

Question 1:

(3 + 4 + 3)

(a) Solve the inequality and express your answer in terms of intervals

$$\frac{2x + 3}{x^2 + 5x + 6} \geq 0.$$

(b) Find  $(f \circ g)(1)$  and  $(g \circ f)(1)$ , where

$$f(x) = x + \frac{1}{x} \quad \text{and} \quad g(x) = \frac{x+1}{x+2}.$$

(c) Determine the value of  $k$  such that the given function is continuous on  $(-\infty, \infty)$

$$f(x) = \begin{cases} 5x + 2, & \text{if } x \leq 1 \\ kx^2, & \text{if } x > 1. \end{cases}$$

Question 2:

(4 + 3 + 3)

(a) Find the following limits, if exist

$$(i) \lim_{x \rightarrow 0} \frac{x^2}{1 - \cos x}, \quad (ii) \lim_{x \rightarrow 0} \frac{\sqrt{x^2 + x + 4} - 2}{x^2 + x}.$$

(b) Find the horizontal asymptote and the vertical asymptote for the graph of the function

$$f(x) = \frac{x^2 + 2}{x^2 - 1}.$$

(c) Use the definition of the derivative to find  $f'(x)$  of the function  $f(x) = \frac{1}{x+1}$ ; and find the equation of the tangent line to the graph of this function at the point  $P(1, \frac{1}{2})$ .

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