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PG-EE-201/6

SUBJECT: Physics

| A | | 11857 Sr. No. |
|------------------------------|---------------------|------------------------------|
| Time: 11/4 Hours | Max. Marks: 100 | otal Questions : 100 |
| Roll No. (in figures) | _ (in words) | |
| Name | Father's Name | |
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| (Signature of the Candidate) | 1000 | ighature of the Invigilator) |

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2 E A L

- **1.** A body starts from rest and moves with a constant acceleration. The ratio of the distance covered in *n*th second to the distance covered in *n* seconds is :
 - (1) $\frac{2}{n} \frac{1}{n^2}$
- (2) $\frac{1}{n^2} \frac{1}{n}$
- (3) $\frac{2}{n^2} \frac{1}{n}$

- (4) $\frac{2}{n} + \frac{1}{n^2}$
- **2.** A particle moves in a straight line so that after 't' seconds, the distance from a fixed point O on the line is given as $x = (t-2)^2(t-5)$. Then:
 - (1) after 2 sec., velocity of particle is zero
 - (2) after 2 sec., the particle reaches O
 - (3) the acceleration is negative, for t < 3 sec.
 - (4) all the three before
- **3.** A solid body rotates about a stationery axis so that its angular velocity depends on the rotational angle φ as $\omega = \omega_0 k\varphi$; ω_0 and k being positive constants & at t = 0, $\varphi = 0$. The time dependence of the rotational angle is :
 - (1) $k\omega_0 e^{-kt}$

(2) $\frac{\omega_0}{k}e^{-kt}$

- $(3) \quad \frac{\omega_0}{k} \left(1 e^{-kt} \right)$
- $(4) \frac{k}{\omega_0} \left(e^{-kt} 1 \right)$
- **4.** A particle of mass m is moving in a horizontal circle of radius r under a centripetal force $\left(-k/r^2\right)$, k being a constant, then:
 - (1) the total energy is (-k/2r)
 - (2) the kinetic energy is (k/r)
 - (3) the potential energy is (k/2r)
 - (4) the kinetic energy is (-k/r)

5. An elastic string of length 'L' and force constant 'k' is stretched by a length x. Thereafter, it is further stretched by another small length 'y', then the work done in second stretching is:

(1)
$$ky^2/2$$

(2)
$$k(x^2+y^2)/2$$

(3)
$$k(x+y)^2/2$$

(4)
$$ky(2x + y)/2$$

6. A smooth steel ball strikes a fixed smooth steel plate at an angle ' θ ' with the vertical. If the coefficient of restitution is 'e', the angle of rebounce will be:

(2)
$$\tan^{-1}(\tan\theta/e)$$

(3)
$$e \tan \theta$$

(4)
$$\tan^{-1}(e/\tan\theta)$$

7. Four masses 1, 2, 3 and 4 kg. each are placed at the corners A, B, C and D of a square ABCD of edge 1 m. If A is taken as origin & AB and AD edges as x axis and y axis respectively, then the coordinates of the centre of mass in SI are:

8. A particle of mass 'm' rotating in a circle of radius 'a' with a uniform angular speed ω_0 is viewed from a frame rotating about z axis with a uniform angular speed ω . The centrifugal force on the particle is :

(1)
$$m\omega^2 a$$

(2)
$$m\omega_{0}^{2}a$$

(3)
$$m[(\omega + \omega_0)/2]^2 a$$

(4)
$$m\omega\omega_0 a$$

9. A particle of mass m is free to move along x-axis has a potential energy $U(x) = k(1 - e^{-x^2})$ for $-\infty \le x \le \infty$, k being a positive constant. Then:

(1) at points away from the origin, the particle is in unstable equilibrium

(2) for any non zero value of x, there is a force directed away from the origin

(3) if its total mechanical energy is k/2, it has the minimum kinetic energy at origin

(4) for small displacement from x = 0, it executes SHM

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| 10. | If for two rings of radius R and nR made up of same material, the ratio of moment of inertia about an axis passing through the centre is 1:8, then the value of 'n' is: | | | | | |
|-----|---|-----------------|-------|---------|--|--|
| | (1) 2 | (2) $2\sqrt{2}$ | (3) 4 | (4) 1/2 | | |

- 11. A highly rigid cubical block of mass 'm' and side 'L' is fixed rigidly on to another cubical block 'B' of same dimensions and lower modulus of rigidity η such that the lower face of 'A' completely covers the upper face of 'B'. The lower face of 'B' is held rigidly on a horizontal surface. A small force F is applied perpendicular to one of the side faces of 'A'. After the force is withdrawn, 'A' executes small oscillation with a time period:
 - (1) $2\pi(\eta mL)^{1/2}$

(1) 2

(2) $2\pi (m\eta/L)^{1/2}$

(3) $2\pi (mL/\eta)^{1/2}$

- (4) $2\pi (m/\eta L)^{1/2}$
- 12. In a steady incomprehensible flow of a liquid:

