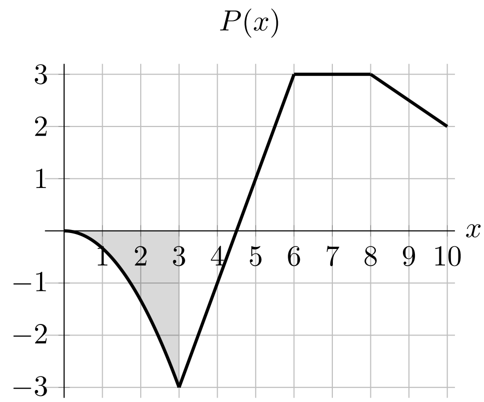
1. [13 points] The function $P(x)$ is defined on the interval $-14 \leq x \leq 14$. The graph of $P(x)$ is shown below for $0 \leq x \leq 10$.



The function $P(x)$ has the following properties:

- it is an even function,
- the shaded region has area equal to 3,
- $P(x)$ is twice differentiable on $(9, 14)$ and P, P', and P'' have the following values

x	10	11	12	13
$P(x)$	2	2.5	3	4
$P'(x)$	-0.5	0.2	-2	1.5
$P''(x)$	0	-0.5	1.7	2.5

In the following questions, your answers must be **exact**. If any of the answers are undefined, write "UND". If there is not enough information to answer a question, write "NEI".

a. [2 points] Find $\lim_{m \to 0} \dfrac{P(m+12) - P(12)}{m}$.

Solution: $P'(12) = -2$ **Answer:** -2

b. [2 points] Let $J(x)$ be an antiderivative of $P(x)$. Find $J'(3)$.

Solution: $J'(3) = P(3) = -3.$ **Answer:** $-3.$

c. [2 points] Let $K(x)$ be an antiderivative of $P(x)$ with $K(8) = -2$. Find $K(0)$.

Solution: $K(8) - K(0) = \int_0^8 P(x)dx$ so $K(0) = -2 - 3 = -5$ **Answer:** $-5.$

d. [3 points] Find $\int_{-3}^{6} (2P(t) + 1)dt$.

Solution: $\int_{-3}^{6} (2P(t) + 1)dt = 2\int_{-3}^{6} P(t)dt + 9 = 2(-6) + 9 = -3$ **Answer:** $-3.$

e. [2 points] Find $\int_{10}^{13} P''(x)dx$.

Solution: $\int_{10}^{13} P''(x)dx = P'(13) - P'(10) = 1.5 - (-0.5) = 2$ **Answer:** $2.$

f. [2 points] Let $Q(x) = P(3x^2 + 1)$. Find $Q'(2)$.

Solution: $Q'(x) = P'(3x^2 + 1)(6x)$ then $Q'(2) = P'(13)(12) = (1.5)(12) = 18$

Answer: $18.$