Homework 10

The **due date** for this homework is **Tue 7 May 2013 12:00 AM EDT**.

Question 1

Let $f(x) = -x^2 + 6x - 3$. Find $f'(-2)$.

- 6
- -1
- -3
- 0
- 10
- 4

Question 2

Given the position function $p(t) = 6 + \frac{1}{2}t + 4t^2$ of a particle as a function of time, what is the particle's velocity at $t = 1$?

- $\frac{17}{2}$
- 6
- 8
- 1
- $\frac{9}{2}$
- $\frac{1}{2}$

Question 3

A very rough model of population size P for an ant species is $P(t) = 2\ln(t+2)$, where t is time. What is the rate of change of the population at time $t = 2$?

- $\frac{1}{4}$
- $\frac{1}{3}$
- 1
- 2
- 4
- $\frac{1}{2}$

Question 4

Find $\frac{dV}{dt}$ for $V = \frac{1}{4}\, t^3$.

- $\frac{dV}{dt} = 0$
- $\frac{dV}{dt} = 3t^2$
- $\frac{dV}{dt} = \frac{3}{4}\, t^2$
- $\frac{dV}{dt} = \frac{1}{4}\, t^2$
- $\frac{dV}{dt} = \frac{3}{4}\, t^3$
- $\frac{dV}{dt} = \frac{1}{3}\, t^2$

Question 5

If a car's position is represented by $s(t) = 4t^3$, what is the car's change in velocity from $t = 2$ to $t = 3$?

- 60
- 108
- 76
- 48
- 20
- 12

Question 6

A particle's position, p, as a function of time, t, is represented by $p(t) = \frac{1}{3}t^3 - 3t^2 + 9t$. When is the particle at rest?

- At $t = 1$.
- At $t = 3$.
- At $t = \frac{1}{3}$.
- At $t = 6$.
- At $t = 0$.
- Never.

Question 7

Hooke's law states that the force F exerted by an *ideal* spring displaced a distance x from its equilibrium point is given by $F(x) = -kx$, where the constant k is called the *spring constant* and varies from one spring to another. In real life, many springs are nearly ideal for small displacements; however, for large displacements, they might deviate from what Hooke's law predicts.

Much of the confusion between nearly-ideal and non-ideal springs is clarified by thinking in terms of series: for x near zero, $F(x) = -kx + O(x^2)$.

Suppose you have a spring whose force follows the equation $F(x) = -2\tan 3x$. What is its spring constant?

- 12
- 1
- 0
- 6
- 3
- 2

Question 8

A rock is dropped from the top of a 320-foot building. The height of the rock at time t is given $s(t) = -8t^2 + 320$, where t is measured in seconds. Find the speed (that is, the absolute value of the velocity) of the rock when it hits the ground in feet per second. Round your answer to one decimal place.

Question 9

The profit, P, of a company that manufactures and sells N units of a certain product is modeled by the function

$$P(N) = R(N) - C(N)$$

The revenue function, $R(N) = S \cdot N$, is the selling price S per unit times the number N of units sold. The company's cost, $C(N) = C_0 + C_{\text{op}}(N)$, is a sum of two terms. The first is a constant C_0 describing the initial investment needed to set up production. The other term, $C_{\text{op}}(N)$, varies depending on how many units the company produces, and represents the operating costs.

Companies care not only about profit, but also *marginal profit*, the rate of change of profit with respect to N. Assume that $S = \$50$, $C_0 = \$75,000$, $C_{\text{op}}(N) = \$50\sqrt{N}$, and that the company currently sells $N = 100$ units. Compute the marginal profit at this rate of production. Round your answer to one decimal place.

Question 10

In Economics, *physical capital* represents the buildings or machines used by a business to produce a product. The *marginal product of physical capital* represents the rate of change of output product with respect to physical capital (informally, if you increase the size of your factory a little, how much more product can you create?).

A particular model tells us that the output product Y is given, as a function of capital K, by

$$Y = AK^{\alpha}L^{1-\alpha}$$

where A is a constant, L is units of labor (assumed to be constant), and α is a constant between 0 and 1. Determine the marginal product of physical capital predicted by this model.

- $\dfrac{dY}{dK} = (\alpha - 1)A\left(\dfrac{L}{K}\right)^{\alpha-1}$

- $\frac{dY}{dK} = \alpha A \, \frac{L^{1-\alpha}}{K^{\alpha-1}}$
- $\frac{dY}{dK} = (1-\alpha) A (KL)^{1-\alpha}$
- None of these.
- $\frac{dY}{dK} = \frac{A}{\alpha} \left(\frac{L}{K} \right)^{1-\alpha}$
- $\frac{dY}{dK} = \alpha A K^{\alpha} L^{1-\alpha}$

☐ In accordance with the Honor Code, I certify that my answers here are my own work.

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