- (1) the speed does not change if the area of cross-section changes
- (2) the speed increases if the area of cross-section increases
- (3) the speed decreases if the area of cross-section increases
- (4) bubbles are produced when the area of cross-section increases
- 13. 10000 small balls, each weighing 1g, strike one square cm of area per second with a velocity 100 m/sec. in a normal direction and rebound with same velocity. The pressure exerted on the surface is:
 - (1) $2 \times 10^3 N/m^2$

(2) $2 \times 10^5 N/m^2$

(3) $10^7 N/m^2$

- (4) $2 \times 10^7 N/m^2$
- 14. A magnet of magnetic moment 20 CGS units is freely suspended in a uniform field of intensity 0.3 CGS units. The amount of work done in deflecting it by an angle of 30° in CGS units will be:
 - (1) 6
- (2) $3\sqrt{3}$
- (3) $3(2-\sqrt{3})$
- (4) 3

15. An electronic transition in hydrogen atom results in the formation of H_{α} line of hydrogen in Lyman series. The energies associated with the electron in each of the orbits involved in the transition (in kcal mol⁻¹) are:

(1) -313.6, 34.84

(2) -313.6, -78.38

(3) -78.4, -34.84

(4) -78.4, -19.6

16. In case two bubbles of radii r_1 and r_2 come in contact with each other to form a single bubble, the resulting radius of curvature 'r' will be :

 $(1) (r_1 + r_2)/2$

 $(2) (r_1 r_2)/(r_1-r_2)$

 $(3) (r_1 r_2)/(r_1+r_2)$

 $(4) (r_1r_2)^{1/2}$

17. If a transverse wave is represented as $y = y_0 \sin 2\pi \left(ft - \frac{x}{\lambda} \right)$, then for what value of '\lambda' the maximum particle velocity is equal to four times the wave velocity?

(1) $y_0\pi$

(2) $(y_0\pi)/2$

(3) $2y_0\pi$

 $(4) (3y_0\pi)/2$

18. A drilling machine of power 10 kW is used to drill a bore in a small aluminium block of mass 8 kg. If half of the power is used up in heating of the machine or to the surroundings, the rise of temperature of the block in 2.5 minutes will be [specific heat of aluminium = $0.91 \text{ J/g}^{\circ}\text{C}$]:

(1) 103°C

(2) 130°C

(3) 105°C

(4) 30°C

Assuming nil loss of energy, the temperature of the mixture 'T', when two perfect monoatomic gases with n_1 and n_2 number of moles at temperatures T_1 and T_2 are mixed will be:

(1) $(n_1 T_2 + n_2 T_1)/(n_1 + n_2)$

(2) $(n_1 T_2 - n_2 T_1)/(n_1 + n_2)$

(3) $(n_1 T_1 + n_2 T_2)/(n_1 + n_2)$ (4) $(n_1 T_1 - n_2 T_2)/(n_1 - n_2)$

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- 20. During an adiabatic process, the specific heat is:
 - (1) zero

(2) greater than zero

(3) less than zero

- (4) infinity
- **21.** Select the *incorrect* statement :
 - (1) The angular momentum is conserved for systems possessing rotational symmetry
 - (2) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved
 - (3) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved, nothing can be predicted about the corresponding linear momentum
 - (4) None of these
- **22.** A drop of water is placed on a glass plate. A double convex lens having radius of curvature of each surface 20 cm is placed on it. The focal length of the water lens in meters is ($\mu_{water} = 1.33$):
 - (1) -0.20
- (2) 0.60
- (3) -0.60
- (4) 0.20
- 23. If electric permittivity and magnetic permeability of free space are ϵ_0 and μ_0 respectively, the index of refraction of a medium with electric permittivity and magnetic permeability ϵ and μ will be :
 - (1) $(\epsilon \mu / \epsilon_0 \mu_0)$

(2) $(\epsilon \mu / \epsilon_0 \mu_0)^{1/2}$

(3) $(\epsilon_0 \mu_0 / \epsilon \mu)$

- (4) $(\epsilon_0 \mu_0 / \epsilon \mu)^{1/2}$
- **24.** A ray of light falls on a transparent glass slab of refractive index 1.62. If the reflected and refracted rays are mutually perpendicular, the angle of incidence is :
 - (1) tan^{-1} (1.62)

