Name _____

Chemistry 3411
Final Exam
April 27, 2018

This exam has two parts. Part 1 consists of 15 multiple choice questions. Part 2 consists of 6 questions where you must work out solutions or write short answers. Read all problems carefully. Full credit will be given only when your work is shown. Partial credit will be given where your thinking is explicit and can be followed.

You may use a calculator (non-graphing), but nothing else. If you need extra room, use the back of exam pages and direct the grader where to look. You may also use scratch paper, but put all final answers on the exam itself and attach any scratch paper with work the grader should read.

You may remove this sheet for ease of reference to constants. If you do, be sure to write your name on the first page of the rest of the exam.

GOOD LUCK!

Constants:

$h = 6.626 \times 10^{-34}\ Js$ $\quad \hbar = \frac{h}{2\pi}$ $\quad c = 3.00 \times 10^{8}\ m\ s^{-1}$

$k = 1.38 \times 10^{-23}\ J\ K^{-1}$ $\quad N_A = 6.022 \times 10^{23}\ mol^{-1}$

$amu = 1.66 \times 10^{-27}\ kg$ $\quad m_e = 9.11 \times 10^{-31}\ kg$ $\quad a_o = 52.9$ pm

$\tilde{R}_\infty = 1.097 \times 10^{5}$ cm^{-1} $\quad e = 1.602 \times 10^{-19}$ C $\quad \epsilon_o = 8.854 \times 10^{-12}\ J^{-1}C^2m^{-1}$

Equations (others are given directly in exam questions):

$\Delta J = \pm 1 \quad \Delta K = 0 \quad \Delta M_J = 0, \pm 1 \quad \Delta v = \pm 1 \quad \Delta J = 0, \pm 2$

$\lambda = \frac{h}{p} \quad \Delta x \Delta p \geq \frac{\hbar}{2\pi} \quad \lambda\nu = c \quad \tilde{\nu} = \frac{1}{\lambda} \quad \Delta E = h\nu = hc\tilde{\nu} = \hbar\omega$

$\hat{H}\psi = E\psi \quad \hat{H} = \frac{-\hbar^2}{2m}\frac{d^2}{dx^2} + \hat{V}(x) \quad \hat{H} = \frac{-\hbar^2}{2m}\nabla^2 + \hat{V}(x) \quad d\tau = r^2 sin\theta dr d\theta d\phi$

$E_n = \frac{-m_e e^4}{32\pi^2\epsilon_o^2\hbar^2} \cdot \frac{Z^2}{n^2} = -hc\tilde{R}_\infty \cdot \frac{Z^2}{n^2} \quad E = \frac{l(l+1)\hbar^2}{2I}$

$P(r) = 4\pi r^2\psi^2 \quad P(r) = r^2\mathcal{R}^2(r)$

$b = \frac{1}{2}(N - N^*)$

$I = \sum_i m_i r_i^2 \quad I = \mu R^2 \quad \mu = \frac{m_1 m_2}{m_1 + m_2} \quad \tilde{B} = \frac{\hbar}{4\pi cI} \quad \tilde{F}(J) = \tilde{B}J(J+1) - DJ^2(J+1)^2$

$\nu = \frac{1}{2\pi}\sqrt{\frac{k}{\mu}} \quad \tilde{G} = \left(\mathrm{v} + \frac{1}{2}\right)\tilde{\upsilon} - \left(\mathrm{v} + \frac{1}{2}\right)^2 x_e\tilde{\upsilon} \quad x_e = \frac{\tilde{\upsilon}}{4\tilde{D}_e} \quad \frac{-\hbar^2}{2m}\frac{d^2}{dx^2}\psi + \hat{V}(x)\psi = E\psi$
