TEST SERIES GATE 2018

BOOKLET SERIES D

Paper Code: PH

Test Type: TEST SERIES

Duration: 3:00 Hours

PHYSICS

Date: 24-01-2018

Maximum Marks: 100

Read the following instructions carefully:

1. Attempt all 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. The digit in the unit position of the integer
$\lfloor 1 + \lfloor 2 + \lfloor 3 + ... + \lfloor 99$ is _____

2. If $\frac{x-4}{-x^2-6} \le \frac{2}{-x^2-6}$, then
(a) $x \le 2$ (b) $x \ge 2$ (c) $x \le 6$ (d) $x \ge 6$

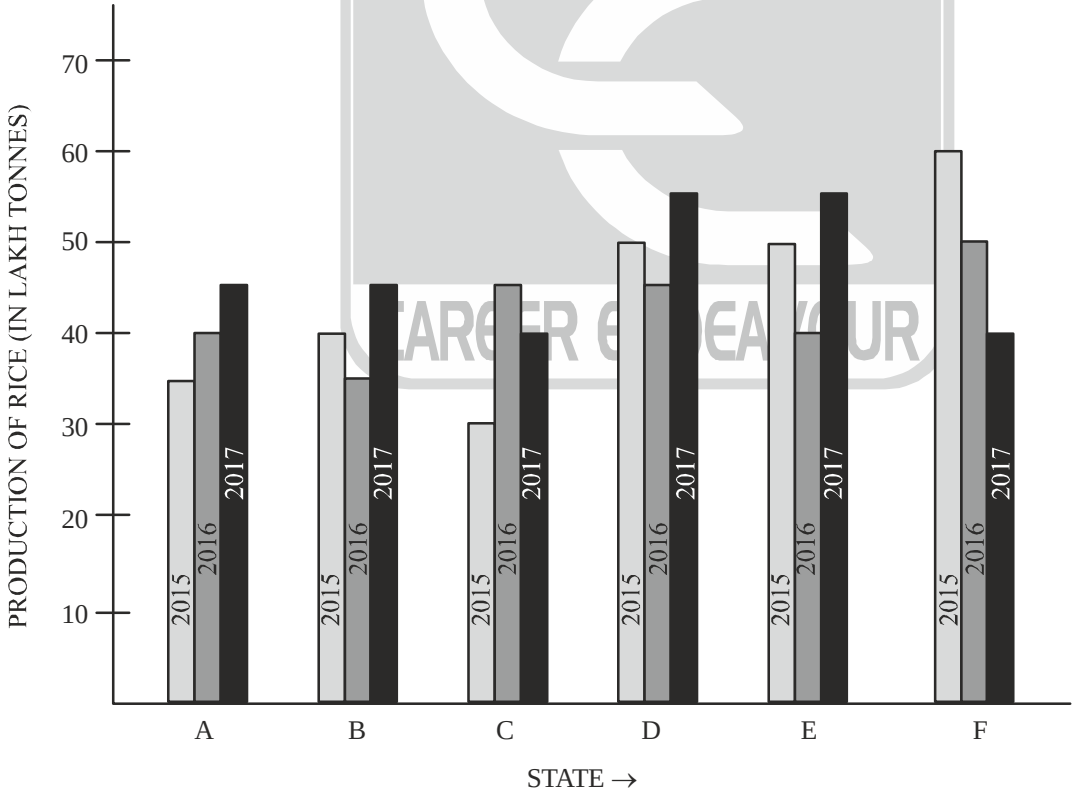
3. In a flag, there are 50 paise coins, 25 paise coins and rupee coins, proportional to the numbers 3, 4 and $2\frac{1}{2}$. If the amount to Rs, 210, then number of rupee coins is
(a) 42 (b) 105 (c) 83 (d) 157

4. Choose the most appropriate word from the options given below to complete the following sentence. The official aswered _____that the complaints of the citizen would be looked into
(a) respectably (b) respectfully (c) reputably (d) respectively

5. Choose the statement where underlined word is used correctly
(a) The minister insured the victims that everything would be all right
(b) He ensured that the company will not have to bear any loss
(c) The actor got himself ensured against any accident
(d) The teacher insured students of good result.

