Physics 2A
Fall 2024

ave. = 5.5
σ = 2.6

Name Answer Key

Lab: early or late (circle one)

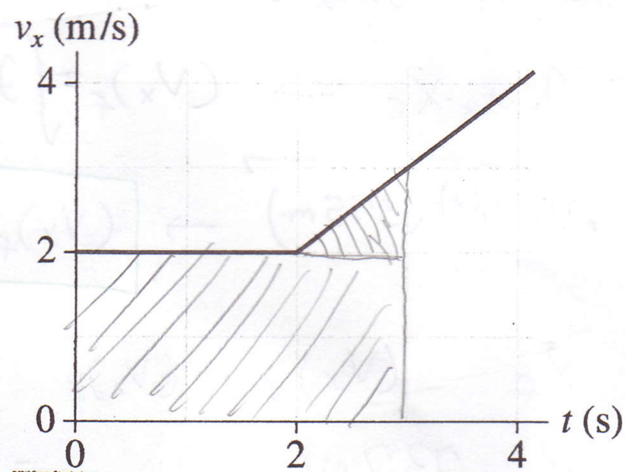
Quiz #2: Motion in One Dimension

Problem 1 (2 points)
A rock is thrown vertically upward from the surface of the earth. The rock rises to some maximum height and then falls back towards the surface of the earth. Which of the following statements is true?

E

a) As the ball rises, its acceleration vector points upward. → acceleration due to gravity always points down
b) The acceleration of the ball is zero when the ball is at its highest point. → $a_y = -9.80 \, m/s^2$
c) The speed of the ball is negative while the ball falls back toward the earth. → speed is never < 0
d) The velocity and acceleration of the ball always point in the same direction. → on way up $\vec{v}$ points up and $\vec{a}$ points down
e) None of the above.

Problem 2 (3 points)
The velocity-versus-time graph for an object moving along an x-axis is shown below. The initial position of the object at t = 0 s is $x_i = -10.0$ m.



What are the position, velocity, and acceleration of the object at t = 3 s? You must show all of your work to get full credit.

area under curve $= \Delta X = X_f - X_i \rightarrow X_f = X_i +$ area under curve between $t = 0$ & $t = 3s$

$$X_f = -10.0m + [(3s)(2m/s) + \tfrac{1}{2}(1s)(1m/s)]$$

$$X_f = -10.0m + 6.5m \rightarrow \boxed{X_f = -3.5\,m}$$

$\boxed{V_x = 3\,m/s}$ (read right from graph)

$$a_x = \frac{\Delta V_x}{\Delta t} = \frac{4m/s - 2m/s}{4s - 2s} \rightarrow \boxed{a_x = 1\,m/s^2}$$

Problem 3 (5 points)
Starting from rest, a race car accelerates at +7.25 m/s^2 for a distance of 375 m. The driver then hits the brakes and the race car slows down at a rate of –3.50 m/s^2. **(a)** How long does it take for the race car to come to rest once the brakes are applied? (b) How far does the car travel once the brakes are applied?

Part 1 → car accelerates at +7.25 m/s^2
Part 2 → car slows down at −3.50 m/s^2

Part 1

x_i	x_f	$(v_x)_i$	$(v_x)_f$	a_x	Δt
0	375m	0m/s	?	7.25m/s^2	?

$$(v_x)_f^2 = \underbrace{(v_x)_i^2}_{=0} + 2a_x(x_f - \underbrace{x_i}_{=0})$$

$$(v_x)_f^2 = 2a_x x_f \rightarrow (v_x)_f = \sqrt{2a_x x_f}$$

$$(v_x)_f = \sqrt{2(7.25\,m/s^2)(375m)} \rightarrow \boxed{(v_x)_f = 73.7\,m/s}$$

Part 2

x_i	x_f	$(v_x)_i$	$(v_x)_f$	a_x	Δt
0m	?	73.7m/s	0m/s	-3.50m/s^2	?

$$\underbrace{(v_x)_f}_{=0} = (v_x)_i + a_x \Delta t \rightarrow \Delta t = \frac{-(v_x)_i}{a_x} = \frac{-(73.7\,m/s)}{-3.50\,m/s^2}$$

$$\Delta t = 21.06s \rightarrow \boxed{\Delta t = 21.1s}$$

$$x_f - \underbrace{x_i}_{=0} = (v_x)_i \Delta t + \tfrac{1}{2}a_x(\Delta t)^2$$

$$x_f = (73.7\,m/s)(21.1s) + \tfrac{1}{2}(-3.50\,m/s^2)(21.1s)^2$$

$$\boxed{x_f = 776\,m}$$