m.

6. D A projectile is fired from the ground across a level field with the same initial speed but a variety of different angles. The range of the projectile is measured in each case. The data is then used to make the graph at the right. If the slope of the line is 22.5, what was the initial speed of the projectile? (Standard SI units.)
a. 1.5 m/s. b. 4.7 m/s. c. 6.7 m/s. d. 15 m/s. e. 47 m/s.



7. B Which of the following graphs would best represent the vertical velocity of a projectile as a function of time?



a. b. c. d. e.

8. C A bullet is fired horizontally across a level field. At the instant the bullet leaves the gun, a second bullet is dropped from the same initial height. Which bullet hits the ground first?
a. The one fired from the gun because it is going so much faster.
b. The one just dropped because it has less distance to fall.
c. Don't be stupid, they hit the ground at the same time.
d. Can't tell because it depends on how fast the gun fires the bullet.

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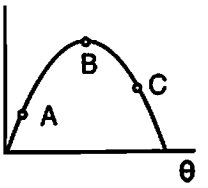
9. B A projectile is launched across a level field, and the resulting range vs initial angle graph is shown to the right. Rank the three lettered points on the plot according to the total flight time. Long to Small



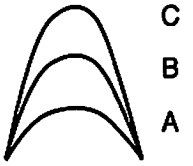
a. ABC b. CBA c. BCA
d. ACB e. can't tell

10. A Two projectiles are fired from the same spot across a level field. The first is fired with an initial velocity of 15 m/s at an angle of 30° above the horizontal, the second is fired with an initial velocity of 15 m/s at an angle of 60° above the horizontal. Which of the following statements are true?

I. They land in the same place. ✓
II. They are in the air the same time. ✗
III. They have the same maximum height. ✗

a. I only. b. II only. c. III only. d. I & II only. e. I, II & III.

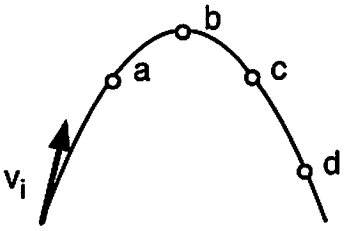
Questions 11 and 12 refer the following:
Three projectiles are fired across level ground; their paths in the air are shown to the right.



11. C Which projectile was in air the longest?
a. A. b. B. c. C.
d. All the same. e. impossible to tell.

12. A Which projectile was the fastest at its maximum height?
a. A. b. B. c. C.
d. All the same. e. impossible to tell.

Questions 13 and 14 refer to the following:
The path of a projectile is shown, along with the projectile's position at a few points along the path. Point b is the maximum. Points a and c are at the same height. The initial velocity vector is also shown.



13. A Which of the following vectors would best represent the direction of the acceleration of the projectile when it is at point c?

a. ↓ b. → c. ↘ d. ↖ e. None of these.

14. D For the positions marked, at which point is the projectile going the fastest?
a. a. b. b. c. c. d. d. e. Can't tell.

Problem Solving: *Show all work. 10 points each.*

15. A car shoots horizontally off a cliff that is 56 meters high. It lands 62 meters away from the edge of the cliff. What was the initial speed of the car?

$56 = \frac{1}{2}(10)t^2$

$t^2 = 11.2$

$t = 3.35$

$X = v_x t$

$62 = v_x (3.35)$

$v_x = 18.5$ m/s

-19.6 m/s²

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16. Some students doing a lab shoot a marble across their lab table. The initial angle of the shot was 40° and the marble landed 85 cm away from the launch point. The marble also landed at the same height from which it was launched. They then launched the marble off the edge of the lab table. If the initial height of the marble was 1.1 m, how far away (horizontally) from the edge of the table did the marble land?

$v_x = 2.94 \cos 40 = 2.25$ m/s

$v_{yi} = 2.94 \sin 40 = 1.89$ m/s

$.85 = \frac{v^2 \sin(2.40)}{10}$

$v^2 = 8.63$

$v = 2.94$

$0 = \frac{1}{2}(-10)t^2 + (1.89)t + 1.1$

$t = \frac{-1.89 \pm \sqrt{(1.89)^2 - 4(-5)(1.1)}}{2(-5)} = \frac{-1.89 \pm 5.06}{-10}$

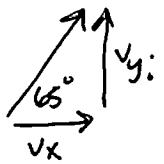
$= .695$

$X = (2.25)(.695)$

$= 1.56$ m

17. A projectile is fired from the ground with an initial angle of 65°. It hits the side of a building that is 17 meters away 2.3 seconds after it was launched. How high up the building did the projectile hit?

so $v_x = \frac{x}{t} = \frac{17}{2.3} = 7.39$ m/s



$v_{yi} = v_x \tan\theta$

$= (7.39)(\tan 65)$

$= 15.9$ m/s

$y = \frac{1}{2}(-10)(2.3)^2 + (15.9)(2.3)$

$y = 10$ m

18. If a projectile is launched from the ground with an initial angle of θ, show that the maximum height, H, of the projectile is given by the expression $H = \frac{1}{4}\tan\theta$. $\frac{H}{R} = ?$

t to top:

$0 = -gt + v\sin\theta$

$t = \frac{v\sin\theta}{g}$

$H = \frac{1}{2}gt^2 = \frac{1}{2}g\left(\frac{v\sin\theta}{g}\right)^2 = \frac{v^2\sin^2\theta}{2g}$

$\frac{1}{2}R = v_x t = v\cos\theta\left(\frac{v\sin\theta}{g}\right)$

$R = \frac{v^2 2\sin\theta\cos\theta}{g}$

So $\frac{H}{R} = \frac{\frac{v^2\sin^2\theta}{2g}}{\frac{v^2 2\sin\theta\cos\theta}{g}} = \frac{1}{4}\tan\theta$

Don't solve for g!

Never do $v = \sqrt{v^2\cos^2\theta + v^2\sin^2\theta}$

Don't use pleasantner in solution

side 3