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

6. The graph shows the production of rice in 6 states in 2015, 2016 and 2017.
What is the ratio of minimum production and maximum production in any of the given states in any of the given years?



(a) 1 : 2 (b) 2 : 3 (c) 1 : 3 (d) 3 : 4

7. If 'FRIEND' is coded as 'HUMJTK', how is 'CANDLE' written in that code?
(a) EDRIRL (b) DCQHQV (c) ESJFME (d) FYOBOC

8. The word similar in meaning to 'dreary' is
(a) cheerful (b) dreamy (c) hard (d) dismal

9. Fill in the blank with the correct idiom/phrase
That boy from the town was a _____in the sleepy village
(a) dog out of herd (b) sheep from the heap
(c) fish out of water (d) bird from the flock

10. Consider the statement
"Every house in every locality has atleast one member serving in either, Indian army or Indian airforce"
Negation of this statement is
(a) There is a house in every locality that has no member serving in either Indian army or Indian airforce.
(b) There is a house in a locality that has all the members serving in either Indian army or Indian airforce.
(c) There is a house in a locality that has no member serving in either Indian army or Indian airforce.
(d) Every house in a locality has all the members serving in either Indian army or Indian airforce.

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

11. The average kinetic energy of an electron in the n = 3 state of Li^{++} is _____eV (upto one decimal places)

12. A spin ½ particle is in a state

$$|\psi\rangle = \frac{1}{\sqrt{2}}|\uparrow\rangle - \frac{1}{\sqrt{2}}|\downarrow\rangle$$

where $|\uparrow\rangle$ and $|\downarrow\rangle$ are the eigenstates of $\hat{S}_z$ operator. The expectation value of the spin angular momentum measured along *x*-direction , is

(a) $\frac{\hbar}{2}$ (b) $-\frac{\hbar}{2}$ (c) 0 (d) $\hbar$

13. The value of the commutator bracket $\left[\hat{x}^4, \hat{p}_x^2\right]$ is

(a) $4i\hbar\left\{\hat{x}^2, \hat{p}_x^2\right\}$ (b) $2i\hbar\left\{\hat{x}^2, \hat{p}_x^2\right\}$ (c) $2i\hbar\left\{\hat{x}^3, \hat{p}_x\right\}$ (d) $4i\hbar\left\{\hat{x}^3, \hat{p}_x\right\}$

14. Let $|\ell, m_\ell\rangle$ be the simultaneous eigenkets of $\hat{L}^2$ and $\hat{L}_z$ respectively. The value of $\left\langle 2, 0\left|\hat{L}_x - i\hat{L}_y\right|2,1\right\rangle$ is _____ $\hbar$ (upto two decimal places)

15. An electron makes a transition from the valence band to the conduction band in a direct band gap semiconductor. Which of the following is not true?
(a) there is momentum change in the electron (b) a photon is absorbed in the process
(c) electrons and hole pairs are created (d) the threshold of continuous optical absorption at frequency

16. An intrinsic material A has an energy gap 0.36 eV while material B has an energy gap of 0.72 eV. The ratio of intrinsic carriers densities $\frac{n_i(A)}{n_i(B)}$ at 300K is _____

17. The highest spin multiplicity of the spectroscopic terms resulting from the LS coupling of a $2p^1\ 3p^1\ 4d^1$ electrons.
(a) 1 (b) 2 (c) 3 (d) 4

18. If the mass of the electron will be halved then ground state energy of the He^+ will
(a) increase (b) decrease (c) remain same (d) can't say

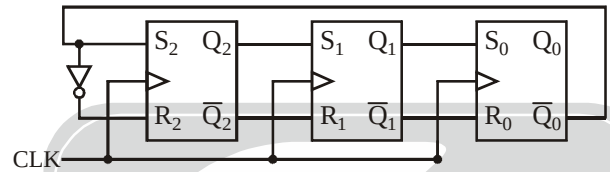
19. The reduced mass of a molecule A is twice the reduced mass of a molecule B and also force constant of molecule A is twice the force constant of molecule B. Then the ratio of their ground state energy of pure vibrational motion is _____

20. If the reaction, $\pi^- + p \longrightarrow X + \Sigma^-$ proceeds via strong interaction, then the value of isospin I and its third component I_3 of the particle X are respectively

