Calculus I
UNIT 5: Integration – SECTION 12 WORKSHEET

Name: ______________________
Date: ______________________

DEFINITE INTEGRAL APPLICATIONS (TOTAL CHANGE THEOREM)

Describe in a complete sentence each of the following scenarios presented.

1. If F(*t*) describes the rate of temperature change in $°F$ per hour, what does $\int_0^{24} F(t)dt$ represent?

The total change in the ~~[illegible]~~ temperature in degrees from (0-24hrs (1 day)

2. If water drains from a reservoir at a rate of W(*t*) gallons per minute, what does $\int_0^{60} W(t)dt$ represent?

The total change ~~[illegible]~~ of water leaving the reservoir in gallons from (0 – 60) minutes (1hr)

Solve each of the following applied scenarios described using the total change theorem. Be sure to show all work involved in this calculation. You may use your calculator to check your solution.

3. Gasoline is being pumped into a storage tank at a rate of $G(t) = 100 + 2t$ gallons/day, where $0 \le t \le 7$. Find the amount of gasoline that is pumped into the tank during:

a) the first 2 days

$\int_0^2 (100+2t)dt = 100t + t^2 \Big|_0^2$

$\boxed{204 \text{ gallons}}$

b) the first week

$\int_0^7 (100+2t)dt = 100t + 2t \Big|_0^7$

$\boxed{749 \text{ gallons}}$

4. A population starts with 10000 fruit flies and decreases at a rate of $f(t) = t^2 + t - 2$ fruitflies per day due to changes in the climate. Determine the population of fruit flies by:

a) the end of the first week

$\int_0^7 (t^2+t-2)dt = \frac{1}{3}t^3 + \frac{1}{2}t^2 - 2t \Big|_0^7$

$10{,}000 - 124.833 = \boxed{9875.167 \text{ flies}}$

b) the end of the month (30 days)

$\int_0^{30} (t^2+t-2)dt = \frac{1}{3}t^3 + \frac{1}{2}t^2 - 2t \Big|_0^{30}$

$10{,}000 - 9390 = \boxed{610 \text{ flies}}$

5. A projectile moves according to:

$v(t) = -9.8t + 19.6$ during $0 \le t \le 5$, where $v(t)$ is measured in meters/sec.

$-9.8t + 19.6 = 0$

$t = 2$

+ −

0 2 5

a. Determine when the particle is moving up, down and is not moving.

UP: (0,2) / Down: (2,5) / Not Moving @ t=2

b. Find the particle's displacement over the given time interval.

$\int_0^5 (-9.8t+19.6)dt = \boxed{-24.5 \text{ meters}}$

c. Find the total distance traveled by the particle over the interval [0,5].

$\int_0^5 |-9.8t+19.6|dt = \boxed{63.7 \text{ meters}}$

d. If the initial position of the projectile is at 10 meters, find the projectile's position at t = 5.

$h(t) = \int (-9.8t+19.6)dt$

$h(t) = -4.9t^2 + 19.6t + C$

$h(t) = -4.9t^2 + 19.6t + 10$

$\boxed{h(5) = -14.5 \text{ meters}}$