SHOW ALL WORK

1. (3 pts each)
   (a) Sketch $\vec{B} - \vec{A}$.   (b) Sketch $\vec{B} + \vec{A}$.   (c) Sketch the projection of $\vec{B}$ onto $\vec{A}$.
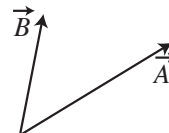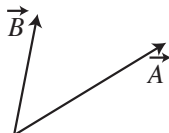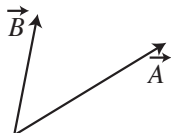
2. Let $\vec{A} = (1,1,2)$, $\vec{B} = (-1,1,1)$, and $\vec{C} = (1,2,3)$.

   (a) Find the cosine of the angle between $\vec{A}$ and $\vec{B}$.
   (b) Find the projection of $\vec{A}$ onto $\vec{B}$.
   (c) Find a unit vector that points in the direction of $\vec{A}$
   (d) Find $\vec{A} \times \vec{B}$.
   (e) Find a vector that is perpendicular to both $\vec{A}$ and $\vec{B}$.
   (f) Find the volume of the parallelopiped with adjacent edges $\vec{A}$, $\vec{B}$, and $\vec{C}$.
   (g) Find the area of the triangle with verticies $\vec{A}$, $\vec{B}$, and $\vec{C}$.

3. The graph of a function f is sketched below.
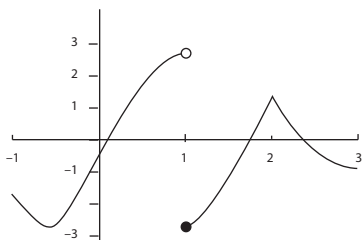
   (a) Determine the segments where $f' > 0$
   (b) Determine the segments where $f' < 0$
   (c) Determine where the graph of f has a horizontal tangent line.
   (d) Where does f' fail to be derfined?
   (e) Where does f fail to be continuous?

4. The graph of the **DERIVATIVE** of f is sketched below.

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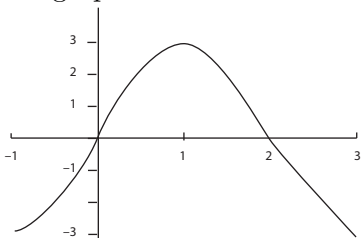
(a) Determine where f attains its maximum.

(b) Determine where f is concave up.

5. (10 pts each) Find the derivative of:

   (a) $f(x) = (4x^{-3/2} + 2x^2 - x^{-2} + \pi)(x^{-3} - x^{4/7} + 3)$.

   (b) $f(x) = (\sin(6\pi x) + 4)/(\cos(5x + 2))$.

   (c) $f(x) = \tan(3x) + \sec(5x + 1) + \cot(x)$.

   (d) $f(x) = e^{(x^2)} + \ln(x^3 + 2)$

6. (10 pts) Find an equation for the line tangent to $f(x) = (x^{-3} + x^2 + 1)$ at $x_0 = 1$.

7. (10 pts) Parameterize the line tangent to $\vec{r}(x) = (\cos(3\pi x), \sin(\pi x), \ln(2x))$ at $x_0 = 1/2$.

8. (10 pts) One leg of a right triangle is fixed at 3 meters as the other leg is decreasing at a rate of 2 m/sec. What is the rate of change of the area of the triangle when the leg of variable length is 1 meter long?

9. (15 pts) Let $f(x) = \dfrac{x^3}{3} + 3x^2 + x$.

   (a) Determine where f is increasing and where f is decreasing.

   (b) Determine the concavity of f.

   (c) Sketch.

10. (10 pts) Find the maximum value for $f(x) = \sin(x)\cos(x)$ on the interval $0 \le x \le 2\pi$.

11. (5 pts each) $\vec{r}(t) = (x(t), y(t))$. You are given the graphs of $x(t)$ and $y(t)$ below.
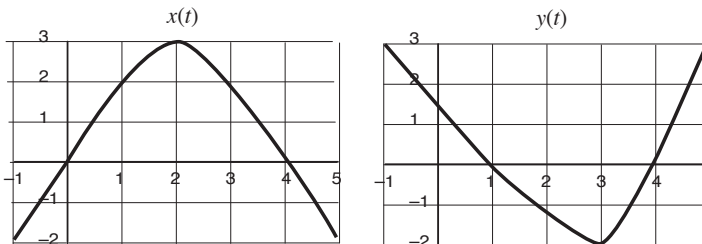
   (a) Determine where the curve parametrized by $\vec{r}$ has a horizontal tangent line.

   (b) Determine where the curve parametrized by $\vec{r}$ has a vertical tangent line.

12. (10 pts each) Let $F(x) = \displaystyle\int_2^x \dfrac{t\,dt}{(t+5)(t-4)}$

   (a) Determine the domain of F.

   (b) Find the derivative of F.

13. (10 pts each) Evaluate

   (a) $\displaystyle\int x^2(x^3 + 1)^{99}\,dx$.

(b) $\int \dfrac{x^2}{x^3 + 1}\, dx.$

(c) $\int x^2 e^{x^3+1}\, dx.$

(d) $\int_0^1 \dfrac{d}{dx}(x^3 + 6x^2)^{2x}\, dx.$

(e) $\int_0^{\pi/2} \sin^3 x \, \cos x \, dx.$