(a) $\frac{1}{2}$ and $\frac{1}{2}$ (b) $\frac{1}{2}$ and $-\frac{1}{2}$ (c) 1 and 1 (d) 1 and –1

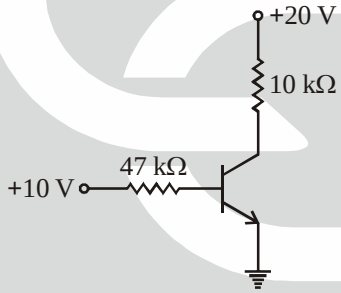
21. For the reaction, $\pi^- + p \to k^+ + \Sigma^-$, if $m_{\pi^-} = 136\,\frac{MeV}{c^2}$, $m_p = 938.2\,\frac{MeV}{c^2}$, $m_{k^+} = 493.8\,\frac{MeV}{c^2}$ and $m_{\Sigma^-} = 1192.5\,\frac{MeV}{c^2}$, then the threshold kinetic energy of the pions when target proton is at rest is equal to _____MeV (upto two decimal places).

22. How many different output states the following circuit is having ?



(a) 3 (b) 4 (c) 5 (d) 6

23. In the transistor circuit shown in Figure, collector-to-ground voltage is +20 V. Which of the following is the probable cause of error ?



(a) Collector-emitter terminals shorted (b) Emitter to ground connection open
(c) 10 kΩ resistor open (d) Collector-base terminals shorted

24. Which of the following cannot be Lagrangian of a particle where equation of motino is $\ddot{x} + x = 0$

(a) $\dot{x}^2 - x^2$ (b) $\dot{x}^2 - x^2 + x\dot{x}$ (c) $\dot{x}^2 - x^2 + \dot{x}e^t + xe^t$ (d) $\dot{x}^2 - x^2 + xe^t$

25. A charged particle is placed in uniform electric field. The phase space trajectory of the particle is
(a) straight line (b) ellipse (c) parabola (d) hyperbola

26. Consider the following complex function,

$$f(z) = \frac{\pi \cdot \cot(\pi z)}{z^2}$$

which of the following statements is/are **CORRECT**?

(a) $z = n(0, \pm 1, \pm 2, ...)$ are simple poles of $f(z)$
(b) $z = 0$ is a second order pole of $f(z)$
(c) $z = 0$ is a third order pole of $f(z)$.
(d) $z = 0$ is removable singular point of $f(z)$

27. The value of the integral

$$\int_0^{\infty} \sqrt[4]{x} \cdot e^{-\sqrt{x}} dx$$

is equal to _____ $\sqrt{\pi}$ (upto one decima; places)

28. A semicircular ring of radius *R* has uniform charge Q on its periphery. Its dipole moment with respect to origin at centre is

(a) QR (b) $Q\pi R$ (c) $\frac{2QR}{\pi}$ (d) $\frac{4QR}{3\pi}$

29. Magnetic field in a region through which electromagnetic waves are propagating is given to be $\vec{B} = B_0 \cos kz \cos \omega t \hat{j}$. Average value of poynting vector is $\frac{\alpha B_0^2 \omega}{\mu_0 k}$, then the value of α _____(an integer)

30. A dielectric sphere of radius *a* and permitivity ε_1 is surrounded by a dielectric shell of inner and outer radii *a* and *b* respectively. The potential inside the sphere and the shell are given respectively by $\phi_1(r, \theta) = Ar\theta$ and $\phi_2(r, \theta) = Aa^2\theta/r$. The free charge density on the interface

(a) zero (b) $(\varepsilon_2 - \varepsilon_1) A\theta$ (c) $(\varepsilon_2 + \varepsilon_1) A\theta$ (d) $\varepsilon_2 A\theta$

31. A longwire carrying current *I* lies at rest in labframe in *x*-direction. An observer moves in x-direction with velocity *v* with respect to the wire. Charge density on wire measured by the observer will be

(a) $\frac{Iv}{c^2}$ (b) $\frac{I}{c}$ (c) $\frac{Iv}{c^2\sqrt{1-v^2/c^2}}$ (d) $\frac{Iv\sqrt{1-v^2/c^2}}{c^2}$

32. The heat of melting of ice at 1 atmosphere pressure and 0°C is 1.4363 kcal/mol. The density of ice under these conditions is 0.917 g/cm^3 and the density of water is 0.9998 g/cm^3. If 1 mole of ice melted under these conditions, then the change in the internal energy will be

(a) 1.4363×10^3 *cal* (b) 1.2212×10^3 *cal* (c) 2.1321×10^3 *cal* (d) 2.2321×10^3 *cal*

33. A system consists of N very weakly interacting particles at a temperature sufficiently high such that classical statistics are applicable. Each particle has mass m and oscillates in one direction about its equilibrium position. The heat capacity at temperature T ,if restoring force is proportional to x^3.

