Pencil and Paper homework Number 6

This homework concerns working out derivatives using the rules.

1) Find the derivatives $f'(x)$ the easy way. Show all steps, or at least most steps. *Remember to use the chain rule*, which you need for many of the problems.

$$\begin{aligned}
a) f(x) &= 3x^3 - 5x^2 - 7x + 31 \\
b) f(z) &= (3z+5)(2z-4) \\
c) f(z) &= (3z+5)(5z^2+3z-4) \\
d) f(x) &= \frac{3x-2}{5x+4} \\
e) f(x) &= \frac{3x^2-2}{5x^+4} \\
f) f(x) &= \sqrt{2x-3} \\
g) f(x) &= \sqrt{x^2-3} \\
h) f(x) &= \sqrt{2x^2-3x+1} \\
i) f(x) &= \frac{1}{\sqrt{x-3}} \\
j) f(x) &= \frac{1}{\sqrt{5x-3}} \\
k) f(x) &= \frac{1}{\sqrt{x^2+5x-3}}
\end{aligned}$$

2) Same as one, but now we use trig functions.

$$\begin{aligned}
a) f(x) &= \sin 3x \\
b) f(x) &= \cos 3x \\
c) f(x) &= \tan 3x \\
d) f(x) &= \sec 3x \\
e) f(x) &= \sin x \cos x \\
f) f(x) &= x^2 \sin x \\
g) f(x) &= \sin^2 x \\
h) f(x) &= \tan^2 x \\
i) f(x) &= \cos^2 x - \sin^2 x \text{ Try to simplify} \\
j) f(x) &= (x^2+4)\sin^2 x
\end{aligned}$$

3) Same as one, but now we use exponential functions.

$$\begin{aligned}
a) f(x) &= e^{3x} \\
b) f(x) &= e^{-4x} \\
c) f(x) &= e^{x^2}
\end{aligned}$$

$$
\begin{aligned}
d) f(x) &= e^{-x^2} \\
e) f(x) &= xe^{-x} \\
f) f(x) &= xe^{x} - e^{x} \\
g) f(x) &= xe^{-x^2} \\
h) f(x) &= (x^2-4)e^{-x} \\
i) f(x) &= (x^2-4)e^{-x^2} \\
j) f(x) &= \ln(x+2) \\
k) f(x) &= \ln\left((x+2)^2\right) \\
m) f(x) &= \ln\left((3x+2)^2\right) \\
n) f(x) &= \ln(x^2) \\
o) f(x) &= \ln(x^2+2) \\
p) f(x) &= \ln(x^3+2) \\
q) f(x) &= \ln\left((x^3+2)^2\right) \\
r) f(x) &= \ln(x^3+x+2) \\
s) f(x) &= x\ln x - x
\end{aligned}
$$

4) Same as one, but now with combos. These kind are very frequent in engineering.

$$
\begin{aligned}
a) f(x) &= e^{-x}\sin x \\
b) f(x) &= e^{-x}\sin 3x \\
c) f(x) &= e^{-2x}\sin 3x \\
d) f(x) &= e^{-2x}(\sin 3x - 2\cos 3x) \\
e) f(x) &= xe^{-2x}\sin 3x \\
f) f(x) &= \ln(\cos x)\ \text{(Simplify!)} \\
g) f(x) &= \ln(\sec x)\ \text{(Simplify!)}
\end{aligned}
$$

5) Now let's do something with it. a)Let $f(x) = xe^{-x}$. Take the derivative and figure out where $f'(x) = 0$. Then graph $f(x)$ on your calculator and see where it has it's maximum. b) Figure out (with your calculator; not by algebra) where $f'(x) = \frac{1}{2}$. Find the tangent lines at these places and graph the function and tangent lines on your calculator, and then draw the picture on the paper.
6) Same as one, but now with combos. These kind are very frequent in engineering.

$$
\begin{aligned}
a) f(x) &= \sinh(5x) \\
b) f(x) &= \cosh(3x) \\
c) f(x) &= \sinh(4x^2) \\
d) f(x) &= \sinh(2x)\cosh(2x) \\
e) f(x) &= e^{-3x}\sinh(2x)
\end{aligned}
$$