

Arts & Science 2D06

Quiz #1 2017 Sept 22

Name: *Solutions*

NB: Mark values are given in brackets [ ] beside each problem. Write all your answers on the quiz paper. No books or notes allowed. Time to write quiz: 50 minutes.

Constant velocity:  $x = x_0 + vt$

Uniform acceleration:  $x = x_0 + v_0t + \frac{1}{2}at^2$   $v^2 = v_0^2 + 2a(x - x_0)$   $v = v_0 + at$

1. [3] Immediately after a projectile is launched horizontally, the vertical component of its velocity

(Choose one statement; *explain/derive* your choice in the space below; ignore air resistance.)

- (~~→~~) (a) is zero.  
(b) remains a non-zero constant.  
→ (c) continuously increases.  
(d) continuously decreases.  
(e) any of the above, depending on the position.

Assume  $y$ -direction is downward.

Since the projectile was launched horizontally,

at  $t=0$ ,  $v_{0y} = 0$ .

From then on,  $v_y$  increases according to

$$v_y = \cancel{v_{0y}}^0 + gt = gt.$$

∴ (c) is correct (but (a) was also accepted).

2. [4] A ball is thrown straight up, reaches a maximum height, and then falls back to its initial height. Which of these statements is correct for the upward motion of the ball?

(Choose one statement; explain/derive your choice in the space below; ignore air resistance.)

- (a) Both its velocity and its acceleration point upward.
- (b) Its velocity points upward and its acceleration points downward.
- (c) Its velocity points downward and its acceleration points upward.
- (d) Both its velocity and its acceleration points downward.
- (e) Neither velocity nor acceleration can be determined without additional information.

• On the way up:  $\Delta y$  points upward → velocity points upward

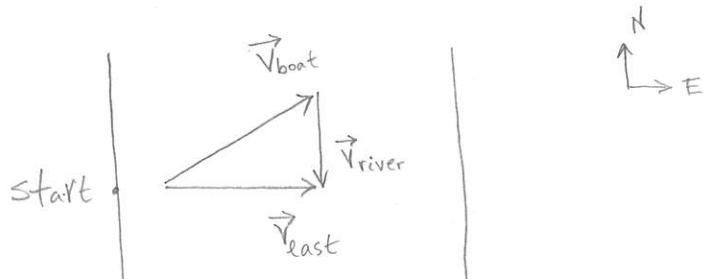
Also, the motion is "free fall"

∴ the acceleration points downward.

3. [3] Suppose that you are trying to cross a river that flows due south with a strong current. You start out in your motorboat on the west bank, and want to reach the east bank directly east from your starting point. To accomplish this, you should head your motorboat

(Choose one statement; no explanation/derivation required; ignore air resistance.)

- (a) due east.
- (b) due north.
- (c) due south.
- (d) in a southeasterly direction.
- (e) in a northeasterly direction.



4. [5] Suppose that the path traveled by a car is given by  $x = 2.4t^2 - 4.3t^3$ . Find the time(s) at which the car's velocity is zero.

$$x = 2.4t^2 - 4.3t^3$$

• Velocity  $V = \frac{dx}{dt} = 4.8t - 12.9t^2 = 0$

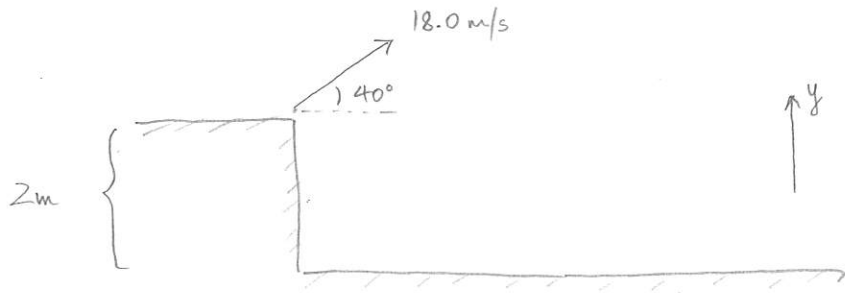
$$\Rightarrow t(4.8 - 12.9t) = 0$$

$$\therefore \underline{t = 0}$$

and

$$4.8 - 12.9t = 0 \Rightarrow \underline{t = 0.37 \text{ second.}}$$

5. [5] A ball is thrown at an angle of  $40.0^\circ$  above the horizontal, across level ground. Furthermore, it is released from a height of  $2.00\text{ m}$  above the ground with a speed of  $18.0\text{ m/s}$ . What is the maximum height above the ground that the ball will reach?



@ maximum height:  $V_y = 0$

- in  $y$ -direction: constant acceleration (free fall)

$$\text{Use } V_y^2 = V_{0y}^2 + 2a\Delta y$$

$$0 = (18 \sin 40^\circ)^2 - 2(9.81)\Delta y$$

$$19.6 \Delta y = 133.9$$

$$\Delta y = 6.83\text{ m}$$

$\therefore$  height above ground:

$$\underline{h = 2\text{ m} + 6.83\text{ m} = 8.83\text{ m}}$$

[20] total marks