TEST SERIES GATE 2019

BOOKLET SERIES B

ATOMIC & MOLECULAR PHYSICS + QM + CLASSICAL MECHANICS

Paper Code: PH

Test Type: TEST SERIES

Duration: 2:30 Hours

PHYSICS-PH

Date: 14-01-2019

Maximum Marks: 100

Read the following instructions carefully:

1. Attempt all the questions.
2. This question paper consists of **2 sections**, General Aptitude (GA) for **15 marks** and the subject specific GATE paper for **85 marks**. Both these sections are compulsory. The GA section consists of **10** questions. Question numbers 1 to 5 are of 1-mark each, while question numbers 6 to 10 are of 2-mark each.
   The subject specific GATE paper section consists of **55** questions, out of which question numbers 11 to 35 are of 1-mark each, while question numbers 36 to 65 are of 2-mark each.
3. The question paper may consist of questions of **multiple choice type** (MCQ) and **numerical answer type**.
4. Multiple choice type questions will have four choices against (a), (b), (c), (d), out of which only **ONE** is the correct answer.
5. For numerical answer type questions, each question will have a numerical answer and there will not be any choices**.**
6. All questions that are not attempted will result in zero marks. However, wrong answers for multiple choice type questions (MCQ) will result in **NEGATIVE** marks. For all MCQ questions a wrong answer will result in deduction of ⅓ marks for a **1-mark** question and ⅔ marks for a **2-mark** question.
7. There is **NO NEGATIVE MARKING** for questions of **NUMERICAL ANSWER TYPE**.
8. Non-programmable type Calculator is allowed

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Q.1-Q. 5 carry ONE mark each.

1. Two guns are fired from red fort on independence day at an interval of 6 minutes, but a person approaching red fort in a train hears the second sound after 5 minutes of the first sound. What is the speed of train, if the speed of sound is 330 m/sec.
(a) 80 m/sec (b) 66 m/sec (c) 50 m/sec (d) 100 m/sec

2. Ranjan leaves from his house and walks 3 km facing the north, then he turns to his right and walks further 8 km. Next he takes a left turn and walks for 3 km more. What is the distance between his starting point and final point.
(a) 11 km (b) 10 km (c) 14 km (d) 8 km

3. One man can do a piece of work in x-days and another man does it in y-days. Together they can do the work in z-days. What is the value of z in terms of x, y ?
(a) $\frac{x+y}{xy}$ (b) $\frac{1}{x}+\frac{1}{y}$ (c) $\frac{xy}{x+y}$ (d) $\frac{xy}{x-y}$

4. In the following question, out of the four alternatives, select the alternative which best expresses the meaning of the idiom/phrase.
To kick the habit
(a) To start a healthy practice (b) To make a habit of hurting other's feelings
(c) To overcome an addiction (d) To have the habit of overcoming obstructions.

5. In the following question, out of the four alternatives, select the alternative which best expresses the meaning of the idiom/phrase.
To zip it
(a) To move along very fast (b) Send a parcel by post
(c) A rude way of telling someone to stop talking (d) To put something precious in a safe place

Q.6-Q. 10 carry TWO marks each.

6. A shopkeeper sells 60 toys at discount of 40 % on the marked price and makes 20 % profit. Ten toys of the total are destroyed in accident while selling the remaining toys, how much discount should be given on the printed price so, that he can make the same amount of profit ?
(a) 20 % (b) 28 % (c) 40 % (d) 35 %

7. Find the missing sequence in the letter series : BY, EV, KP, TG, ___ ?
(a) FU (b) AZ (c) FR (d) BY

8. If a equilateral triangle and a square has sides in the ratio 4 : 3, then what is the ratio of the area of the triangle and the square ?
(a) $4:\sqrt{3}$ (b) $3\sqrt{3}:4$ (c) $4:3\sqrt{3}$ (d) 16 : 9

9. A sentence has been given with a blank to be filled with an appropriate word. Choose the correct alternative. They were _____ because all their plans had gone away.
(a) Defeated (b) Rejected (c) Elated (d) Distraught

10. A sentence has been given with a blank to be filled with an appropriate word. Choose the correct alternative. This brings nothing else _____ joy to us.
(a) than (b) from (c) but (d) to

Q.11-Q.35 carry one mark each.

