

1. Find the limits for the following:(20%)

$$\lim_{x \rightarrow 1} \frac{x^2 - 1}{x^2 + x - 2}$$

$$\lim_{x \rightarrow \infty} \frac{2x^2 - 1}{x^2 + 1}$$

$$\lim_{x \rightarrow -\infty} \frac{x^3 + 2}{x - 1}$$

$$\lim_{x \rightarrow +\infty} \left(x - \sqrt{x^2 + 1} \right)$$

$$\lim_{x \rightarrow -\infty} \left(\sqrt{x^2 - 1} + x \right)$$

2. Differentiate the following:(20%)

$$x^2 \sin 2x$$

$$\sqrt{\sin 2x}$$

$$x^{\sin x}$$

$$\frac{\sin x + \cos x}{\sin x - \cos x}$$

$$\log \left| \tan x + \frac{1}{\cos x} \right|$$

3. Find the following integrals:(40%)

$$\int \frac{e^x}{e^x + 1} dx$$

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

$$\int \ln^2 x dx$$

$$\int \arcsin x dx$$

$$\int \sqrt{\frac{a-x}{x-b}} dx$$

$$\int \frac{\sqrt{x^2 + 2x}}{x} dx$$

$$\int \cos x \cos 3x dx$$

$$\int \frac{dx}{1 + 2 \tan x}$$

$$\int \frac{dx}{\sqrt{e^{2x} + e^x + 1}}$$

$$\int \frac{x dx}{\cosh^2 x}$$

4. Find the following integrals:(20%)

$$\int_0^{\infty} x e^{-x^2} dx$$

$$\int_{-\infty}^{\infty} \frac{dx}{x^2 + 2x + 2}$$

$$\int_0^{\pi} \frac{\cos t + a}{1 + 2a \cos t + a^2} dt$$

$$\int_1^{\infty} \frac{dx}{x^2(x+1)}$$

$$\int_1^{\infty} \frac{dx}{\sqrt{x}}$$