(a) $\frac{3}{2}$Nk (b) $\frac{5}{2}$Nk (c) Nk (d) $\frac{3}{4}$Nk

34. Mass density of a circular disc of radius *R* and mass *M* is proportional to n^{th} power of distance from center of disc. If moment of inertia of disc about its axis passing through center and perpendicular to its plane lie $\frac{5}{7}MR^2$ then value of *n* is

(a) 1 (b) 2 (c) 3 `(d) 4

35. Let (p, q) and (P, Q) be two pairs of canonical variables. The transformation $Q = q^{\alpha} \cos \beta p, P = q^{\alpha} \sin \beta p$ is canonical for

(a) $\alpha = 2, \beta = \frac{1}{2}$ (b) $\alpha = 2, \beta = 2$ (c) $\alpha = 1, \beta = 1$ (d) $\alpha = \frac{1}{2}, \beta = 2$

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

36. A particle of mass *m* is moving inside a deep square well potential, extending from $x = 0$ to $x = L$. At time t = 0, the state vector of the particle is given as

$$\left|\psi\left(x, t=0\right)\right\rangle = \sqrt{\frac{2}{L}}\sin\left(\frac{3\pi x}{L}\right)$$

The uncertainty in the position of the particle, will be _____L. (Upto 2 decimal places)

37. Consider the elastic scattering of 50 MeV neutrons from a nucleus. If the scattering is due to *s* wave and *p* wave only with phase shifts $\frac{\pi}{3}$ and $\frac{\pi}{6}$ respectively, then total cross-section will be _____barn. (Upto 2 decimal places). [Given : 1 barn = 10^{-28} m^2)

38. A particle is moving in a spherically symmetric potential $V\left(r\right) = -\frac{\alpha}{r^3}$, where α is a positive constant. In a stationary state, the relation between average kinetic energy and energy of the particle is

(a) $\left\langle E_k \right\rangle = 3E$ (b) $\left\langle E_k \right\rangle = \frac{3}{5}E$ (c) $\left\langle E_k \right\rangle = \frac{3}{2}E$ (d) $\left\langle E_k \right\rangle = -\frac{1}{3}E$

39. A spherical blackbody A of radius 3 cm, is maintained at a temperature of 2000K. Another spherical black-body B of radius 5 cm, is maintained at a temperature 4000K. Let I and λ_{max} denote the total intensity of radiation and the wavelength where maximum radiation is emitted. Then

(a) $\lambda_{\max}^{A} = 2\lambda_{\max}^{B}, I_A = \frac{1}{16}I_B$ (b) $\lambda_{\max}^{A} = 2\lambda_{\max}^{B}, I_A = \frac{9}{25}I_B$

(c) $\lambda_{\max}^{A} = \frac{1}{2}\lambda_{\max}^{B}, I_A = \frac{1}{16}I_B$ (d) $\lambda_{\max}^{A} = \frac{1}{2}\lambda_{\max}^{B}, I_A = \frac{9}{25}I_B$

40. Consider a spinless particle of mass *m*, moving in an infinite potential well of length 2*L*, with walls at $x = -L$ and $x = L$

$$V\left(x\right) = \begin{cases} 0 & -L \le x \le L \\ \infty & \text{otherwise} \end{cases}$$

If the bottom of the potential, is modified by the perturbation $V_p\left(x\right) = \lambda V_0 \sin\left(\frac{\pi x}{2L}\right)$ $\left[\lambda << 1\right]$ then first order correction to ground state energy of the particle, is

(a) 0 (b) $\frac{8\lambda V_0}{3\pi}$ (c) $\frac{2\lambda V_0}{3\pi}$ (d) $\frac{\lambda V_0}{3\pi}$

41. Which of the following is not true about BCS theory of superconductivity?
(a) the electron-lattice-electron leads to an energy gap of observed magnitude
(b) an attractive interaction between electrons can lead to a ground state separated from excited state by an energy gap
(c) magnetic flux through a superconductivity ring is quantised and effective unit of charge is 2e
(d) the coherence length and penetration are not emerges as natural consequence of BCS theory.