(2) $tan^{-1}(1/1.62)$

- (3) $1/\tan^{-1}(1.62)$
- (4) $\tan^2(1.62)$

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| 25. A point charge Q is placed at the centre of a hemisphere. The electric through the flat surface of hemisphere is: | | |
|--|--|--|
| | (1) Q/ϵ_0 (2) zero (3) $Q/2\epsilon_0$ (4) $Q/4\epsilon_0$ | |
| 26. | A length $'l'$ of a wire is bent to form a circular coil of few turns. The maximum torquacting on the coil it is placed in a magnetic field B and a current I is passed through i will be: | |
| | (1) IBl^2 (2) $4\pi IBl^2$ (3) $IBl^2/4\pi$ (4) $I^2Bl/4\pi$ | |
| 27. | A non-relativistic proton beam passes without deviation through the region of space where there are uniform transverse mutually perpendicular electric and magnetifields with $E=120~\mathrm{kV/m}$ and $B=50~\mathrm{mT}$ respectively. The beam then strikes grounded target. If the beam current is $I=80\mathrm{mA}$, the force with which the beam strikes the target will be: | |
| | (1) $80 \mu\text{N}$ (2) $25 \mu\text{N}$ (3) $20 \mu\text{N}$ (4) $35 \mu\text{N}$ | |
| 28. | Magnetic field of an infinitely long ideal solenoid of radius R carrying current I: | |
| | (1) increases radially inside, zero outside | |
| | (2) is constant inside and zero outside | |
| | (3) is constant inside and decays as 1/r outside | |
| | (4) is constant inside and decays as $e^{-(1/r)}$ outside | |
| 29. | A metal rod moves at a constant velocity in a direction perpendicular to its length. A constant uniform magnetic field exists in space in a direction perpendicular to the rod as well as its velocity. In such a situation: | |
| | (1) the entire rod is at same potential | |
| | (2) there is an electric field in the rod | |
| | (3) the electric potential is highest at the centre of the rod and decreases towards the ends | |

(4) the electric potential is lowest at the centre of the rod and increases towards the ends

- **30.** The average value of electric energy density in an electromagnetic wave is:

- (1) $\epsilon_0 E^2 / 2$ (2) $E^2 / 2\epsilon_0$ (3) $\epsilon_0 E^2$ (4) $\epsilon_0 E^2 / 4$
- **31.** Which of the following statements is *correct*?
 - (1) the displacement current is produced only by varying magnetic field
 - (2) the displacement current is produced only by varying electric field
 - (3) the displacement current is produced by varying magnetic field as well as varying electric field
 - (4) the displacement current is produced neither by varying magnetic field nor by varying electric field
- Two wires one of copper and another of steel having the same cross-sectional area and lengths 1.0 and 0.5 m respectively, are fastened end to end and stretched by a load M. If copper wire is stretched by 1 mm, the total extension of the combination is:

$$[Y_{\text{copper}} = 1 \times 10^{11} \text{n/m}^2, Y_{\text{steel}} = 2 \times 10^{11} \text{n/m}^2]$$

- (1) 0.125 cm (2) 0.20 cm
- (3) 0.120 cm
- (4) 0.25 cm
- 33. If one litre of a perfect gas at a pressure of 72 cm of mercury is compressed isothermally to 900 cc, the resulting stress is:
 - (1) $9.88 \times 10^3 \text{ N/m}^2$
- (2) $10.88 \times 10^3 \,\mathrm{N/m^2}$
- (3) $1.088 \times 10^3 \text{ N/m}^2$

- (4) $4.48 \times 10^3 \,\mathrm{N/m^2}$
- Which of the following is correct order in respect of r.m.s. velocity (v_{rms}), average velocity (vay) and most probable velocity (vmp)?
 - $(1) \quad v_{mp} > v_{av} > v_{rms}$

 $(2) \quad v_{rms} > v_{av} > v_{mp}$

(3) $v_{av} > v_{mp} > v_{rms}$

(4) $v_{mp} > v_{rms} > v_{av}$

which the gas is heated is:

| | (1) 1000 K | (2) 1400 K | (3) 1200 K | (4) 800 K |
|-------|-----------------------|------------------------|------------------------|---|
| 36. | If rest mass of an e | electron is 9.1 × 10 | kg, then its mass | equivalent energy is: |
| | (1) 0.511 erg | (2) 0.511 J | (3) 0.511 eV | (4) 0.511 MeV |
| 37. | A reference frame | attached to the ear | th: | ednike wyce Charle of 185 mulasiadakhi a fi 781. |
| | (1) is an inertial fr | came by definition | | va bin Als snivay . |
| | (2) can not be an i | nertial frame becau | ise the earth is revol | ving round the sun |
| | (3) is an inertial fr | ame as Newton's la | aws are applicable | an anne finale at pare |
| | (4) can not be an i | nertial frame becau | se the earth is rotati | ng about its own axis |
| 38. | | | | ough the laboratory with a bserver in the laboratory is: |
| | (1) more than one | micro-second | (2) 1.0 μ sec | |
| | (3) less than one r | nicro-second | (4) 0.09 μ sec | |
| 39. | In an L-C circuit: | | | |
| | (1) the energy stor | red in L as well as i | n C is magnetic ener | ·gy |
| | (2) the energy stor | red in L is magnetic | but in C it is electri | cal energy |
| | (3) the energy stor | red in L is electrical | but in C it is magne | etic energy |
| | (4) the energy stor | red in L as well as i | n C is electrical ener | gy |
| 40. | dissipated due to | current induced i | n the coil. If the n | etic field. Electrical power is number of turns were to be wer dissipated would be: |
| | (1) halved | (2) the same | (3) doubled | (4) quadrupled |
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| | | | | |

