Assessment 2

The due date for submitting this assignment has passed. Due on 2017-02-19, 23:59 IST.

Submitted assignment

Chemistry I: Introduction to Quantum Chemistry and Molecular Spectroscopy
Week 1 Tutorial 2 by Prof. Mangala Sunder Krishnan
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1) Earth travel around the sun at a velocity of 67000 mile per hour. (one mile is 1.6 km). The mass of earth is $5.97 \times 10^{24} \text{ kg}$. The de Broglie wave length associated with this motion is closest to

- $0.4 \times 10^{-62} \text{ m}$
- $0.4 \times 10^{-58} \text{ m}$
- $0.4 \times 10^{-66} \text{ m}$
- $6.626 \times 10^{-34} \text{ m}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$0.4 \times 10^{-62} \text{ m}$

2) The value of Planck's constant $\hbar$ is

- $6.626 \times 10^{-34} \text{ Js}$
- $6.626 \times 10^{-34} \text{ Js}^{-1}$
- $6.626 \times 10^{-27} \text{ Js}$
- $6.626 \times 10^{-34} \text{ J}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$6.626 \times 10^{-34} \text{ Js}$

3) Physical dimension of the Hamiltonian operator in the Schrödinger equation is

- $6.626 \times 10^{-34} \text{ Js}$
24/07/2018

Chemistry I: Introduction to Quantum Chemistry and Molecular Spectroscopy - - Unit 2 - Week 1

Week 7

Week 8

ML^2 T^{-1}

ML T^{-1}

ML^2 T^{-2}

M^2 L^2 T^{-1}

No, the answer is incorrect.
Score: 0
Accepted Answers:
ML^2 T^{-2}

4) Planck's formula for energy of radiation in terms of wavelength \( \lambda \) of the radiation and speed of light in vacuum \( c \) is

\[
E = h \lambda
\]

\[
E = h c \lambda
\]

\[
E = h c \lambda
\]

\[
E = \lambda c h
\]

No, the answer is incorrect.
Score: 0
Accepted Answers:

\[
E = h c \lambda
\]

5) For the function \( f(x) = e^{kx} \), let \( f(x) \) double each time \( x \) is increased by \( x_0 \), namely,

\[
f(x) = u
\]

\[
f(x + x_0) = 2u
\]

\[
f(x + 2x_0) = 4u
\]

\[
f(x + 3x_0) = 8u
\]

... ...

The value of \( k \) is

\[
\frac{\ln 2}{x_0}
\]

\[
\frac{\ln x_0}{2}
\]

\[
\ln \left( \frac{2}{x_0} \right)
\]

\[
\ln \left( \frac{x_0}{2} \right)
\]

No, the answer is incorrect.
Score: 0
Accepted Answers:

\[
\frac{\ln 2}{x_0}
\]

6) The time dependent Schrödinger equation contains a wave function \( \psi(t) \) associated with the system being studied. If the Hamiltonian is time independent, the solution of the equation

\[
i \hbar \frac{\partial \psi(t)}{\partial t} = \hat{H} \psi(t)
\]

is

\[
\psi(t) = e^{i \hat{H} \hbar / \psi(0)}
\]
\[ \psi(t) = e^{i\frac{\hat{H}t}{\hbar}} \psi(0) \]

\[ \psi(t) = e^{-i\frac{\hat{H}t}{\hbar}} \psi(0) \]

\[ \psi(t) \text{ is a constant, independent of time} \]

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

\[ \psi(t) = e^{i\frac{\hat{H}t}{\hbar}} \psi(0) \]

7) A related mathematical problem for this lesson is the solution of differential equation

\[ \frac{d\psi(x)}{dx} + ky(x) = 0 \text{ where } k \text{ is independent of } x. \]

the solution of \( y(x) \) is given as

- \( y(x) = e^{-kx} y(0) \)
- \( y(x) = \text{constant and independent of } x \)
- \( y(x) = e^{kx} y(0) \)
- \( y(x) = ke^{-x} y(0) \)

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

\[ y(x) = e^{-kx} y(0) \]

8) For the function \( f(x) = (2 - kx)e^{-kx} \), the minimum of \( f(x) \) is at

- \( x = k \)
- \( x = \frac{3}{k} \)
- \( x = \frac{1}{k} \)
- \( x = \frac{k}{3} \)

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

\( x = \frac{3}{k} \)

9) For the function \( (x - 2)e^{-kx} \), the maximum is given by

- \( x = k \)
- \( x = 2 + \frac{1}{k} \)
- \( x = \frac{1}{k} \)
- \( x = 2 \)

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

\( x = 2 + \frac{1}{k} \)

10)
The integral \( \int_0^\infty e^{-kx} \, dx \) is \( \frac{1}{k} \); \( k > 0 \). For \( n \), an integer in the range \( 0 < n < \infty \), the value of the integral \( \int_0^\infty x^n e^{-kx} \, dx \) is

\[
\frac{n!}{k^n} \quad n!
\]

\[
\frac{n!}{k^{n+1}} \quad k
\]

No, the answer is incorrect.

Score: 0

Accepted Answers:

\[
\frac{n!}{k^{n+1}}
\]