42. The total resistivity of a sample can be written as the sum of contribution coming out from individual scattering process

$$\rho = \frac{m}{ne^2}\left(\tau_{\text{impurity}}^{-1} + \tau_{el-el}^{-1} + \tau_{el-phonon}^{-1}\right)$$

where, τ^{-1} is the scattering rate.
Which of the following is correct? (T = temperature)

(a) τ_{el-el}^{-1} goes as T^2 while $\tau_{el-phonon}^{-1}$ goes as T^5 (b) $\tau_{\text{impurity}}^{-1}$ goes as T^2 while τ_{el-el}^{-1} goes as T^3.

(c) $\tau_{el-phonon}^{-1}$ goes as T^3 (d) none of these

43. The debye temperature of carbon (diamond) is 18.50 K. The heighest lattice frequency involved in the debye theory is _____$\times 10^{13}$ Hz (correct upto 2 decimal places).

44. The magnetic moment of spectroscopic term $3p_2$, in terms of Bohr's magneton is _____

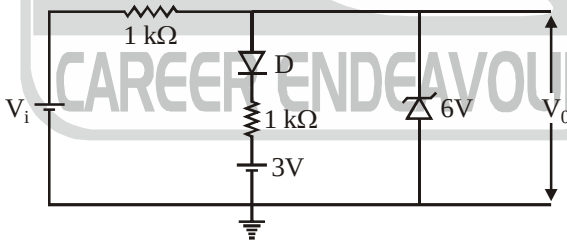
45. A sodium atom in the first excited 3p states has a lifetime of 15 ns for decaying to the gro und 3s state. The corresponding line width of the transition (in frequency) units is
(a) 1.1×10^7 Hz (b) 3.2×10^7 Hz (c) 4×10^6 Hz (d) 2.5×10^7 Hz

46. The strangeneous and hypercharge of a neutral elementary particle which has baryon number B = +1 and third component of Isospin $I_3 = ½$ are, respectively
(a) 0 and 1 (b) –1 and 0 (c) 1 and 2 (d) –2 and –1

47. $_{14}X^{27}$ and $_{13}Y^{27}$ are mirror nuclei. If their coulomb energy difference is 3 MeV, then their radius is equal to _____fermi. (upto two decimal places)

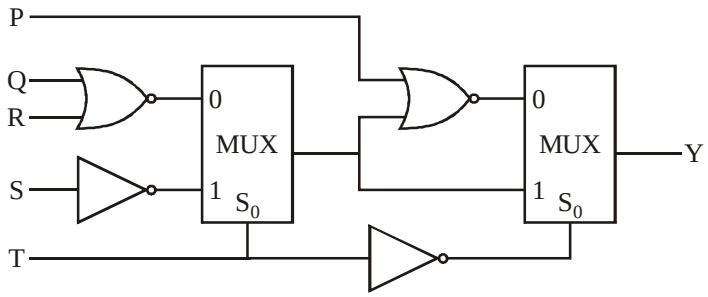
48. A diode whose terminal characteristic are related as $I_D = I_s\left(\frac{V}{V_T}\right)$, where I_s is the reverse saturation current and V_T is the thermal voltage (= 25 mV), is based at $I_D = 2\,\text{mA}$. Its dynamic resistance is _____ohms (an integer).