11. A voltage applied to an X-ray being increased n times, the short wvaelength limit of X-ray continuous spectrum shifts by $d\lambda = 26\ pm\left(\text{pico-meters}\right)$. If $n=\frac{3}{2}$, the initial voltage applied to the tube is _____KV. (Upto two decimal places).

12. The possible values of $\vec{L}\cdot\vec{S}$ for $L=1$ and $S=\frac{1}{2}$ are

(a) $\hbar^2$ and $-\hbar^2$ (b) $-\hbar^2$ and $\frac{\hbar^2}{2}$ (c) $\frac{\hbar^2}{2}$ and $\frac{2\hbar^2}{3}$ (d) $-\frac{\hbar^2}{2}$ and $\frac{\hbar^2}{4}$

13. The wavelength of the resonance line emitted in the transition, $n = 2$ to $n = 1$ for He^+ is _____Å. (Upto two decimal places). [Given : $R_\infty = 1.097\times10^7\ m^{-1}$]

14. A sample of certain element is placed in a magnetic field of 1 Tesla and suitably excited. The Zeeman shift for the 600 nm spectral line of this element will be _____Å. (Upto two decimal places).

15. The ground state term for an atom is $^2P_{3/2}$. The given atom is
(a) ^7N (b) ^{12}Mg (c) ^{30}Zn (d) ^{17}Cl

16. The stationary state of an electron of mass '*m*' in a Hydrogen atom is given by

$$\psi(\vec{r}) = \frac{1}{4\sqrt{2\pi a_0^3}}\left(2-\frac{r}{a_0}\right)e^{-\frac{r}{2a_0}} \quad \left[a_0 \equiv \frac{\hbar^2}{me^2} \text{ is Bohr radius}\right]$$

Expectation value of potential energy for this state is,

(a) $+\frac{me^4}{4\hbar^2}$ (b) $-\frac{me^4}{8\hbar^2}$ (c) $-\frac{me^4}{16\hbar^2}$ (d) $-\frac{me^4}{4\hbar^2}$

17. $[\hat{A},\hat{B}]$ is a Hermitian operator. Which of the following is a possibility?

(a) $\hat{A}\equiv i\hat{x}, \hat{B}\equiv\frac{d}{dx}$ (b) $\hat{A}\equiv\hat{x}, \hat{B}\equiv\frac{d}{dx}$ (c) $\hat{A}\equiv e^{\hat{p}}, \hat{B}\equiv\frac{d^2}{dx^2}$ (d) $\hat{A}\equiv\hat{L}_x, \hat{B}\equiv\hat{L}_y$

18. A photon of wavelength λ scatters off an electron by 'θ' and the scattered photon again scatters off another electron by '$\theta/2$'. If the total shift in photon wavelength is 7.2 pm, the value of θ is _____ (degrees). [The answer is an integer]

19. A constant electric field $\vec{E} = E_0\hat{i}$ is applied on a 1-D infinite potential well that spans from '0' to 'a'.First order correction to ground state energy is _____(in units of E_0a). [Answer upto 2 decimal places]

20. Consider a pair of 2 electron systems 'A' and 'B' where electrons are in singlet and triplet states respectively.

$\frac{\langle\vec{s}_1\cdot\vec{s}_2\rangle|_A}{\langle\vec{s}_1\cdot\vec{s}_2\rangle|_B}$ is equal to,

