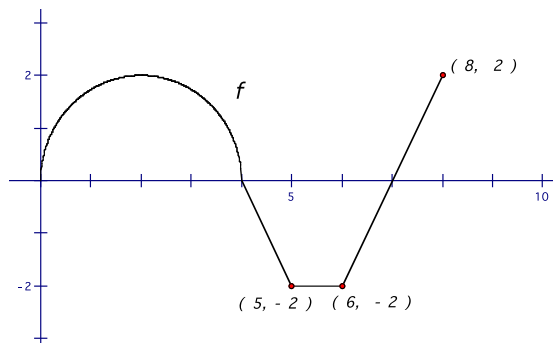*Show and label your work with proper notation. Use complete math sentences. Rationalized, simplified, and factored answers.*

1._____ **1.** The graph below is the function f defined on $[0, 8]$ and consists of 3 line segments and a

semicircle. Use the graph to answer questions (a) – (c), where $g(x) = \int_0^x f(t)\,dt$.

(a) Find g(4), g(7), g'(2), and g" (7).

(b) Find the x-coordinate of any relative extrema of g, if any, on $[0, 8]$ and state whether it is a local maximum or local minimum. Justify your answer.

(c) What is the average rate of change of g on $[0, 7]$?

2. Write the following limit as a definite integral in 2 ways (not the same or opposite limits):

$\lim_{n \to \infty} \sum_{i=1}^{n} \frac{3}{n}\left(\frac{3}{2} + \frac{3i}{n}\right) \cdot 2^{\frac{3}{2} + \frac{3i}{n}}$

Explain your reasoning by finding $f(x)$ and c_i for each of the integrals.

3. _____Find the critical points (x value only) of the function $y = \left(\int_0^x \cos t\, dt\right)^3$.

4. _____Calculate the average value of $f(x) = \cos^2 x \, dx$ on the interval $[\frac{\pi}{6}, \frac{\pi}{4}]$.

5. _____ Evaluate $\int \frac{x^3 + x}{\sqrt{x}} \, dx =$

6. _____ Find $y = \int (\tan 2x + \cot 2x)^2 \, dx$

7. _____ Find $y = \int \frac{2x+21}{4x^2+4x+2} dx$

8. _____ Consider the function $f(x) = \int_1^{2x} \ln(\ln t)\, dt$. It is known that $f'''(a) = 0$. Find a, where $a \in R$.