This exam is closed book. No graphing calculators or cell phones are allowed. No bathroom breaks are permitted while taking the exam. Good luck!

1 Multiple Choice **(2 points each)**

(1) Find the limit if it exists: $\lim_{x\to 2^+} \dfrac{\sqrt{x+2}-\sqrt{x}}{x-2}$

(A) 0 (B) $\frac{2-\sqrt{2}}{0}$ (C) ∞ (D) $-\infty$

(2) Fill in the blanks: A derivative _____ the _____ change of a function for a given Δx.

(A) equals, horizontal
(B) approximates, horizontal
(C) equals, vertical
(D) approximates, vertical

(3) Suppose that the value V of a machine depreciates with time t (measured in months) at the rate $V(t) = 5 + e^{-0.15t+2}$. Find $\lim_{t\to\infty} V(t)$

(A) 0 (B) 5 (C) 7 (D) 12

(4) Find the average rate of change for $f(x) = \sqrt{2x}$ if x increases from 2 to 18 .

(A) $\frac{1}{4}$ (B) $\frac{1}{3}$ (C) $\frac{-3}{10}$ (D) 2

(5) Find the instantaneous rate of change for $f(x) = \sqrt{2x}$, at $x = 18$.

(A) 6 (B) $\frac{1}{6}$ (C)$\frac{1}{6\sqrt{2}}$ (D) $\frac{1}{2\sqrt{2}}$

(6) A firm faces the profit function $P(x) = -3x^3 + 9x + 9$. At what output level is profit maximized?

(A) $x = 0, \frac{4}{9}$ (B) $x = 1, -1$ (C) $x = \sqrt{3}$ (D) $x = 1$

(7) Suppose the firm in question (6) doubles production, from $x = 1$ to $x = 2$. What is the marginal profit of producing the 2^{nd} unit?

(A) -\$12 (B) \$0 (C) -\$27 (D) \$3

(8) Solve the matrix equation AX = B for $\mathrm{X} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$, where $\mathrm{A} = \begin{bmatrix} 5 & 6 \\ 4 & 5 \end{bmatrix}$ and $\mathrm{B} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$

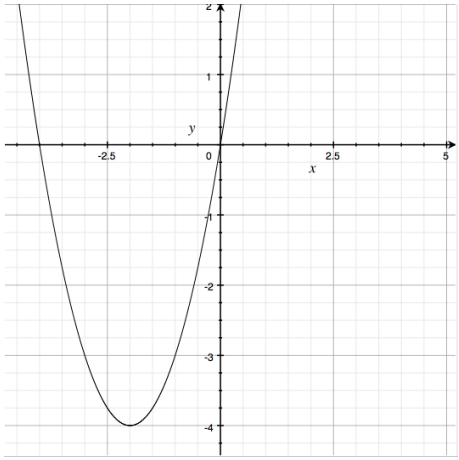
(A) $\begin{bmatrix} -7 \\ 6 \end{bmatrix}$ (B) $\begin{bmatrix} 7 \\ -6 \end{bmatrix}$ (C) $\begin{bmatrix} 5 & -6 \\ -4 & 5 \end{bmatrix}$ (D) $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$

(9) Let $\mathrm{A} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and $\mathrm{B} = \begin{bmatrix} 6 & 1 & 3 \\ 47 & 7 & 1 \\ 1 & 8 & 2 \end{bmatrix}$. Find the product AB if possible.

(A) $\begin{bmatrix} 6 & 1 & 3 \\ 47 & 7 & 1 \\ 1 & 8 & 2 \end{bmatrix}$ (B) $\begin{bmatrix} 6 \\ 47 \\ 1 \end{bmatrix}$ (C) $\begin{bmatrix} 6 & 0 & 0 \\ 0 & 7 & 0 \\ 0 & 0 & 2 \end{bmatrix}$ (D) $\begin{bmatrix} 6 & 1 & 3 \end{bmatrix}$

(10) If $f'(x) = 2x + 4$ and the graph of $f(x)$ is given below, what is $f(x)$?

(A) $f(x) = x^2 + 4x$
(B) $f(x) = 2x^2 + 4x$
(C) $f(x) = \frac{1}{2}x^2 + 4x$
(D) $f(x) = (x-2)^2 - 4$



2 Short Answer **(3 points each)**

Remember: number problems clearly, show all of your work, and circle your final answer.

(11) Is the matrix N $= \begin{bmatrix} -1 & -1 & 1 \\ -2 & -1 & 2 \\ -1 & -1/2 & 3/2 \end{bmatrix}$ the inverse of matrix M $= \begin{bmatrix} 1 & -2 & 2 \\ -2 & 1 & 0 \\ 0 & -1 & 2 \end{bmatrix}$?

(12) Labor and material costs for producing two guitar models are given:

Model	*Labor*	*Material*
A	\$30	\$20
B	\$40	\$30

In week 1, \$1,800 is allocated to labor and \$1,200 to materials. In week 2, \$1,750 and \$1,250 are. Use matrix equations to solve the quantities of each model, a and b, to produce each week.

(13) A new firm lacks a functional model of their revenue. Fortunately, they've hired an analyst (you!) to help them *approximate* the change in their revenue from increasing production by from 55,700 to 56,300 units. Given that their marginal revenue when producing 55,700 units was \$18,000, what is their estimated change in revenue?

(14) (i) Show that the *limit* of the difference quotient for $f(x) = \frac{1}{x}$ is equal to its derivative, $f'(x)$, as found using derivative properties. (HINT: $\lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$)

(ii) Graph $f(x)$, evaluate $f'(2)$, then write the equation of the tangent line at $x = 2$ and graph. (HINT:$y - y_1 = m(x - x_1)$)