35. 12 gms of a gas occupy a volume of 4×10^{-3} m³ at a temperature of 7°C. If the gas is heated at constant pressure, its density becomes 6×10^{-4} g/cm³. The temperature to

| 41. | The depletion region of a junction diode is formed: |
|-----|---|
| | (1) when forward bias is applied to it |
| | (2) when the temperature of the junction is reduced |
| | (3) under reverse bias |
| | (4) during the manufacturing process |
| 42. | In a full wave rectifier with R – C filter, the conduction angle of the diode is : |
| | (1) 0 (2) $<\pi$ (3) $>\pi$ (4) $=\pi$ |
| 43. | A BJT with h_{FE} value of 100 is found to be operating at I_B = 100 μA and I_C = 5 mA. The transistor is operating in the : |
| | (1) active region (2) active or saturation region |
| | (3) saturation region (4) cut-off region |
| 44. | Faster switching OFF of a p-n junction: |
| | (1) requires zero current in the reverse direction |
| | (2) requires reverse saturation current in the reverse direction |
| | (3) requires a large current in the reverse direction |
| | (4) is independent of the reverse current |
| 45. | The collector to base bias method in amplifier circuit: |
| | (1) requires low dc supply |
| | |
| | (2) requires high dc supply (3) makes operating point independent of variation in I _{co} |
| | (4) makes operating point independent of variation in β |
| | |

| 46. | In a R-C coupled CE amplifier, emitter lead resistance R _E is used to: | | | |
|-------|---|---|--|--|
| | (1) increase the load | (2) decrease the load | | |
| | (3) attain proper stability factor | (4) decrease V _{CE} voltage | | |
| 47. | In a multi stage amplifier, on increproduct: | easing the number of stages, the gain-bandwidth | | |
| | (1) remains constant | (2) increases | | |
| | (3) decreases | (4) becomes zero | | |
| 48. | A common collector amplifier has : | | | |
| | (1) high voltage gain but low curre | nt gain | | |
| | (2) low voltage gain and low current | nt gain | | |
| | (3) high output impedance but low | input impedance | | |
| | (4) low output impedance but high | input impedance | | |
| 49. | Which of the following is most suita | able for generating 1 kHz frequency? | | |
| | (1) Wien bridge oscillator | (2) Colpitt's oscillator | | |
| | (3) Hartley oscillator | (4) Tuned collector oscillator | | |
| 50. | During an isothermal expansion of a | an ideal gas : | | |
| | (1) its internal energy decreases | | | |
| | (2) its internal energy does not char | nge | | |
| | (3) the work done by the gas is equ | al to the quantity of heat absorbed by it | | |
| | (4) both (2) and (3) are correct | | | |
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P. T. O.

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| 51. | The inside and outside temperatures of a refrigerator are 270 K and 303 K respectively. Assuming the refrigerator cycle to be reversible, for every joule of work done, the heat delivered to the surrounding is: | | | | |
|-----|---|-------------------|--|---------------------------------------|--------|
| | (1) 10 J (2) 20 J | (3) | 30 J | (4) 50 J | |
| 52. | If a gas is heated at constant pressur used for up for external work [γ for g | e, then $a = 4/3$ | what percenta 3]: | age of total heat supplied is | 3 |
| | (1) 25% (2) 50% | (3) | 75% | (4) 57% | |
| 53. | The enthalpy of vaporization of wat will be: | er is 186 | 5.5 J/mol. The | entropy of its vaporization | 1 |
| | (1) $0.5 \text{JK}^{-1} \text{mol}^{-1}$ | (2) | 1.0 JK ⁻¹ mol ⁻¹ | | |
| | (3) $1.5 \mathrm{JK}^{-1} \mathrm{mol}^{-1}$ | (4) | 2.0 JK ⁻¹ mol ⁻¹ | | |
| 54. | In a biprism experiment, if the wave green light is 5.2×10^{-7} m, the vaccoincides with n th red bright band for | alue of | 'n' for which | (n+1) th green bright band | f d |
| | (1) 2 (2) 3 | (3) | 4. | (4) 1 | |
| 55. | The contrast in the fringes in any int | erferenc | ce pattern dep | ends on : | |
| | (1) fringe width | (2) | wavelength | | |
| | (3) intensity ratio of the sources | (4) | distance bety | veen the sources | |
| 56. | Yellow light emitted by a sodium laby monochromatic blue light of the | amp in \ same in | Young's doubl tensity, then : | e slit experiment is replace | d |
| | (1) the fringe width will decrease | | | | |
| | (2) the fringe width will increase | | | | |
| | (3) the fringe width will be unchan | ged | | | |
| | (4) the intensity of the fringes will | decrease | | | |

