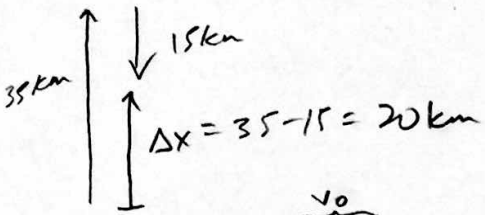
Name: STANFORD Date:_____ Block:_____

NV College Physics quiz - Chapter 2 part 1

Show all your work and circle or box your answer for full credit.

Part 1: Short-Answer (60 points)

1) A cyclist rides northward for 35km in 2.5h. They then turn around and ride south for 15km in 1.5h. What is their average velocity (in km/h) for the trip?



$$v_{avg} = \frac{\Delta x}{t} = \frac{20\,km}{(2.5+1.5)h} = \boxed{5\,km/h \text{ North}}$$

2) A car traveling at +40m/s slows to a velocity of +25m/s in 5s. What is the acceleration of the car?

$$a_{avg} = \frac{\Delta v}{\Delta t} = \frac{25-40}{5} = \boxed{-3\,m/s^2}$$

3) A train traveling eastward along a straight track with an initial velocity of 12m/s accelerates at 1.5m/s^2 for 6s as it goes down a hill. What it its velocity at the bottom of the hill where it stops accelerating?

$v_0 = 12\,m/s$
$a = 1.5\,m/s^2$
$t = 6\,s$

$$v = v_0 + at$$
$$v = 12 + (1.5)(6) = \boxed{21\,m/s \text{ East}}$$

4) Top-Fuel drag racers typically accelerate at about 36m/s^2. If such a vehicle starts from rest, how far will it travel in the first 3s of motion?

$v_0 = 0$
$a = 36\,m/s^2$
$t = 3s$

$$\Delta x = v_0 t + \frac{1}{2}at^2$$
$$\Delta x = \frac{1}{2}(36)(3^2) = \boxed{162\,m}$$

5) A train emerges from a station at 10m/s and accelerates with constant acceleration to 40m/s over a distance of 600m. How much time does it take to reach its final speed?

$v_0 = 10\,m/s$
$v = 40\,m/s$
$\Delta x = 600\,m$
$t = ?$

$$\Delta x = \frac{1}{2}(v_0 + v)t$$
$$t = \frac{2(\Delta x)}{v_0 + v} = \frac{2(600)}{10+40} = \boxed{24\,s}$$

6) Drag-racers deploy chutes to slow their cars down at the end of a race. These chutes can slow the vehicle at an average of about 50m/s^2. If the initial velocity of the car is 120m/s, how far will it travel before coming to rest?

$v_0 = 120\,m/s$
$v = 0\,m/s$
$a = -50\,m/s^2$
$\Delta x = ?$

$$v^2 = v_0^2 + 2a(\Delta x)$$
$$\Delta x = \frac{v^2 - v_0^2}{2a} = \frac{0 - 120^2}{2(-50)} = \boxed{144\,m}$$

Part 2: Problem-solving (40 points)

1) A speeder is traveling at 40m/s when he sees a police car directly ahead. The instant he sees the policeman, he slows to a speed of 20m/s in a time of 4s. He then travels the remaining distance at a constant speed of 20m/s for another 5s at which point he passes the police car. He then accelerates at 3m/s^2 for 6s. How far does the speeder travel in the entire 15s?

Stage 1 (slowing down)

$v_0 = 40$m/s → $v = 20$m/s, $t = 4$s

Equation ①:

$\Delta x_1 = \frac{1}{2}(v_0 + v)t$

$\Delta x_1 = \frac{1}{2}(40 + 20)(4)$

$\Delta x_1 = 120$m

Stage 2 (const. speed)

$v_0 = 20$m/s → $v = 20$m/s, $t = 5$s

Equation ③: ($a = 0$)

$\Delta x_2 = v_0 t + \frac{1}{2}at^2$

$\Delta x_2 = (20)(5)$

$\Delta x_2 = 100$m

Stage 3 (speeding up)

$v_0 = 20$m/s, $a = 3$m/s^2, $t = 6$s

Equation ③:

$\Delta x_3 = v_0 t + \frac{1}{2}at^2$

$\Delta x_3 = 20(6) + \frac{1}{2}(3)(6^2) = 174$m

$\Delta x_{TOTAL} = 120 + 100 + 174 = 394$m

2. A bus passes its stop at a constant speed of 6m/s. Three seconds later, a commuter waiting at the bus stop starts to run after it.

a) If the owner accelerates from rest at 1.5m/s^2 How long before the commuter catches the bus?

b)How far down the road will the commuter catch the bus?

Given:

$v_b = 6$ m/s

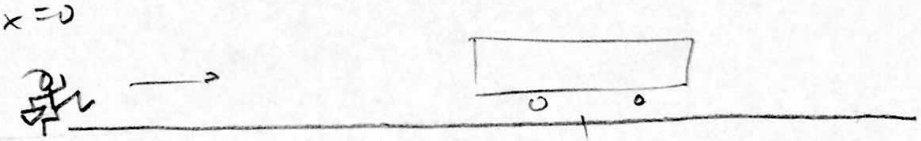
$v_{c0} = 0$

$a_c = 1.5$ m/s^2

Set $t = 0$ when commuter starts running

$x_{b0} = 18$m

$a_b = 0$



$v_{b0} = 6$ m/s

$a_c = 1.5$ m/s^2

$x_{b0} = 18$m

For commuter:

$\Delta x_c = v_0 t + \frac{1}{2}at^2$ ($v_0 = 0$)

$\Delta x_c = \frac{1}{2}(1.5)t^2 = \frac{3}{4}t^2$

$x_c - x_{c0} = \frac{3}{4}t^2$ ($x_{c0} = 0$)

For bus:

$\Delta x_b = v_{b0} t + \frac{1}{2}a_b t^2$ ($a_b = 0$)

$\Delta x_b = 6t$

$x_b - x_{b0} = 6t$

$x_b - 18 = 6t$, $x_b = 6t + 18$

$x_c = x_b$

$\frac{3}{4}t^2 = 6t + 18$ or $t^2 - 8t - 24 = 0$

use quad. formula

$t = 10.3$s or $t = -2.32$s

$x_c = \frac{3}{4}t^2 = \frac{3}{4}(10.3)^2 =$ 79.6m