

4. a)  $(\frac{\pi}{2} + 2k\pi, 1)$ ;  $(\frac{\pi}{2} + 2k\pi, -1)$   
 b) none c) none d) none  
 e)  $(\frac{1}{e}, \frac{-1}{e})$   
 f)  $(-1, \frac{-1}{e})$

4. For each case, find the critical points.  
 a)  $f(x) = \sin x$  b)  $f(x) = \tan x$   
 c)  $f(x) = e^x$  d)  $f(x) = \ln x$   
 e)  $f(x) = x \ln x$  f)  $f(x) = xe^x$

5. a)  $LM(\pm 1, 0)$ ;  $LM(0, 1)$   
 b)  $LM(0, 0)$ ;  $LM(1, 1)$   
 c) none  
 d)  $LM(\frac{1}{4}, -\frac{1}{4})$   
 e)  $(0.3968, -0.4724)$  LM  
 f)  $(\pm 2, 0)$  LM;  $(0, 4)$  LM

5. For each case, find any local extrema using the first derivative test.  
 a)  $f(x) = x^4 - 2x^2 + 1$  b)  $f(x) = x^2(3 - 2x)$   
 c)  $f(x) = \frac{1+x}{1-x}$  d)  $f(x) = x - \sqrt{x}$   
 e)  $f(x) = x^2 - \sqrt{x}$  f)  $f(x) = |x^2 - 4|$

6. a)  $GM(-2, 21)$ ;  $GM(1, -6)$   
 b)  $GM(4, 4)$ ;  $GM(0, 0)$   
 c)  $GM(1, 5)$ ;  $GM(4, 5)$   
      $GM(2, 4)$   
 d)  $GM(0, 1)$ ;  $GM(2\pi, 1)$   
      $GM(\pi, -1)$   
 e) wrong!  $f(0)$  not defined  
 f)  $GM(1, 1/e)$ ;  $GM(-1, -e)$   
 g)  $GM(2\pi, 2i)$ ;  $GM(0, 0)$

6. For each case, find the absolute extrema (maximum or minimum) points.  
 a)  $f(x) = 2x^3 + 3x^2 - 12x + 1$ , for  $x \in [-3, 2]$   
 b)  $f(x) = \frac{5x}{x+1}$ , for  $x \in [0, 4]$   
 c)  $f(x) = x + \frac{4}{x}$ , for  $x \in [1, 4]$   
 d)  $f(x) = \cos x$ , for  $x \in [-\pi/2, 2\pi]$   
 e)  $f(x) = x \log x$ , for  $x \in [0, 10]$   $x \in [1, 10]$   
 f)  $f(x) = xe^{-x}$ , for  $x \in [-1, 2]$   
 g)  $f(x) = x + \sin x$ , for  $x \in [0, 2\pi]$

7. a) up  $(-\infty, -1)$  or  $(1, \infty)$   
     down  $(-1, 1)$   
 b) up  $(-\infty, -1)$  or  $(-\frac{1}{\sqrt{5}}, \frac{1}{\sqrt{5}})$  or  $(1, \infty)$   
     down  $(-1, -\frac{1}{\sqrt{5}})$  or  $(\frac{1}{\sqrt{5}}, 1)$   
 c) up  $(-1, 0)$  or  $(1, \infty)$   
     down  $(-\infty, -1)$  or  $(0, 1)$   
 d) up  $(-\infty, -1)$  or  $(0, \infty)$   
     down  $(-1, 0)$   
 e) up  $(-\infty, -2 - \sqrt{2})$  or  $(-2 + \sqrt{2}, \infty)$   
     down  $(-2 - \sqrt{2}, -2 + \sqrt{2})$

7. For each case, find the intervals of concavity.  
 a)  $f(x) = x^4 - 6x^2$  b)  $f(x) = (x^2 - 1)^3$   
 c)  $f(x) = \frac{x}{x^2 - 1}$  d)  $f(x) = (x - 1)(x + 1)^3$   
 e)  $f(x) = x^2 e^x$  f)  $f(x) = x \ln x$   
 g)  $f(x) = x^2 \ln x$  h)  $f(x) = x + \cos x$   
 f) up  $(0, \infty)$   
 g) down  $(0, 0.223)$ ; up  $(0.223, \infty)$   
 h) up  $(2k\pi + \pi/2, 2k\pi + 3\pi/2)$   
     down  $(2k\pi - \pi/2, 2k\pi + \pi/2)$