| 57. | Ratio of adiabatic ela | sticity to isotherma | al ela | sticity is: | William State Military | .645 |
|-------|---|----------------------------|--------|--------------------------|------------------------|--------|
| | (1) 0 | (2) 1 | (3) | γ | (4) 1/γ | |
| 58. | The enthalpy 'H' alor | ng an isothermal cu | ırve | for an ideal gas i | s: | -1 |
| | (1) constant | | (2) | variable | | |
| | (3) infinite | | (4) | unpredictable | | |
| 59. | A system of non-interproportional to $\sqrt{\epsilon}$, particle at T = 0 K is | where ϵ is the en | | | | |
| | (1) $\varepsilon_f/6$ | | (2) | $\epsilon_f/5$ | | |
| | (3) $2\varepsilon_f/5$ | | (4) | $3\varepsilon_{\rm f}/5$ | | |
| 60. | Gibb's potential rema | ains constant in wh | ich o | f the following? | | |
| | (1) isothermal proce | SS | (2) | isobaric process | | |
| | (3) both (1) and (2) | | (4) | adiabatic proces | S | |
| 61. | The coefficient of diff | fusion is: | | | | |
| | (1) directly proportion | onal to pressure an | d inv | versely proportion | nal to (temperature |) 2 |
| | (2) inversely propor | tional to pressure a | and d | irectly proportion | nal to (temperature) |) 2 |
| | (3) directly proportion | onal to pressure an | d inv | versely proportion | nal to (temperature) | 3/2 |
| | (4) inversely propor | tional to pressure a | ind d | irectly proportio | nal to (temperature) | 3/2 |
| 62. | The ratio of average $[M_{Br} = 80 M_{H}]$ | speed of hydroger | n an | d bromine gas n | nolecules at 27°C w | ill be |
| | (1) $\sqrt{1/80}$ | | (2) | $\sqrt{80}$ | | |
| | (3) $\sqrt{40}$ | | (4) | $\sqrt{1/40}$ | oscienski (i) | |
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- **63.** Which of the following is the correct Clapeyron's latent heat relation?
 - $(1) \quad \frac{dP}{dT} = \frac{L}{T(V_2 V_1)}$

 $(2) \quad \frac{dL}{dT} = \frac{P}{T(V_1 - V_2)}$

 $(3) \quad \frac{dV}{dT} = \frac{L}{V(P_1 - P_2)}$

- (4) $\frac{dP}{dT} = \frac{L(V_2 V_1)}{T}$
- **64.** In Fresnel's biprism experiment, the distance between the biprism and the screen is 4 m. The angle of the prism is 2×10^{-3} radian and the refractive index is 1.5. If the fringewidth on screen is 15×10^{-4} m, the number of fringes is :
 - (1) 3
- (2) 2
- (3) 6
- (4) 8

- 65. Polarisation of light proves the:
 - (1) corpuscular nature of light
- (2) quantum nature of light
- (3) transverse nature of light
- (4) longitudinal nature of light
- **66.** For two coherent monochromatic light beams of intensities *I* and 4*I* super imposed on each other, the maximum and minimum possible intensities in the resulting beams are:
 - (1) 5I and I
- (2) 5I and 3I
- (3) 9I and I
- (4) 9I and 3I
- **67.** The first diffraction minimum due to single slit diffraction is θ for incident radiation of 5000 Å. If the width of the slit is 1×10^{-4} cm, the value of θ is :
 - (1) 30°
- (2) 45°
- (3) 60°
- (4) 15°
- **68.** Two points at a distance of 0.1 mm from each other can just be inspected in a microscope under incident radiation 6000 Å. If instead the radiation is changed to 4800 Å, the limit of resolution will be:
 - (1) 0.80 mm

(2) 0.12 mm

(3) 0.10 mm

(4) 0.08 mm

| 69. | | | glass plate at an angle of incidence equal efractive index of glass, the angle between |
|-----|--|-------|--|
| | (1) 90° + φ | (2) | $\sin^{-1}(\mu \cos \phi)$ |
| | (3) 90° | (4) | $\sin^{-1}(\mu \sin \phi)$ |
| 70. | Two Nicol prisms are first crossed and percentage of light transmitted is : | the | n one of them is rotated through 60°. The |
| | (1) 1.25 | (2) | 25.0 |
| | (3) 37.5 | (4) | 50.0 |
| 71. | The ratio of de-Broglie wavelength of energy is: | an | α -particle and a proton of same kinetic |
| | (1) 1:2 | (2) | 1:1 |
| | (3) $1:\sqrt{2}$ | (4) | 4:1 |
| 72. | X-rays are used for structural analysis o | f cry | vstals as these: |
| | (1) have the wavelength of the order of | the | inter-atomic spacing |
| | (2) are highly penetrating radiations | | |
| | (3) have the wavelength of the order of | the | nuclear size |
| | (4) are highly coherent in nature | | |
| 73. | A radioactive nuclide is emitting beta p heated to a very high temperature, the r | | cles at a certain rate. When this nuclide is of emission will: |
| | (1) increase | (2) | decrease |

(4) fluctuate

(3) remain the same

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74. The fission of uranium nuclide:

- (1) always leads to same pair of fission products, say barium and krypton
- (2) does not always produce barium and krypton but different pair of fission products
- (3) produces barium and any other fission product
- (4) always produces at least one radioactive fission product

75. Mirror nuclei are those which have:

- (1) the same number of protons
- (2) the same number of neutrons
- (3) the number of protons equal to the number of neutrons
- (4) the number of neutrons in one equal to the number of protons in the other