(a) + 3 (b) –3 (c) $\frac{1}{3}$ (d) $-\frac{1}{3}$

21. The reflection co-efficient, when a 9 eV beam of particles is incident on a step potential of 5 eV is R_1. If the potential height is increased to 8 eV, new reflection co-efficient will be _____(in units of R_1)
[Answer upto two decimal places]

22. The hamiltonian of a system is of the form

$$H_0 = V_0\begin{pmatrix}1&2&0\\2&1&0\\0&0&-1\end{pmatrix}$$

to which a perturbation is applied $H_P = \delta\begin{pmatrix}1&0&0\\0&-1&0\\0&0&0\end{pmatrix}$

The first order correction to the excited state energy is _____δ. [Answer is an integer]

23. $|\phi_1\rangle$ and $|\phi_3\rangle$ are the respective ground state and second excited states of a symmetric potential system. $|\psi\rangle = \frac{1}{\sqrt{5}}\left[|\phi_1\rangle + 2i|\phi_3\rangle\right]$ is an eigenstate of the parity operator with an eigen value _____. [The answer is an integer].

24. If $\{|\ell, m\rangle\}$ are the normalized simultaneous eigenstates of $\hat{L}^2$ and $\hat{L}_z$, $\langle \ell, m|L_+ L_-|\ell, m\rangle$ is equal to

(a) $\left[\ell(\ell+1) - m(m-1)\right]\hbar^2$ (b) $\left[\ell(\ell+1) - m(m+1)\right]\hbar^2$

(c) $\left[\ell(\ell-1) + m(m-1)\right]\hbar^2$ (d) $\left[\ell(\ell-1) + m(m+1)\right]\hbar^2$

25. Consider two spherical blackbodies having a temperature ratio of 1 : 2 and radius ratio of 2 :1. If P is the total power emitted by the first one, the total power emitted by the second one is _____ (in units of P) [The answer is an integer]

26. Consider the spin state of an electron to be

$$|\chi\rangle = \frac{1}{\sqrt{3}}|\uparrow\rangle + \sqrt{\frac{2}{3}}|\downarrow\rangle$$

The value of $\langle e^{\hat{s}_z} \rangle$ for this state is

(a) $\frac{e^{\hbar/2} + e^{-\hbar/2}}{2}$ (b) $\frac{e^{\hbar/2} - e^{-\hbar/2}}{2}$ (c) $\frac{2e^{\hbar/2} + e^{-\hbar/2}}{3}$ (d) $\frac{e^{\hbar/2} + 2e^{-\hbar/2}}{3}$

27. A particle is moving in a closed orbit under a central force $F = -\frac{\beta}{r^6}$. Time period of revolution of the particle depends on its energy E as

(a) $E^{-5/6}$ (b) $E^{-5/4}$ (c) $E^{-3/4}$ (d) $E^{-2/3}$

28. Two blocks of masses m and $3m$ are connected by a spring of force constant K and made to oscillate. Angular frequency of oscillation of the system is

(a) $\sqrt{\frac{K}{m}}$ (b) $\sqrt{\frac{2K}{m}}$ (c) $\sqrt{\frac{4K}{3m}}$ (d) $\sqrt{\frac{3K}{2m}}$

29. Assume Earth to be uniform solid sphere of radius R. If gravitational pressure at the centre of Earth is P_0, then pressure at difference $r = \frac{R}{2}$ from centre will be

(a) $\frac{P_0}{4}$ (b) $\frac{P_0}{2}$ (c) $\frac{3P_0}{4}$ (d) $\frac{2P_0}{3}$

30. Two particles each of mass m are moving in circle of radius r under mutual attraction. Angular momentum of system is $N\sqrt{Gm^3 r}$. The value of N is _____(answer should be an integer).

31. A mixture of two non-reactive diatomic ideal gases A_2 and B_2 is kept in a rigid container. If the bond between the atoms of molecule A_2 is rigid and that of between the atoms of molecule B_2 is non-rigid, the ratio of molar specific heat at constant pressure of gases A_2 and B_2 is

(a) $\frac{5}{7}$ (b) $\frac{7}{9}$ (c) $\frac{5}{6}$ (d) $\frac{7}{8}$

32. In how many different ways can we arrange three particles among four different boxes, with no more than one per box, if the particles are distinguishable ?

