NAME:

Chemistry 410A   **Drill 1**   **Spring 2016**
Solutions

1. Evaluate

$$\frac{d}{d\theta} \left[2\sin(3\theta) - 3\cos(2\theta) \right]$$

   Solution:

$$\frac{d}{d\theta} \left[2\sin(3\theta) - 3\cos(2\theta) \right] = 2\frac{d}{d\theta}\sin(3\theta) - 3\frac{d}{d\theta}\cos(2\theta)$$
$$= 2\left[3\cos(3\theta) \right] - 3\left[-2\sin(2\theta) \right]$$
$$= \boxed{6\left[\cos(3\theta) + \sin(2\theta) \right].}$$

2. Give the numerical value for the following integral. Show work for full credit.

$$\int_1^e \frac{2}{x}\, dx.$$

   Solution:

$$\int_1^e \frac{2}{x}\, dx = 2\int_1^e \frac{dx}{x} = 2\ln(x)\big|_1^e = 2\left[\ln(e) - \ln(1) \right] = 2\left[1 - 0 \right] = \boxed{2.}$$

3. If the rotational constant B for a polyatomic molecule is an energy given by

$$B \equiv \frac{\hbar^2}{2I_b} \tag{1}$$

   where $\hbar$ is the fundamental constant (see back of this page), then what are the SI units of I_b in terms of *only* kg, m, and/or s? **Solution:**

$$I_b = \frac{\hbar^2}{2B} \rightarrow \frac{(\mathrm{J\,s})^2}{\mathrm{J}} = \mathrm{J\,s}^2 = \left(\frac{\mathrm{kg\,m}^2}{\mathrm{s}^2} \right)\mathrm{s}^2 = \boxed{\mathrm{kg\,m}^2.} \tag{2}$$

4. Give the **name** and **atomic symbol** of element 11. **Solution:** $\boxed{\text{sodium, Na}}$