

Read directions carefully and show all your work. Partial credit will be assigned based upon the correctness, completeness, and clarity of your answers. Correct answers without proper justification or those that use unapproved short-cut methods will not receive full credit.

1. (20 pts) Find the derivative for each of the following functions:

(a) $f(t) = 2t^5 - \sqrt[3]{t^2} - 17$

(b) $g(x) = ax^4 + bx^2 - cx + d$, where a, b, c , and d are constants.

(c) $h(u) = \frac{1-u}{u^3}$

2. (15 pts) Find the solution to the initial value problem: $y' = -\frac{2}{x^2} + 3$ when $y(1) = 4$.

3. (15 pts) Use the definition of the derivative as a limit to show $\frac{d}{dx}(5 - 4x - 3x^2) = -4 - 6x$.

4. (30 pts) Consider $f(x) = \begin{cases} 2 + \cos x, & \text{if } x \leq 0 \\ 3 - x^2, & \text{if } 0 < x \leq 1 \\ \frac{x^2 - x - 2}{x - 2}, & \text{if } x > 1 \end{cases}$

Determine the following values (if they exist)

(a) $\lim_{x \rightarrow 0^-} f(x)$

(e) $\lim_{x \rightarrow 1^-} f(x)$

(b) $\lim_{x \rightarrow 0^+} f(x)$

(f) $\lim_{x \rightarrow 1^+} f(x)$

(c) $f(0)$

(g) $\lim_{x \rightarrow 1} f(x)$

(d) $\lim_{x \rightarrow 2} f(x)$

(h) $f(1)$

(i) Is f continuous at $x = 0$? Explain your answer using limits.

(j) Is f continuous at $x = 2$? Explain your answer.

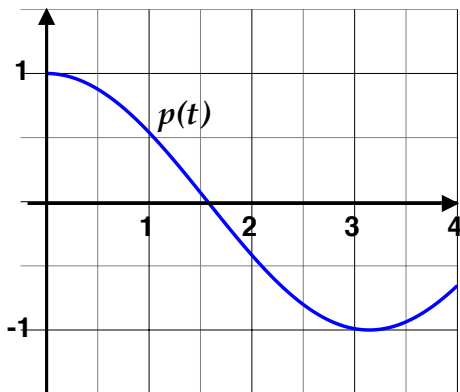
(k) Does $f'(0)$ exist? Explain your answer. (Hint: consider the graph of f .)

(l) Does $f'(1)$ exist? Explain your answer. (Hint: consider the graph of f .)

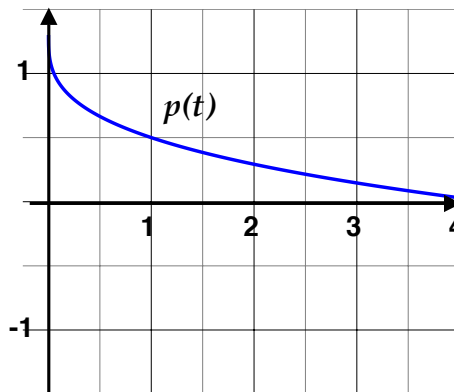
(m) What is the range of f ?

5. (20 pts) Each of the graphs below shows the position $p(t)$ of an object moving along the x -axis as a function of time t for $0 \leq t \leq 4$. When $p(t) < 0$, the object is to the left of the origin and when $p(t) > 0$, the object is to the right of the origin.

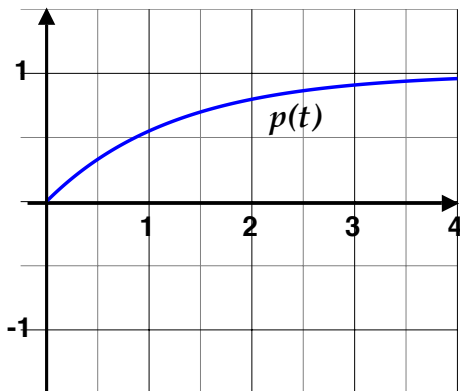
Graph A



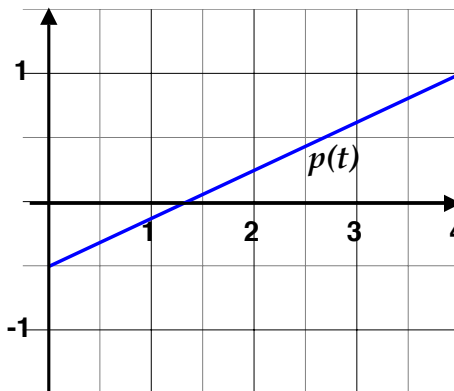
Graph B



Graph C



Graph D



On the interval $[0, 4]$, which graph(s) depicts an object that

- (a) has constant velocity?
- (b) has positive acceleration over the entire interval?
- (c) has average velocity equal to 0.375?
- (d) has greatest initial speed?
- (e) has zero acceleration?
- (f) has decreasing velocity over the entire interval?
- (g) changes direction?