49. For the diode circuit shown, $V_Z = 6\,V$, V_γ of diodes to be 0.7 V the required value of V_i to get zener diode ON is



(a) $3.7 < V_i < 6\,V$ (b) $V_i > 6\,V$ (c) $3.7 < V_i < 8.3\,V$ (d) $V_i > 8.3\,V$

50. For the circuit shown in the figure, the delays of NOR gates, multiplexers and inverters are 2 ns, 1.5 ns and 1 ns, respectively. If all the inputs P, Q, R, S and T are applied at the same time instant, the maximum propagation delay (in ns) of the circuit is _____



51. A solid sphere of mass *M* and radius *R* rolls down an inclined plane of inclination θ, from a height h. If the sphere starts from rest then work done by frictional torque on the sphere during the time it take to reach bottom of inclined plane is

(a) $mgh\sin\theta$ (b) $\frac{5}{2}mgh$ (c) $\frac{2}{7}mgh$ (d) $\frac{5}{7}mgh$

52. Two particle each of rest mass m_0 are moving in $+x$ and $+y$ direction with equal speed $c/2$ with respect to lab frame. The energy of one particle in rest frame of the other is

(a) $\frac{2m_0c^2}{\sqrt{3}}$ (b) $\frac{4}{3}m_0c^2$ (c) $\frac{m_0c^2}{2}$ (d) $\frac{2m_0c^2}{\sqrt{5}}$

53. The alzebraic multiplicity of the eigenvalue $\lambda = 3$, corresponding to the following matrix

$$\begin{bmatrix} -3 & 1 & -3 \\ 20 & 3 & 10 \\ 2 & -2 & 4 \end{bmatrix}$$

is equal to _____(an integer)

54. The fourier transform of the function,

$$\left[F\{f(x)\} = \int_{-\infty}^{\infty} f(x)\, e^{-ikx} dx\right] f(x) = e^{-a|x+b|}$$

(*a*, *b* are positive real constant) will be

(a) $e^{-ikb}\cdot\frac{2a}{k^2+a^2}$ (b) $e^{ikb}\cdot\frac{2a}{k^2+a^2}$ (c) $e^{-kb}\cdot\frac{2a}{k^2+a^2}$ (d) $e^{kb}\cdot\frac{2a}{k^2+a^2}$

55. Consider the following function,

$$f(x) = \begin{cases} +1 & for\ 0 < x < 1 \\ -1 & for\ -1 < x < 0 \end{cases}$$

If $f(x)$ is represented by the following series,

$$f(x) = C_0P_0(x) + C_1P_1(x) + \ldots\ldots + C_nP_n(x) + \ldots\ldots$$

(where $P_n(x)$ is Legendre polynomial of order *n*), then the value of the coefficient C_{100} will be equal to _____(upto two decimal places)

56. Which of the following relation is/are not CORRECT?
(Symbols have their usual meanings)

(a) $\left[\hat{L}_i, \hat{L}_j\right] = i\hbar \in_{ijk} \hat{L}_k$ (b) $\left[\hat{\sigma}_i, \hat{\sigma}_j\right] = 2i \in_{ijk} \sigma_k$

(c) $\hat{\sigma}_i\ \hat{\sigma}_j = i \in_{ijk} \hat{\sigma}_k$ (d) $\vec{A}\cdot\left(\vec{B}\times\vec{C}\right) = \in_{ijk} A_i B_j C_k$

57. A long wire lying in *z*-direction carries a time varying current. At some point (*x*, *y*, *z*) near the middle of wire which of the following is true for electric field

(a) $E_x = E_y = E_z = 0$ (b) $E_x = E_y = 0, E_z \neq 0$

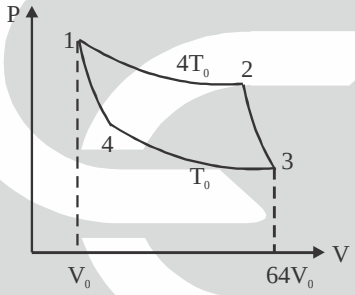
(c) $E_x = E_y \neq 0, E_z = 0$ (d) $E_x \neq 0, E_y \neq 0, E_z \neq 0$

58. A circular wire of radius R carries a current $I = I_0 \cos \omega t$. Magnetic field at the distance *r* from centre of wire for $r >> R$ and $r >> \frac{c}{\omega}$ varies as $B = kr^n$. The value of *n* is _____ (an integer)

59. When relativistic charge particle is thrown into perpendicular magnetic field. It moves in circular path. If radius of circular orbits be R_1 and R_2 for kinetic energies m_0c^2 and $2m_0c^2$ respectively then value of $\frac{R_2}{R_1}$ is _____