(a) 4 (b) 6 (c) 12 (d) 24

33. For a system in thermal equilibrium at temperature T, the value of variance of energy is given by temperature T,

($\beta = \frac{1}{k_B T}$ and z is the partition function of the system)

(a) $\frac{\partial^2}{\partial \beta^2} \ln z$ (b) $-\frac{\partial^2}{\partial \beta^2} \ln z$ (c) $\frac{1}{\beta}\frac{\partial}{\partial \beta} \ln z$ (d) $-\frac{1}{\beta}\frac{\partial}{\partial \beta} \ln z$

34. An ideal gas having N molecules is enclosed in a rigid container of volume V. If a doubling the temperature of the gas, the mean free path becomes x times the initial value of the mean free path. The value of x is _____[Specifiy your answer in integers].

35. A container of volume V has a photon gas at temperature T. If the photon gas undergoes free expansion till its temperature falls to half of its initial temperature T, the final volume of the photon gas is _____V. [Specify your answer in integers].

Q.36-Q.65 carry TWO marks each.

36. The reduced mass of diatomic molecule X is μ times the reduced mass of diatomic molecule Y. Considering the molecules as rigid rotator, the shift in spectral line corresponding to a transition $J = 2 \rightarrow J = 3$ for both the molecules in terms of rotational constant B is

(a) $\frac{3B\mu}{(\mu - 1)}$ (b) $\frac{4B(\mu - 1)}{\mu}$ (c) $\frac{6B(\mu - 1)}{\mu}$ (d) $\frac{4B\mu}{(\mu - 1)}$

37. If fundamental mode of H^1Cl^{35} occurs at Wcm–1 and that of D^2Cl^{35} occurs at $x\omega cm^{-1}$, then the value of x is _____(upto two decimal places).

38. A substance shows a Raman line at 4567 Å when exciting line 4358Å isused. The position of Antistokes line for the same substance for the exciting line 4047Å is _____Å (Upto two decimal places).

39. The number of hyperfine components of Na $\left(I = \frac{3}{2}\right)$ for the transition $^2P_{3/2} \rightarrow {}^2S_{1/2}$ is

(a) 4 (b) 6 (c) 7 (d) 10

40. Choose the correct option from the following

(a) Lande g-factor for the term $^2P_{3/2}$ is $\frac{2}{3}$

(b) The number of lines observed in Anomalous Zeeman pattern for $^2D_{3/2} \rightarrow {}^2P_{1/2}$ are 5

(c) The number of lines observed for the $4^2F \rightarrow 4^2D$ transition in fine structure of sodium are 3

(d) The number of lines allowed for first line of L-series in fine structure of X-ray spectra are 6.

41. Consider the numbers:

$a_1 = \frac{\sqrt{2}}{1+i}, \quad a_2 = e^{\frac{7\pi i}{8}}, \quad a_3 = \frac{3+4i}{5}$

which of the above can possibly be eigenvalues of a matrix satisfying $e^{i\hat{H}}$, where $\hat{H}$ is the hamiltonian of a quantum system ?

(a) a_1 and a_2 (b) a_2 and a_3 (c) a_1 and a_3 (d) all of them

42. The radial wavefunction of a Hydrogen atom stationary state of energy (–0.85) eV has 2 nodes. $\langle L^2 \rangle$ for this state is _____ (in units of $\hbar^2$) [The answer is an integer]

43. The energy of the 3rd excited state of a rigid rotator of moment of inertia 'I' is equal to the energy of the 2nd excited state of a half-harmonic oscillator of frequency 'ω'. The vaue of 'ω' is,

(a) $\frac{12\hbar}{11I}$ (b) $\frac{11\hbar}{12I}$ (c) $\frac{8\hbar}{9I}$ (d) $\frac{9\hbar}{8I}$

44. The minium excitation energy (E_1) when 6 electrons are placed in a 2-D box is 0.75 eV. The side length of the box is _____nm. [Answer upto two decimal Places]

45. Two protons are placed in a 1-D harmonic oscillator of frequency 'ω'. If in the ground state configuration of the system, total spin is zero, which of the following discribes the spatial part of the wave function?

