Thursday:

4. Let $P$ denote the amount of substance remaining at time $t$. $P'$ is proportional to $P$ so $P' = -k^2P$. Note that $P' < 0$ because $P$ is decaying.

Friday: 1.1

6. Let $T$ represent the temperature at time $t$. Since the potato is cooling off, $T'$ is negative. So, $T' = -k^2(T - A)$ where $A$ represents the ambient temperature. Notice that $T - A$ is positive as the potato has been heated above the ambient temperature. (This is a Newton’s Cooling Law problem)

8. Here the force is proportional to but opposite the particle’s displacement. (This is a Hooke’s Law problem).
On one hand: $F = ma = mx''$
On the other hand: $F = -k^2x$ (note: "proportional to but opposite of")
So we get: $mx'' = -k^2x$ which is ok OR $x'' = -a^2x$ where $a = -\frac{k^2}{m}$.

1.3

4. $y' = 2\sin(3t) - \cos(5t) \rightarrow y = \int 2\sin(3t) - \cos(5t) dt = -\frac{2}{3}\cos(3t) - \frac{1}{5}\sin(5t) + C$
The graphs vary with "C". Interval of validity: $(-\infty, \infty)$.

10. $y' = x\sin(3x) \rightarrow y = \int x\sin(3x) dx = -\frac{1}{3}x\cos(3x) + \frac{1}{3}\cos(3x) + C$; Interval of validity: $(-\infty, \infty)$.

24. $v' = \frac{r^2}{r+1}; v(0) = 0 \rightarrow v = \int \frac{r^2}{r+1} dt = \int r - 1 + \frac{1}{r+1} dr = \frac{1}{2}r^2 + C$ $v(0) = C \rightarrow C = 0$. So $v = \frac{1}{2}r^2 - r + \ln|r + 1|$. Interval of validity: must contain $r = 0$. It cannot contain $r = -1$.
So the correct interval is $(-1, \infty)$. 

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