Homework 7.2 – Quantum Models of Motion

Name: _____

Excercise 7D.1(b) (5 points)

Evaluate the linear momentum and kinetic energy of a free proton described by the wavefunction e^{-ikx} with $k = 5\,nm^{-1}$

Exercise 7D.8(a) (5 points)

An electron is confined to a square well of length L. What would be the length of the box such that the zero-point energy of the electron is equal to its rest mass energy, $m_e c^2$? Express your answer in terms of the parameter $\lambda_C = {}^{h}/_{m_e c}$, the "Compton wavelength" of the electron.

Exercise 7D.9(a) (5 points)

For a particle in a box of length L and in the state with $n = 3$, at what positions is the probability density at a maximum? At what positions is the probability density zero?

Exercise 7D.15(b) (5 points)

Suppose that a proton of an acidic hydrogen atom is confined to an acid that can be represented by a barrier of height $2.0\,eV$ and length $100\,pm$. Calculate the probability that a proton with energy $1.4\,eV$ can escape from the acid.

Exercise 7E.2(a) (5 points)

For a certain harmonic oscillator of effective mass $1.33 \times 10^{-25}\,kg$, the difference in adjacent energy levels is $4.82\,zJ$. Calculate the force constant of the oscillator

Exercise 7E.5(a) (5 points)

Assuming the vibrations of a $^{35}Cl_2$ molecule are equivalent to those of a harmonic oscillator with a force constant $k_f = 329\,Nm^{-1}$, what is the zero-point energy of vibration of this molecule? Use $m(^{35}\text{Cl}) = 34.9688\,m_u$.

Exercise 7E.7(a) (5 points)

How many nodes are there in the wavefunction of a harmonic oscillator with (i) $v = 3$; (ii) $v = 4$?

Exercise 7F.1(b) (5 points)

The rotation of a molecule an be represented by the motion of a particle moving over the surface of a sphere with angular momentum quantum number $l = 2$. Calculate the magnitude of its angular momentum and the possible components of the angular momentum along the z-axis. Express your results as multiples of $\hbar$.

Exercise 7F.10(a) (5 points)

How many angular nodes are there for the spherical harmonic $Y_{3,0}$ and at which values of θ do they occur?

Exercise 7F.12(a) (5 points)

What is the degeneracy of a molecule rotating with $J = 3$?

The Mortician in San Francisco

By Randall Mann

This may sound queer,
but in 1985 I held the delicate hands
of Dan White:
I prepared him for burial; by then, Harvey Milk
was made monument—no, myth—by the years
since he was shot.

I remember when Harvey was shot:
twenty, and I knew I was queer.
Those were the years,
Levi's and leather jackets holding hands
on Castro Street, cheering for Harvey Milk—
elected on the same day as Dan White.

I often wonder about Supervisor White,
who fatally shot
Mayor Moscone and Supervisor Milk,
who was one of us, a Castro queer.
May 21, 1979: a jury hands
down the sentence, seven years—

in truth, five years—
for ex-cop, ex-fireman Dan White,
for the blood on his hands;
when he confessed that he had shot
the mayor and the queer,
a few men in blue cheered. And Harvey Milk?

Why cry over spilled milk,
some wondered, semi-privately, for years—
it meant "one less queer."
The jurors turned to White.
If just the mayor had been shot,
Dan might have had trouble on his hands—

but the twelve who held his life in their hands
maybe didn't mind the death of Harvey Milk;
maybe, the second murder offered him a shot
at serving only a few years.
In the end, he committed suicide, this Dan White.
And he was made presentable by a queer.