[ϕ_0 and ϕ_1 are the ground state and the first excited states, respectively ; x_1 and x_2 denote the positions of the two protons]

(a) $\frac{1}{\sqrt{2}}[\phi_0(x_1)\phi_1(x_2) - \phi_0(x_2)\phi_1(x_1)]$ (b) $\frac{1}{\sqrt{2}}[\phi_0(x_1)\phi_1(x_2) + \phi_0(x_2)\phi_1(x_1)]$

(c) $[\phi_0(x_1)\phi_1(x_2)]$ (d) $\phi_0(x_1)\phi_0(x_2)$

46. $\{|\psi_1\rangle, |\psi_2\rangle, |\psi_3\rangle\}$ constitute an orthnormal basis.Consider two states given by,

$|\psi_1\rangle = 3|\phi_1\rangle + |\phi_2\rangle + |\phi_3\rangle$

$|\psi_2\rangle = 4|\phi_1\rangle + 3|\phi_2\rangle + c|\phi_3\rangle$

If $|\psi_1\rangle$ and $|\psi_2\rangle$ are orthogoral to each other, the probability of finding $|\phi_3\rangle$ upon measuring $|\psi_2\rangle$ is _____[Answer upto two decimal place]

47. A potential of the form

$$V = \frac{1}{2}m\omega^2(x^2 + 4y^2 + \alpha z^2)$$

has a ground state energy of $3\hbar\omega$. The order of degeneracy of the third excited state is _____.
[The answer is an integer]

48. Consider a 3-D isotropic harmonic oscillator of frequency 'ω'. $\langle i[L_x, y] \rangle$ for the ground state of a particle of mass 'm' in this potential is

(a) zero (b) $\sqrt{\frac{\hbar}{m\omega}}$ (c) $\sqrt{\frac{\hbar}{2m\omega}}$ (d) $\sqrt{\frac{2\hbar}{m\omega}}$

49. Lagrangian of a particle is $L = \frac{1}{2}m(\dot{r}^2 + r^2\dot{\theta}^2) + \frac{GMm}{r}$. If p_θ be generalized momentum conjugate to θ and H be Hamiltonian of system then value of $\dot{p}_\theta$ is

(a) $\frac{p_\theta}{m}$ (b) $\frac{2p_\theta}{m}$ (c) $\frac{p_\theta}{2m}$ (d) zero

50. Lagrangian of a system is $L = \frac{1}{2}m(\dot{x}^2 + \dot{y}^2) - \frac{1}{2}m\omega^2(\dot{x}y - \dot{y}x)$. If L_z be z component of angular momentum and H be Hamiltonian then value of $\frac{dL_z}{dt}$ is

(a) p_z (b) z (c) $L_y - xp_z$ (d) zero

51. Lagrangian of a system is

$L = \dot{x}\dot{y}xy$

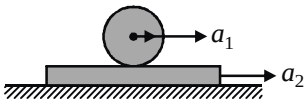
corresponding Lagrangian of the system is

(a) $-\frac{p_x p_y}{xy}$ (b) $\frac{p_x p_y}{xy}$ (c) $xyp_x p_y$ (d) $-xyp_x p_y$

52. Value of Poisson bracket $\{\vec{p}\cdot\vec{L}, \vec{r}\cdot\vec{p}\}$ is, where $\vec{p}, \vec{L}$ and $\vec{r}$ are momentum, angular momentum and position vector respectively.

