



3. (20pts) Start this problem on a **new** page. The following problems are not related.

(a)(10pts) For what value(s) of  $x \in \mathbb{R}$  does the function  $f(x) = 2x^3 + 3x^2 - 12x + 1$  have a *horizontal tangent*?

(b)(10pts) The position function of a particle is given by  $s(t) = t^3 - 4.5t^2 - 7t$  where  $t \geq 0$  is in seconds and distance is in feet. (i)(5pts) Find the velocity of the particle as a function of  $t$ . (ii)(5pts) When is the acceleration equal to 0?

**Solution:**

(a)(10pts) We need to find all  $x$  in the domain such that  $f'(x) = 0$ , note that

$$f'(x) = [2x^3 + 3x^2 - 12x + 1]' = 6x^2 + 6x - 12 = 6(x^2 + x - 2) = 6(x+2)(x-1)$$

thus  $f'(x) = 0 \implies x = -2, 1$  which is in the domain since  $f(x)$  is a polynomial thus  $f(x)$  has horizontal tangents at  $x = -2, 1$ .

(b)(i)(5pts) Here we have the velocity is  $v(t) = s'(t) = [t^3 - 4.5t^2 - 7t]' = 3t^2 - 9t - 7$ .

(b)(ii)(5pts) The acceleration is  $a(t) = v'(t) = [3t^2 - 9t - 7]' = 6t - 9$  thus  $a(t) = 0 \implies 6t - 9 = 0 \implies t = \frac{3}{2}$  sec.

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4. (28pts) Start this problem on a **new** page. The following problems are not related.

(a)(12pts) If  $y = \sec(x)$ , find  $y'$