AP Calculus AB
4.5 - Group Assignment – FR Questions on FTC

*Questions marked * are Non-Calculator.*

*1. The table below shows the speedometer readings of a car at several time intervals over $0 \le t \le 5$ hours.

t (hr)	0	1	2	3	4	5
$v(t)$ (miles/hr)	10	40	50	30	80	70

Estimate the value of $\int_0^5 v(t)\,dt$ using:

a. Five trapezoids
b. MRAM, N=5

Use correct units for the answers and interpret your answers.

2. The rate at which people enter a park on a given day is modeled by the function, $E(t) = \dfrac{15600}{t^2 - 24t + 160}$. The rate at which people leave the same park on the same day is modeled by the function, $L(t) = \dfrac{9890}{t^2 - 38t + 370}$. Both $E(t)$ and $L(t)$ are measured in people per hour, and time *t* is measured in hours after midnight. These functions are valid for $9 \le t \le 23$, the hours during which the park is open. At time, $t = 9$, there are no people in the park.

a. How many people have entered the park by 5:00pm (t=17)? Round your answer to the nearest whole number.
b. The price of admission to the park is $15 until 5:00pm (t=17). After 5:00pm the price of admission is $11. How much money is collected from admissions to the park on the given day?
c. Let $H(t) = \int_9^t E(x) - L(x)\,dx$ for $9 \le t \le 23$. Explain the meaning of $H(17) = 3725$.
d. Determine the value of $H'(17)$ and interpret the meaning of your answer.
e. At what time(s) over $9 \le t \le 23$ are there maximum people in the park?

3. A particle moves along the y-axis so that its velocity v at time $t \ge 0$ is given by $v(t) = 1 - \tan^{-1}(e^t)$.

At time $t = 0$, the particle is at $y = -1$. (Note: $\tan^{-1} x = \arctan x$)

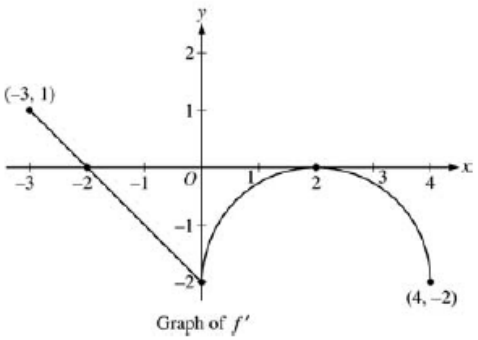
(a) Find the acceleration of the particle at time $t = 2$.

(b) Is the speed of the particle increasing or decreasing at time $t = 2$? Give a reason for your answer.

(c) Find the time $t \ge 0$ at which the particle reaches its highest point. Justify your answer.

(d) Find the position of the particle at time $t = 2$. Is the particle moving toward the origin or away from the origin at time $t = 2$? Justify your answer.

*4. Let f be a function defined on the closed interval $-3 \le x \le 4$ with $f(0) = 3$. The graph of f', the derivative of f, consists of one line segment and a semicircle, as shown above.



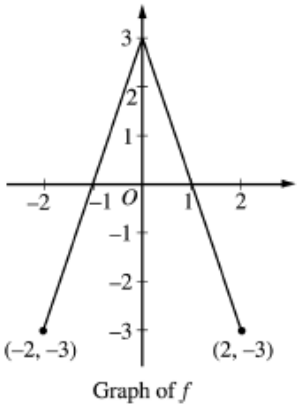
(a) On what intervals, if any, is f increasing? Justify your answer.

(b) Find the x-coordinate of each point of inflection of the graph of f on the open interval $-3 < x < 4$. Justify your answer.

(c) Find an equation for the line tangent to the graph of f at the point $(0,3)$.

(d) Find $f(-3)$ and $f(4)$. Show the work that leads to your answers.

*5. The graph of the function f shown above consists of two line segments. Let g be the function given by $g(x) = \int_0^x f(t)\,dt$.



(a) Find $g(-1)$, $g'(-1)$, and $g''(-1)$.

(b) For what values of x in the open interval $(-2,2)$ is g increasing? Explain your reasoning.

(c) For what values of x in the open interval $(-2,2)$ is the graph of g concave down? Explain your reasoning.

(d) On the axes provided, sketch the graph of g on the closed interval $[-2,2]$.

6. A tank contains 125 gallons of heating oil at time $t = 0$. During the time interval $0 \le t \le 12$ hours, heating oil is pumped into the tank at the rate

$$H(t) = 2 + \frac{10}{(1 + \ln(t+1))} \text{ gallons per hour.}$$

During the same time interval, heating oil is removed from the tank at the rate

$$R(t) = 12\sin\left(\frac{t^2}{47}\right) \text{ gallons per hour.}$$

(a) How many gallons of heating oil are pumped into the tank during the time interval $0 \le t \le 12$ hours?

(b) Is the level of heating oil in the tank rising or falling at time $t = 6$ hours? Give a reason for your answer.

(c) How many gallons of heating oil are in the tank at time $t = 12$ hours?

(d) At what time t, for $0 \le t \le 12$, is the volume of heating oil in the tank the least? Show the analysis that leads to your conclusion.