(a) $2\vec{r}$ (b) $2\vec{p}$ (c) $2\vec{L}$ (d) zero

53. A circular disc rolls on a planck which slides on smooth horizontal surface. If a_1 and a_2 be the respective accelerations of disc and planck with respect to surface, then value of a_2/a_1 is _____(answer should be an integer).



54. A particle of mass *m* is attached to a string of length *l* and whirled in a horizontal circle on a smooth plane. The length of string is slowly reduced at constant rate β. After what time tension in string will become 8 times

(a) l/β (b) $2l/\beta$ (c) $l/2\beta$ (d) $l/4\beta$

55. A particle of unit mass initially at rest is subjected to a force $F = t - t^3$. The maximum speed attained by the particle before it stops is _____. (Upto two decimal places)

56. A uniform stick of mass *M* and length *L* is held in horizontal position with end *B* on edge of table and the other end *A* held at rest by hand. The vertical acceleration of centre of mass at the moment its end *A* is released, is

(a) g (b) $g/2$ (c) $2g/3$ (d) $3g/4$

57. Consider a photon in quantum state of energy 0.1 eV in an over at 500K. The chemical potential of a photon is zero. How much more likely(approximately) are we to find 0 photons than 1 photon in this particular state?

(a) 10 (b) 5 (c) 3 (d) 1

58. The Maxwell-Boltzmann speed distribution for N molecules of an ideal gas at temperature T is given by

$$f(v) = 4\pi\left(\frac{M}{2\pi RT}\right)^{3/2} v^2 \exp\left(\frac{-Mv^2}{2RT}\right)$$

where *M* is the molar mass of the gas and $0 < v < \infty$. The value of $\langle v\rangle\left\langle\frac{1}{v}\right\rangle$ is

(a) 3 (b) $\frac{1}{3}$ (c) 2 (d) $\frac{1}{2}$

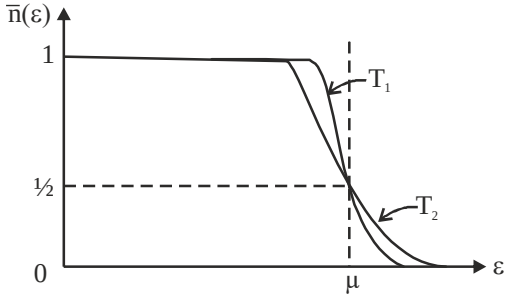
59. The correct relativistic formula that relates momentum to energy at all speeds is

$\varepsilon^2 = p^2c^2 + m_0^2c^4$, where m_0 is the rest mass of the each particle

The density of states $g(\varepsilon)$ varies with energy ε as

(a) ε (b) $\sqrt{\varepsilon^2 - m_0^2c^4}$ (c) $\varepsilon\sqrt{\varepsilon^2 - m_0^2c^4}$ (d) $\frac{\sqrt{\varepsilon - m_0^2c^4}}{\varepsilon}$

60. The occupation number $\bar{n}(\varepsilon)$ for Fermi-Dirac statistics, at two different temperature T_1 and T_2 is shown below.



If μ is the chemical potential of the fermions, which of the following is correct?

(a) $T_1 < T_2$ (b) $T_1 > T_2$ (c) $T_1 = T_2$ (d) Can't conclude

61. The Gibbs free energy of a gas is given as

$$G = Nk_BT \ln\left(\frac{P}{P_0}\right) - BP$$

where B is a function of T only and other variables have their standard corresponding meaning. The equation of the gas is

