Physics 10154 - Exam #1c

Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. (30 pts) A car drives in a straight line, due East, with a constant speed of 72 miles/hour. During the trip, the driver makes a 28 minute rest stop. The average velocity for the entire trip, including the rest stop, is 57 miles/hour. What is the total distance covered during the trip, in miles?

Part 1	Part 2	Total
$\Delta x_1 = ?$	$\Delta x_2 = 0$	$\Delta x_T = ?$
$t_1 = ?$	$t_2 = 0.467\ hr$	$t_T = ?$
$V_1 = 72\ mi/hr$	$V_2 = 0$	$V_T = 57\ mi/hr$

$$V_T = \frac{\Delta x_1 + \Delta x_2}{t_1 + t_2}$$

$$= \frac{V_1 t_1 + 0}{t_1 + t_2}$$

$$57 = \frac{72\, t_1}{t_1 + .467} \quad \therefore$$

$$57 t_1 + 26.6 = 72 t_1$$

$$26.6 = 15 t_1 \qquad t_1 = 1.77\ hr$$

$$\Delta x_T = V_1 t_1 = (72)(1.77) = \boxed{130\ miles}$$

2. (30 pts) A parachutist is descending at a constant speed of 16 miles/hour. She drops her camera, which hits the ground 4.0 seconds after it is dropped.

From what altitude (in meters) was the camera dropped, and with what speed (in meters/sec) does the camera hit the ground?

Assume down is positive

$\Delta y = ?$

$v_0 = 16 \frac{mi}{hr} = 7.15 \frac{m}{s}$

$v = ?$

$a = 9.8 \frac{m}{s^2}$

$t = 4.0 s$

$\Delta y = (7.15)(4) + \frac{1}{2}(9.8)(4)^2$

$= 107 m$ or $\boxed{110 m}$

$v = v_0 + at$

$= 7.15 + (9.8)(4) = \boxed{46 \frac{m}{s}}$

3. (40 pts) A rocket starts from rest at ground level and accelerates at a rate of 25 m/s² for 3.0 seconds while travelling in a straight line 65° above the horizontal. It then travels in free fall until hitting the ground.

a) What maximum height above ground level does the rocket reach?

b) What is the rocket's speed at maximum height?

c) How far does the rocket travel before landing, in horizontal distance, from the launch point?

Part 1

$\Delta s = ?$
$v_0 = 0$
$v = ?$
$a = 25$
$t = 3$

$\Delta s = (0)(3) + \frac{1}{2}(25)(3)^2 = 112.5$

$v = (0) + (25)(3) = 75$

$\Delta x_1 = \Delta s \cos 65° = 47.54$

$\Delta y_1 = \Delta s \sin 65° = 101.96$

$v_x = 75 \cos 65° = 31.7$

$v_y = 75 \sin 65° = 68.0$

Part 2 (to max height)

$\Delta y = ?$
$v_{0y} = 68.0$
$v_y = 0$
$a_y = -9.8$
$t = ?$

$0^2 = (68)^2 + 2(-9.8)\Delta y$

$\Delta y = 235.7$

$\Delta y_{TOT} = 235.7 + 101.96 = \boxed{340 \text{ m}}$

At max height $v = v_x = 31.7$ m/s or $\boxed{32 \text{ m/s}}$

Part 3 (total time in free fall)

$\Delta y = -102$
$v_{0y} = 68$
$v_y = ?$
$a_y = -9.8$
$t = ?$

$-102 = 68t - 4.9t^2$

$4.9t^2 - 68t - 102 = 0$

$t = \dfrac{68 \pm \sqrt{(-68)^2 - 4(4.9)(-102)}}{9.8}$

$= 6.94 \pm 8.30$

$= 15.2 \text{ s}$

$\Delta x = v_x t$

$= (31.7)(15.2)$

$= 483.2$

$\Delta x_T = 483.2 + 47.5$

$= \boxed{530 \text{ m}}$

Alternate solution to part c

To max height

$\Delta x = v_{0x} t$

$v_y = v_{0y} + at$

$0 = 68 - 9.8t \Rightarrow t = 6.94\ s$

$\Delta x = (31.7)(6.94) = 220\ m$

On way down from max height:

$\Delta y = -340$

$v_{0y} = 0$

$v_y = ?$

$a_y = -9.8$

$t = ?$

$-340 = (0)t - 4.9t^2$

$t = \sqrt{\frac{340}{4.9}} = 8.3$

$\Delta x = v_{0x} t$

$= (31.7)(8.3) = 264\ m$

$\Delta x_{TOT} = 47.54 + 220 + 264 = \boxed{530\ m}$