AP Calculus Test Review #9 *name*_____*p*___

Calculators allowed (1, 2)

1. (*2002 exam*) The rate at which people enter an amusement park on a given day is modeled by the function *E* defined by

$$E(t)=\frac{15600}{\left(t^2-24t+160\right)}$$

The rate at which people leave the same amusement park on the same day is modeled by the function *L* defined by

$$L(t)=\frac{9890}{\left(t^2-38t+370\right)}$$

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 5:00 P.M. (*t* = 17)? Round your answer to the nearest whole number.

(b) The price of admission to the park is $15 until 5:00 P.M. (*t* = 17). After 5:00 P.M., the price of admission to the park is $11. How many dollars are collected from admissions to the park on the given day? Round your answer to the nearest whole number.

(c) Let $H(t)=\int_9^t\left(E(x)-L(x)\right)dx$ for $9\le t\le 23$. The value of $H(17)$ to the nearest whole number is 3725. Find the value of $H'(17)$, and explain the meaning of $H(17)$ and $H'(17)$ in the context of the amusement park.

(d) At what time *t*, for $9\le t\le 23$, does the model predict that the number of people in the park is a maximum?

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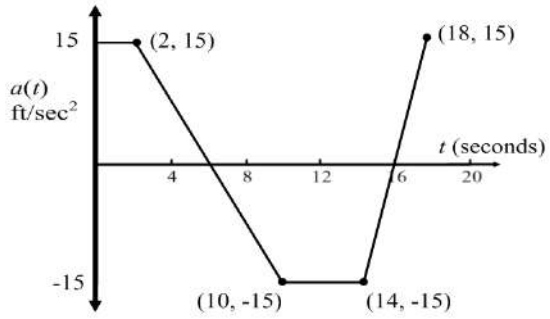
2. (*2001 exam*) A car is traveling on a straight road with velocity 55 ft/sec at time *t* = 0. For $0\le t\le 18$ seconds, the car's acceleration $a(t)$, in ft/sec^2, is the piecewise linear function defined by the graph below.



(a) Is the velocity of the car increasing at *t* = 2 seconds? Why or why not?

(b) At what time in the interval $0\le t\le 18$, other than *t* = 0, is the velocity of the car 55 ft/sec? Why?

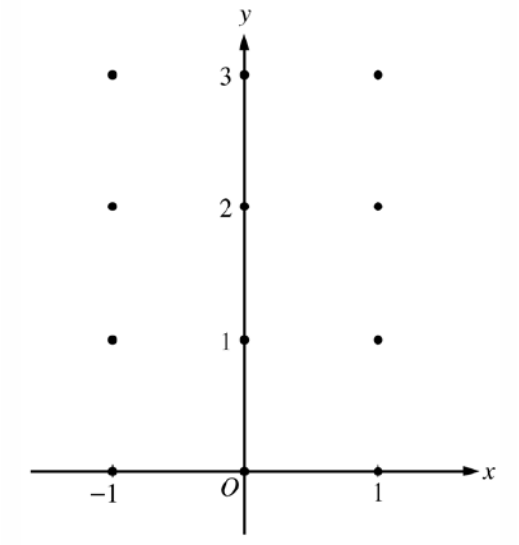
(c) On the time interval $0\le t\le 18$, what is the car's absolute maximum velocity, in ft/sec, and at what time does it occur? Justify your answer.

(d) At what times in the interval $0\le t\le 18$, if any, is the car's velocity equal to zero? Justify your answer.

Calculators are not allowed (3, 4)

3. (*2004 exam*) Consider the differential equation $\frac{dy}{dx} = x^4(y-2)$.

   (a) On the axes provided, sketch a slope field for the given differential equation at the twelve points indicated.



   b) While the slope field in part (a) is drawn at only twelve points, it is defined at every point in the *xy*-plane. Describe all points in the *xy*-plane for which the slopes are negative.

   c) Find the particular solution $y = f(x)$ to the given differential equation with the initial condition $f(0) = 0$.

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4. Let *h* be a function defined for all $x \neq 0$ such that $h(4) = -3$ and the derivative of *h* is given by

$$h'(x) = \frac{x^2 - 4}{x}$$

   (a) Find all values of *x* for which the graph of *h* has a horizontal tangent, and determine whether *h* has a local maximum, a local minimum, or neither at each of these values. Justify your answers.

   (b) On what intervals, if any, is the graph of *h* concave up? Justify your answer.

   (c) Write an equation for the line tangent to the graph of *h* at $x = 8$.

   (d) Does the line tangent to the graph of *h* at $x = 8$ lie above or below the graph of *h* for $x > 8$? Why?