1. Using graphs (A) - (E), answer the following.

(a) (10 points) Given the graph of \( y = f'(x) \) below, select the graph above which could be that of \( y = f(x) \).

(b) (10 points) Given the graph of \( y = f(x) \) below, select the graph above which could be that of \( y = f'(x) \).
2. A mass is suspended from a spring. The distance from the rest position (down being the positive direction) is given by \( x(t) = 5 \cos(2\pi t) \) for \( 0 \leq t \leq 1 \).

(a) (5 points) Find the interval(s) in time in which the mass is moving downward.

(b) (5 points) Find the time(s) that the mass is not moving.

(c) (5 points) Find the time(s) that the downward speed is the highest.

3. Find the derivative of the following.

(a) (5 points) 
\[
 v(w) = 2e^w + \sqrt{e}
\]

(b) (5 points) 
\[
 q(t) = (t - \sqrt{t})(t + \sqrt{t}).
\]

(c) (5 points) 
\[
 u(v) = \frac{e^v}{e^v + 1}
\]
4. (10 points) Find the derivative of

\[ f(x) = \sin(x) \cos(x). \]

5. (10 points) Prove that the function

\[ f(t) = 2\sin^2(t) + \cos(2t) + 1 \]

is a constant function by finding its derivative. (Note the trigonometric identity \( \sin(2t) = 2\sin(t)\cos(t) \).) Evaluate \( f(0) \) to find that constant.

6. (10 points) Find the derivative of the following function.

\[ h(p) = e^p \cos(p) \]
7. (10 points) Find \( \frac{dy}{dx} \).

\[ y = \sin^{-1}(2x) \]

8. (10 points) Find \( y' \) and \( y'' \).

\[ y = x \ln(x) \]

9. **Bonus**: (10 Points) Show that

\[ \lim_{n \to \infty} \left(1 + \frac{r}{n}\right)^n = e^r \]

for any \( r > 0 \), thus the compound interest formula

\[ A = P \left(1 + \frac{r}{m}\right)^{mt} \]

goes to \( A = Pe^{rt} \) as the number of compoundings per year \( m \) goes to infinity. Hint: use \( f(x) = r \ln(x) \) and \( n = 1/h \) in the definition of \( f'(1) \).