76. Beta rays emitted in a radioactive material are:

- (1) electromagnetic radiations
- (2) electrons orbiting around the nucleus
- (3) charged particles emitted by the nucleus
- (4) neutral particles in the nucleus
- 77. The radio active decay of an element X to elements Y and K is represented by the equation $\frac{A}{Z}X \to \frac{A}{Z+1}Y \to \frac{A-4}{Z-1}K \to \frac{A-4}{Z-1}K$. The sequence of emitted radiations is:
 - (1) α, β, γ

(2) β, α, γ

(3) γ, α, β

(4) β, γ, α

(3) 89Ac ²²⁵

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| | | | - |
|-----|---|---|----|
| 78. | Atomic explosion is the result of : | PACE Steman State Commence of the Commence of | |
| | (1) uncontrolled chain reaction in fission | on | |
| | (2) controlled chain reaction in fusion | | |
| | (3) uncontrolled chain reaction in fusion | on | |
| | (4) controlled chain reaction in fission | na na maranta da maran Maranta da maranta da m | |
| 79. | | on a crystal and the second order reflection of at an angle of 45°. The lattice constant of th | |
| | $(1) \lambda/\sqrt{2} $ | (3) λ (4) 2λ | |
| 80. | The amount of a substance that gives 3. | $.7 \times 10^7$ disintegration per second (dps) is : | |
| | (1) one becquerel | (2) one curie | |
| | (3) one mili-curie | (4) one rutherford | |
| 81. | Only $1/8^{th}$ of the original amount of a The value of $t_{1/2}$ of the material is : | radioactive material remains after 96 minutes | s. |
| | (1) 12 minutes | (2) 32 minutes | |
| | (3) 24 minutes | (4) 48 minutes | |
| 82. | The weight of 1 curie $_{82}\text{Pb}^{214}$ ($t_{1/2} = 26.8$ | 8 min.) in grams is: | |
| | (1) 3.1×10^{-8} g | (2) $1.55 \times 10^{-8} \text{ g}$ | |
| | (3) $6.2 \times 10^{-8} \text{ g}$ | (4) $3.1 \times 10^{-10} \mathrm{g}$ | |
| 83. | The final product, if $_{92}U^{235}$ emits two α | and one β particle, will be : | |
| | (1) $\operatorname{cr} A c^{221}$ | (2) $m \wedge c^{235}$ | |

(4) 89Ac²²⁷

| 84. | Stern Gerlach experiment proves the ex- | ister | ace of: |
|-----|--|--------|--|
| | (1) electronic charge | (2) | electron dipole moment |
| | (3) electron spin | (4) | electron mass |
| 85. | An electron with energy E incident upon thickness <i>l</i> , then the transmission coefficient | | potential barrier of V such that V > E and |
| | (1) is zero | | |
| | (2) proportional to <i>l</i> ² | | |
| | (3) increases exponentially with thickn | ess | |
| | (4) decreases exponentially with thickr | ness | Sandy Sandyanik (i) the |
| 86. | The probability of finding an electron in | n a h | ydrogen atom is: |
| | (1) independent of <i>r</i> | (2) | independent of θ |
| | (3) independent of φ | (4) | independent of all the three before |
| 87. | In case of a rigid rotator, the rotational | freq | uency is given as: |
| | (1) $\hbar L^2/2\pi I$ | (2) | $\hbar L/2\pi I$ |
| | (3) $\hbar L/2\pi I^2$ | (4) | $\hbar L/2\pi(2I+1)$ |
| 88. | The energy between two adjacent level | s is § | given by: |
| | (1) (2n + 1) times the zero point energy | 7 | |
| | (2) $(2n-1)$ times the zero point energy | 7 | |
| | (3) 2n ² times the zero point energy | | Edicate etal opticulation, pr |
| | (4) n² times the zero point energy | | |

| | (1) 13.6 eV | (2) 27.2 eV |
|-------|---|---|
| | (3) 40.8 eV | (4) 122.4 eV |
| 90. | The wave function considered to be $\psi(x) = \sqrt{2/L} \sin(\pi x/L)$ in the region 0 in the region $0 < x < L/2$ is: | be confined within a box of length L is $< x < L$. The probability of finding the particle |
| | (1) 0 (2) 1/2 | (3) 1 (4) 0.66 |
| 91. | The axial parameter $a = b \neq c$ and $\alpha = system$: | $\beta = 90^{\circ}$, $\gamma = 120^{\circ}$ correspond to the following |
| | (1) Tetragonal | (2) Cubic |
| | (3) Hexagonal | (4) Rhombohedral |
| 92. | If the Lagrangian L is not an explicit fur | nction of time, the Hamiltonian H is: |
| | (1) Zero | (2) Constant of motion |
| | (3) Infinity | (4) Variable with motion |
| 93. | For Bose-Einstein condensation to happ | en, which of the following is true? |
| | (1) Number of particles decreases temperatures and low pressures | rapidly in lower energy levels at high |
| | (2) Number of particles increases rapid and low pressures | ly in lower energy levels at high temperatures |
| | (3) Number of particles decreases rapid and high pressures | dly in lower energy levels at low temperatures |
| | (4) Number of particles increases rapic and high pressures | lly in lower energy levels at low temperatures |
| PG-EE | -2016/(Physics)/(A) | |
| | | |