(a) $P(V-B) = Nk_BT$ (b) $P(V+B) = Nk_BT$

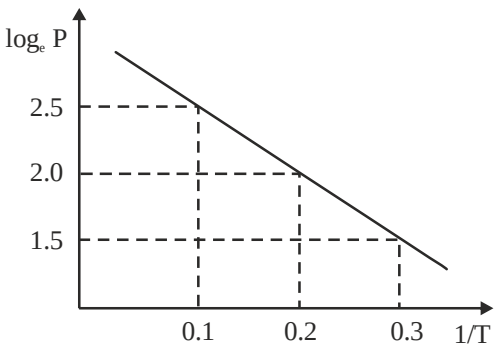
(c) $P(V+2B) = Nk_BT$ (d) $P(V-2B) = Nk_BT$

62. Two Bosons are distributed in a system in thermal equilibrium at temperature T where two energy levels $-\varepsilon/2$ and $\varepsilon/2$ are available to each Boson. The Helmholtz free energy of the system is

(a) $-k_BT \ln\left[1+2\sinh\frac{\varepsilon}{k_BT}\right]$ (b) $k_BT \ln\left[1+2\sinh\frac{\varepsilon}{k_BT}\right]$

(c) $-k_BT \ln\left[1+2\cosh\frac{\varepsilon}{k_BT}\right]$ (d) $k_BT \ln\left[1+2\cosh\frac{\varepsilon}{k_BT}\right]$

63. Consider the first order phase transition of the sublimation of camphor. Assume the vapour to be an ideal gas and the molar volume of the solid to be negligible, the variation of logarithmic of vapour pressure P with inverse temperature (where P is in Pascal and T is in Kelvin) is shown below:



The value of latent heat of sublimation is _____J/mol. [Specifiy your answer to one place after decimal].

64. Consider a 1-D system of N distinghuishable, identical particles fixed at their lattice site at temperature *T*. If an external potential energy, $V(x) = -V_0 e^{-x^2}$, $0 < x < \infty$ is applied on the system, the average value of *x* is _____[Specify your answer to two places after the decimal places].

65. Consider a system of six distinghuishable spin-½ particles each with magnetic moment μ. If an external magnetic field B is applied on the system, the entropy of the system, when the total energy of the system is $2\mu_0 B$, is

(a) $2k_B \ln 3 + k_B \ln 5$ (b) $k_B \ln 3 + 2k_B \ln 5$ (c) $k_B \ln 3 + k_B \ln 5$ (d) $2k_B \ln 3 + 2k_B \ln 5$

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Space for rough work

PHYSICS-PH

GATE TEST SERIES-B

Date: 14-01-2019

ATOMIC & MOLECULAR PHYSICS + QM + CLASSICAL MECHANICS

ANSWER KEY

1. (b)	**2.** (b)	**3.** (c)	**4.** (c)	**5.** (c)
6. (b)	**7.** (a)	**8.** (c)	**9.** (c)	**10.** (c)
11. (15.93 to 15.95)	**12.** (b)	**13.** (303.84 to 303.87)	**14.** (0.15 to 0.18)	**15.**(d)
16. (b)	**17.** (b)	**18.** (180)	**19.** (-0.48 to -0.52)	**20.**(b)
21. (6.23 to 6.27)	**22.** (0)	**23.** (1)	**24.** (a)	**25.** (4)
26. (d)	**27.** (d)	**28.** (c)	**29.** (c)	**30.** (1)
31. (b)	**32.** (d)	**33.** (a)	**34.** (1)	**35.**(16)
36. (c)	**37.** (0.70 to 0.73)	**38.** (3882.00 to 3882.04)	**39.** (b)	**40.** (c)
41. (d)	**42.** (2)	**43.** (a)	**44.** (1.20 to 1.24)	**45.**(d)
46. (0.89 to 0.92)	**47.** (3)	**48.** (a)	**49.** (d)	**50.** (d)
51. (b)	**52.** (d)	**53.** (3)	**54.** (c)	**55.**(0.24 to 0.26)
56. (d)	**57.** (a)	**58.** (a)	**59.** (c)	**60.** (a)
61. (b)	**62.** (c)	**63.** (41 to 42)	**64.** (0.50 to 0.60)	**65.** (c)