60. A carnot engine has a cycle as shown in the figure below. If *W* and *W* ' represents work done by 1 mole of monatomic and diatomic gas, respectively, then the ratio $\frac{W'}{W}$ _____

(Your answer should be upto two decimal places)



61. A 100 ohm resistor is held at a constant temperature of 300K. A current of 10 amperes is passed through the resistor for 300 sec. The change in entropy of the resistor is _____ (J/K)

62. The relative energy fluctuation $\frac{\sqrt{(\Delta E)^2}}{< E >}$ of an ideal gas of N atoms at temperature T is :

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

63. Consider a system of two atoms, each having only 3 quantum states of energies 0, ε and 2ε . The system is in contact with a heat reservoir at temperature T. Assume the particles obey classical statistics and are indistinguishable The partition function of the system will be

(a) $\left[1+\exp\left(-\beta\varepsilon\right)+\exp\left(-2\beta\varepsilon\right)\right]^2$ (b) $\frac{\left[1+\exp\left(-\beta\varepsilon\right)+\exp\left(-2\beta\varepsilon\right)\right]^2}{2}$

(c) $\left[\exp\left(-\beta\varepsilon\right)+\exp\left(-2\beta\varepsilon\right)+\exp\left(-3\beta\varepsilon\right)\right]$ (d) $\left[1+\exp\left(-\beta\varepsilon\right)+\exp\left(-2\beta\varepsilon\right)\right]\left[1+\exp\left(-2\beta\varepsilon\right)\right]$

64. The Lagrangian of a diatomic molecule is given by $L = \frac{m}{2}\left(\dot{x}_1^2 + \dot{x}_2^2\right) - \frac{k}{2}x_1x_2$ where, m is the mass each atom and x_1, x_2 are displacements from equilibrium position and k > 0. The normal frequencies are

(a) $\pm\left(\frac{k}{m}\right)^{1/2}$ (b) $\pm\left(\frac{k}{m}\right)^{1/4}$ (c) $\pm\left(\frac{k}{2m}\right)^{1/4}$ (d) $\pm\left(\frac{k}{2m}\right)^{1/2}$

65. The Hamiltonian of a particle is $H = \frac{p^2}{2m} + pq,$ where q is generalised coordinate and p is the corresponding canonical momentum. The Lagrangian is

(a) $\frac{m}{2}\left(\frac{dq}{dt} + q\right)^2$ (b) $\frac{m}{2}\left(\frac{dq}{dt} - q\right)^2$

(c) $\frac{m}{2}\left[\left(\frac{dq}{dt}\right)^2 + q\frac{dq}{dt} - q^2\right]$ (d) $\frac{m}{2}\left[\left(\frac{dq}{dt}\right)^2 - q\frac{dq}{dt} + q^2\right]$

Space for rough work

PHYSICS-PH

Date: 24-01-2018

GATE TEST SERIES-D

ANSWER KEY

1. (3)	**2.** (d)	**3.** (b)	**4.** (b)
5. (b)	**6.** (a)	**7.** (a)	**8.** (d)
9. (d)	**10.** (c)	**11.** (13.5 to 13.7)	**12.** (b)
13. (d)	**14.** (2.42 to 2.48)	**15.** (a)	**16.** (1010 to 1020)
17. (d)	**18.** (a)	**19.** (1)	**20.** (a)
21. (899 to 891)	**22.** (d)	**23.** (b)	**24.** (d)
25. (c)	**26.** (c)	**27.** (1.5)	**28.** (a)
29. (0)	**30.** (c)	**31.** (c)	**32.** (b)
33. (d)	**34.** (c)	**35.** (d)	**36.** (0.26 to 0.29)
37. (0.07 to 0.09)	**38.** (a)	**39.** (a)	**40.** (a)
41. (d)	**42.** (a)	**43.** (3.86)	**44.** (3.64 to 3.69)
45. (a)	**46.** (d)	**47.** (7.75 to 7.79)	**48.** (12.4 to 12.7)
49. (d)	**50.** (7)	**51.** (c)	**52.** (b)
53. (2)	**54.** (b)	**55.** (0)	**56.** (c)
57. (b)	**58.** (–1)	**59.** (1.63 to 1.65)	**60.** (0.32 to 0.34)
61. (0)	**62.** (a)	**63.** (b)	**64.** (d)
65. (b)			