1 (a) F (b) T (c) F (d) T (e) F

2

$$\frac{d}{dx}\sin x = \lim_{h\to 0}\frac{\sin(x+h)-\sin(x)}{h}$$

$$= \lim_{h\to 0}\frac{\sin(x)\cos(h)+\sin(h)\cos(x)-\sin(x)}{h}$$

$$= \lim_{h\to 0}\left[\sin(x)\frac{\cos(h)-1}{h} + \cos(x)\frac{\sin h}{h}\right]$$

$$= \sin(x)\lim_{h\to 0}\underbrace{\frac{\cos(h)-1}{h}}_{\to 0} + \cos(x)\lim_{h\to 0}\underbrace{\frac{\sin(h)}{h}}_{\to 1}$$

$$= \underline{\cos(x)}$$

3 (a) $\boxed{h'(t) = \pi^3 t^{\pi^3-1} + \ln(\pi^3)(\pi^3)^t + \pi}$

(b) $\frac{d}{d\theta}\ln[\theta\cos\theta] = \frac{1}{\theta\cos\theta}\frac{d}{d\theta}[\theta\cos\theta] = \boxed{\frac{\cos\theta - \theta\sin\theta}{\theta\cos\theta}}$

(c) $\frac{d}{dx}e^{[5^x + x\ln x]} = e^{[5^x+x\ln x]}\frac{d}{dx}[5^x + x\ln x]$

$$= \boxed{e^{[5^x+x\ln x]}\left(\ln(5)5^x + \ln x + 1\right)}$$

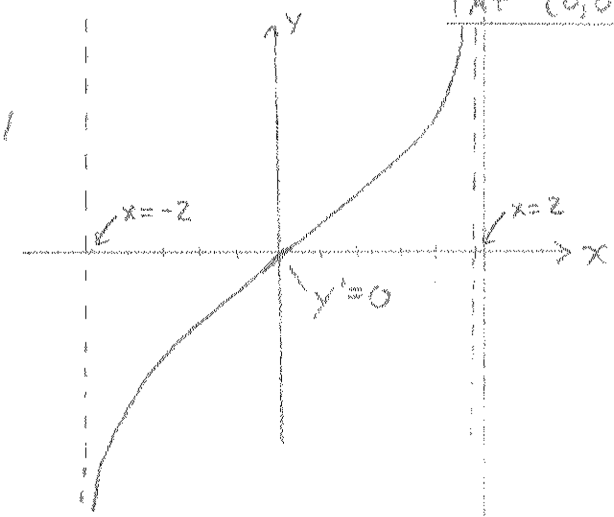
(d) $y = \frac{x}{y+a} \Rightarrow y' = \frac{d}{dx}\left[x(y+a)^{-1}\right] = \left[(y+a)^{-1} - x(y+a)^{-2}y'\right]$

$$y'\left[1 + x(y+a)^{-2}\right] = \frac{1}{y+a} \qquad y' = \frac{1}{(y+a)\left[1+\frac{x}{(y+a)^2}\right]}$$

$$y' = \frac{(y+a)}{(y+a)^2 + x} \qquad y'\Big|_{x=0,y=0} = \frac{1}{a}$$

$\boxed{\text{SLOPE OF PERP LINE AT } (0,0) = -a}$

4 TAKEN FROM EXAM #1



5

(a) $$\frac{dg}{dx} = \begin{cases} 2x-1 & -\infty < x \le 1 \\ \ln(x) & 1 < x < 1.5 \end{cases}$$

$\frac{dg}{dx}$ IS UNDEFINED AT $x=1$, AND ZERO AT $x = 1/2$

$\boxed{\text{CRITICAL POINTS } x=1,\ x=1/2}$

INTERVALS

$(-\infty, 1/2)$: $g'(0) = -1 < 0$ DECREASING

$(1/2, 1)$: $g'(3/4) = \frac{3}{2} - 1 > 0$ INCREASING

$\Big\}$ $x = 1/2$ LOCAL MIN

$(1, 1.5)$: $g'(x) > 0$ INCREASING

(b) g'' UNDEFINED AT $x = 1$; NONZERO FOR $x \ne 1$

$(-\infty, 1)$ $g'' = 2 > 0$ CONCAVE UP

$(1, 1.5)$ $g'' = 1/x > 0$ CONCAVE UP

$\Big\}$ NO INFLECTION POINTS

(c) SKETCH

SOME VALUES

$g(0) = 0$ $\lim_{x \to 1.5} g(x) = 1.5 \ln(1.5) - 0.5 \approx 0.1$ (NOT EXPECTED TO CALC.)

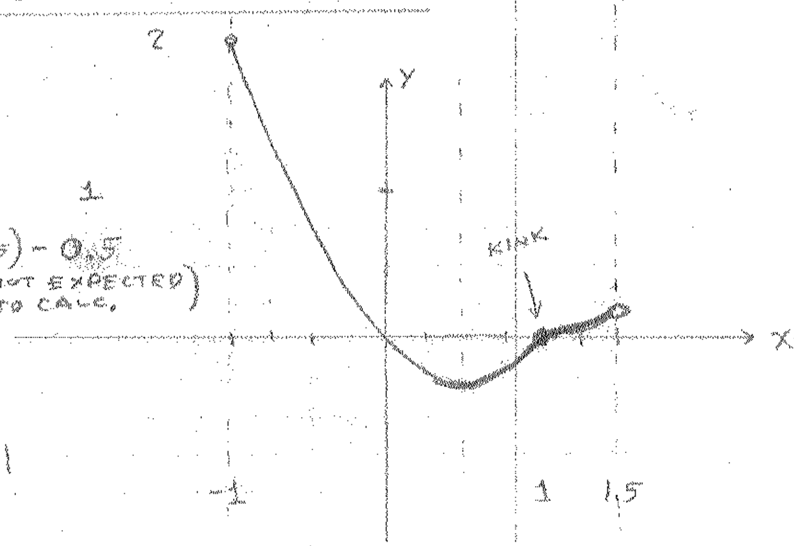
$g(1) = 0$

$g(-1) = 2$

$g(\frac{1}{2}) = -1/4$

$\left.\frac{dg}{dx}\right|_{x=-1} = -3$ $\left.\frac{dg}{dx}\right|_{x=0} = -1$

dg



(d) $g(1/2)$ IS A GLOBAL MIN ; NO GLOBAL MAXIMA

6 (a) $\tilde{g}(x) = g(-1) + g'(-1)[x - (-1)]$

$\tilde{g}(x) = 2 + (-3)(x+1) = 2 - 3x - 3$ $\boxed{\tilde{g}(x) = -3x - 1}$

(b) $E(x) = g(x) - \tilde{g}(x)$

$E(1.2) = 1.2 \ln(1.2) - 0.2 + 3(1.2) + 1$

$= 1.2 \ln(1.2) + 4.4$

3.6