

## Math 151 Help Session Interview Questions

1. A 20 N force acts on an object in the direction  $30^\circ$  from the positive  $x$ -axis. A second 10 N force acts on the object in the direction  $120^\circ$  from the positive  $x$ -axis. Find the resultant vector force  $\mathbf{F}$ .
2. Calculate the following limits.

(a)  $\lim_{x \rightarrow 3^+} \frac{x-4}{x-3}$

(b)  $\lim_{x \rightarrow 2^-} \frac{|x-2|}{x^2-4}$

(c)  $\lim_{x \rightarrow -\infty} \frac{\sqrt{9x^2+1}}{5-2x}$

(d)  $\lim_{x \rightarrow 0} \frac{\sin x - x}{x^3 + 3x^2}$

3. Determine the values of  $C$  and  $D$  that make the function below continuous everywhere.

$$f(x) = \begin{cases} x^2 + C & \text{if } x < 2 \\ D & \text{if } x = 2 \\ Cx - 3 & \text{if } x > 2 \end{cases}$$

4. Use the definition of the derivative to find  $f'(x)$  for  $f(x) = \sqrt{2x+1}$ .
5. Differentiate the following functions.
  - (a)  $f(x) = \sin 3x + \cos^4 x$
  - (b)  $g(t) = te^{t^2}$
  - (c)  $f(x) = x^3 \ln(x^2 + x)$
  - (d)  $f(x) = x^{\tan x}$
6. Find an equation of the tangent line to the graph of  $f(x) = \frac{2x}{x^2+3}$  at the point where  $x = 1$ .
7. A 15 m ladder rests against a vertical wall. If the bottom of the ladder slides away from the wall at a speed of 3 m/s, at what rate is the angle between the top of the ladder and the wall changing when the angle is  $\frac{\pi}{6}$ .
8. Consider  $f(x) = x^2 e^{-x}$ . Find where  $f(x)$  is increasing and decreasing, and identify the  $x$ -coordinates of all local extrema.
9. Consider  $f(x) = x^5 + 5x^4$ . Find where  $f(x)$  is concave up and concave down, and identify the  $x$ -coordinates of all inflection points.
10. Find the absolute maximum and minimum values of  $f(x) = 3x^4 + 4x^3 - 12x^2$  on the interval  $[-1, 1]$ .
11. A box with no top has a rectangular base with one side three times as long as the other. The total surface area of the material used to make the box is  $144 \text{ cm}^2$ . Find the dimensions of the box (length, width, height) that will give the largest volume.
12. Suppose the acceleration of a particle is given by  $a(t) = \sqrt{t} + \cos t + e^t$ . If the initial velocity of the object is 2 m/s and the initial position of the object is at 0 m, find the position function of the particle.
13. Compute the following integrals.

(a)  $\int \frac{x^2+1}{\sqrt{x}} dx$

(b)  $\int_0^1 (x^2 + 4x - e^x) dx$