Answers for Sample Exam #3

1. a) $\cos 3x - 3x \sin 3x$
   b) $-(x+1)^{-1/2}(x-1)^{-3/2}$ OR ...
   c) $\dfrac{32}{(1-4x)^3}$ OR ...
2. $k = \ln 10$
3. $f'(2) = \lim\limits_{h\to 0} \dfrac{f(2+h)-f(2)}{h} = \lim\limits_{h\to 0} \dfrac{\dfrac{5}{5+3h} - 1}{h} = \lim\limits_{h\to 0} \dfrac{-3h}{h(5+3h)} = -\dfrac{3}{5}$
4. $-\dfrac{4}{10}$ OR $-\dfrac{2}{5}$ OR -0.4; $\dfrac{768}{1000}$ OR ...
5. $\dfrac{1}{\pi}$; Rewrite the limit as $\lim\limits_{x\to 0}\left[e^{3x}\cos(\pi x)\dfrac{\pi x}{\pi \sin(\pi x)}\right]$. Since $\lim\limits_{u\to 0} e^u = \lim\limits_{v\to 0}\cos v = 1$, we need only find $\lim\limits_{w\to 0}\dfrac{w}{\sin w}$, which is 1 by a standard result.
6. $a = \dfrac{1 \pm \sqrt{5}}{2}$ (the calculator approximations are not enough)
7. If the initial mass is 100, the mass at time t is $M(t) = 100e^{-kt}$, where $k = (\ln 4)/27$. Since $M(t) = a$ if and only if $t = f(a)$, this equation can be rearranged to give $f(a) = 27\left(\dfrac{\ln 100 - \ln a}{\ln 4}\right)$.
8. 4.004
9. 6000 meters
10. $\sqrt{2+\sqrt{2}}$ by $\sqrt{2-\sqrt{2}}$ OR $2\cos(\pi/8)$ by $2\sin(\pi/8)$ OR even 1.8477591 by 0.7653669.
11. 1.2 radians per minute
12. $\sqrt{3}/2$ OR 0.8660254
13. a) $c = 0.06$, $k = -0.002$
    b) $\dfrac{dW}{dt} = kW$
    c) $W = 0.06e^{-0.002t}$, $V = 30(1 - e^{-0.002t})$