89. The ionization potential of Li^{+2} ions using Bohr's theory is :

- **94.** The value of radius of the Fermi sphere of a degenerate free electron gas at zero temperature, having N particles contained in volume V is given as:
 - (1) $(3\pi^2)^{1/3}(N/V)^{2/3}\hbar$

(2) $(3\pi^2)^{1/3}(N/V)^{1/6}\hbar$

(3) $(3\pi^2)^{1/3}(N/V)^{1/3}\hbar$

- (4) $(3\pi^2)^{1/3}(N/V)^{1/2}\hbar$
- 95. The hyperfine splitting of spectral lines of an atom is due to:
 - (1) coupling between spins of two or more electrons
 - (2) coupling between spins and orbital angular momenta of the electrons
 - (3) coupling between electron spins and the nuclear spins
 - (4) None of the above
- **96.** The energy separation between two consecutive stokes lines in Raman scattering depends on :
 - (1) Wavelength of the incident light
 - (2) Energy separation between vibrational levels in the excited states
 - (3) Intensity of the incident light
 - (4) Energy separation between vibrational levels in the ground state
- 97. The Debye theory of specific heat is valid at:
 - (1) room temperature

- (2) low temperature
- (3) intermediate temperature
- (4) all temperature
- 98. For a bcc crystal, the first Brillouin zone is a :s
 - (1) cube

- (2) Rectangular parallelepiped
- (3) Truncated octahedron
- (4) Regular rhombic dodecahedron

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- **99.** Which of the following is *not* the use of Hall's effect?
 - (1) Determination of the sign of charge carriers
 - (2) Determination of number density of charge carriers
 - (3) Measurement of potential difference
 - (4) Measurement of magnetic field
- **100.** What is the behaviour of the pure *Si* crystal at absolute zero temperature?

 - (1) behaves as perfect conductor (2) behaves as perfect insulator
 - (3) contains no electron (4) none of the above

The Cabre Medit of specific heat is valid of the

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PG-EE-2016

SUBJECT: Physics

| В | 33 | 11894 Sr. No. |
|------------------------------|---------------------|-----------------------------|
| Time: 11/4 Hours | Max. Marks: 100 | / Total Questions : 100 |
| Roll No. (in figures) | _ (in words) | |
| Name | Father's Name | No. |
| Mother's Name | Date of Examination | X. |
| (Signature of the Candidate) | (3) | gnature of the Invigilator) |

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- 1. All questions are compulsory.
- 2. The candidates *must return* the duestion booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means/misbehaviour will be registered against him/her, in addition to lodging of an FIR with the police. Further the answer sheet of such a candidate will not be evaluated.
- 3. In case there is any discrepancy in any question(s) in the Question Booklet, the same may be brought to the notice of the Controller of Examinations in writing within two hours after the test is over. No such complaint(s) will be entertained thereafter.
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- 5. There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.
- 6. Use only Black or Blue Ball Point Pen of good quality in the OMR Answer-Sheet.
- 7. Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained 30 minutes after starting of the examination.

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EAL

| | (1) when forward bias is applied to | it | |
|-------|---|------------------------------|--------------------------------------|
| | (2) when the temperature of the june | ction is reduced | idasi saraker rasaka (2). |
| | (3) under reverse bias | | |
| | (4) during the manufacturing proces | SS | |
| 2. | In a full wave rectifier with R – C filt | er, the conduction an | gle of the diode is: |
| | (1) 0 (2) $<\pi$ | (3) > π | $(4) = \pi_{\text{exercise}} (0)$ |
| 3. | A BJT with h_{FE} value of 100 is four The transistor is operating in the : | | $I_B = 100 \mu A$ and $I_C = 5 mA$. |
| | (1) active region | (2) active or satu | |
| | (3) saturation region | (4) cut-off region | |
| 4. | Faster switching OFF of a p-n junction | on: | |
| | (1) requires zero current in the reve | | |
| | (2) requires reverse saturation curre | ent in the reverse direct | ction |
| | (3) requires a large current in the re | verse direction | (I) Wien bridge oscill |
| | (4) is independent of the reverse cur | rrent | |
| 5. | The collector to base bias method in | amplifier circuit : | |
| | (1) requires low dc supply | | |
| | (2) requires high dc supply | | |
| | (3) makes operating point independ | dent of variation in Ico | |
| | (4) makes operating point independ | dent of variation in β | en (School Gederation) |
| PG-EE | -2016/(Physics)/(B) | | (fi) (e) (Finys) (fi) P. T. O |

1. The depletion region of a junction diode is formed:

| 6. | In a R-C coupled CE amplifier, emitter lead resistance R _E is used to : | | | | |
|-------|--|---|--|--|--|
| | (1) increase the load | (2) decrease the load | | | |
| | (3) attain proper stability factor | (4) decrease V _{CE} voltage | | | |
| 7. | In a multi stage amplifier, on incr product: | easing the number of stages, the gain-bandwidth | | | |
| | (1) remains constant | (2) increases | | | |
| | (3) decreases | (4) becomes zero | | | |
| 8. | A common collector amplifier has: | and the constitution of the constitution of | | | |
| | (1) high voltage gain but low curre | nt gain | | | |
| | (2) low voltage gain and low current gain | | | | |
| | (3) high output impedance but low input impedance | | | | |
| | (4) low output impedance but high | input impedance | | | |
| 9. | Which of the following is most suita | able for generating 1 kHz frequency? | | | |
| | (1) Wien bridge oscillator | (2) Colpitt's oscillator | | | |
| | (3) Hartley oscillator | (4) Tuned collector oscillator | | | |
| 10. | During an isothermal expansion of | an ideal gas : | | | |
| | (1) its internal energy decreases | | | | |
| | (2) its internal energy does not cha | nge | | | |
| | (3) the work done by the gas is equ | al to the quantity of heat absorbed by it | | | |
| | (4) both (2) and (3) are correct | | | | |
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| 11. | The ratio of de-Broglie wavelength of an α -particle and a proton of same kinetic energy is : | |
|------|--|----|
| | (1) 1:2 (2) 1:1 (3) $1:\sqrt{2}$ (4) 4:1 | |
| 12. | X-rays are used for structural analysis of crystals as these: | |
| | (1) have the wavelength of the order of the inter-atomic spacing | |
| | (2) are highly penetrating radiations | |
| | (3) have the wavelength of the order of the nuclear size | |
| | (4) are highly coherent in nature | |
| 13. | A radioactive nuclide is emitting beta particles at a certain rate. When this nuclide is heated to a very high temperature, the rate of emission will: | |
| | (1) increase (2) decrease | |
| | (3) remain the same (4) fluctuate | |
| 14. | The fission of uranium nuclide: | 7 |
| | (1) always leads to same pair of fission products, say barium and krypton | |
| | (2) does not always produce barium and krypton but different pair of fission products | |
| | (3) produces barium and any other fission product | |
| | (4) always produces at least one radioactive fission product | |
| 15. | Mirror nuclei are those which have : | |
| | (1) the same number of protons | |
| | (2) the same number of neutrons | |
| | (3) the number of protons equal to the number of neutrons | |
| | (4) the number of neutrons in one equal to the number of protons in the other | |
| PG-E | E-2016/(Physics)/(B) |). |

| 16. | Beta rays emitted in a radioactive material are : | | | |
|-------|---|---|--|--|
| | (1) electromagnetic radiations | | | |
| | (2) electrons orbiting around the nucleu | s | | |
| | (3) charged particles emitted by the nuc | leus | | |
| | (4) neutral particles in the nucleus | | | |
| 17. | | X to elements Y and K is represented by the X. The sequence of emitted radiations is: | | |
| | (1) α, β, γ | (2) β, α, γ | | |
| | (3) γ, α, β | (4) β, γ, α | | |
| 18. | | | | |
| | (1) uncontrolled chain reaction in fission | | | |
| | (2) controlled chain reaction in fusion | | | |
| | (3) uncontrolled chain reaction in fusion | | | |
| | (4) controlled chain reaction in fission | | | |
| 19. | | a crystal and the second order reflection on at an angle of 45°. The lattice constant of the | | |
| | (1) $\lambda/\sqrt{2}$ (2) $\sqrt{2}\lambda$ | | | |
| 20. | | \times 10 ⁷ disintegration per second (dps) is : | | |
| | (1) one becquerel | (2) one curie | | |
| | (3) one mili-curie | (4) one rutherford | | |
| PG-EE | E-2016/(Physics)/(B) | (Standard The foliable) | | |

| 21. | The | | $\beta = 90^{\circ}$, $\gamma = 120^{\circ}$ correspond to the following |
|-----|-------|---|---|
| | (1) | Tetragonal | (2) Cubic |
| | (3) | Hexagonal | (4) Rhombohedral |
| 22. | If th | e Lagrangian L is not an explicit fun | action of time, the Hamiltonian H is: |
| | (1) | Zero | (2) Constant of motion |
| | (3) | Infinity | (4) Variable with motion |
| 23. | For | Bose-Einstein condensation to happe | en, which of the following is true? |
| | | Number of particles decreases temperatures and low pressures | rapidly in lower energy levels at high |
| | | Number of particles increases rapid and low pressures | ly in lower energy levels at high temperatures |
| | | Number of particles decreases rapic and high pressures | dly in lower energy levels at low temperatures |
| | | Number of particles increases rapid and high pressures | lly in lower energy levels at low temperatures |
| 24. | | value of radius of the Fermi sphe perature, having N particles contain | ere of a degenerate free electron gas at zero ed in volume V is given as: |
| | (1) | $(3\pi^2)^{1/3}(N/V)^{2/3}\hbar$ | (2) $(3\pi^2)^{1/3}(N/V)^{1/6}\hbar$ |

(4) $(3\pi^2)^{1/3}(N/V)^{1/2}h$

(3) $(3\pi^2)^{1/3}(N/V)^{1/3}\hbar$

- **25.** The hyperfine splitting of spectral lines of an atom is due to :
 - (1) coupling between spins of two or more electrons
 - (2) coupling between spins and orbital angular momenta of the electrons
 - (3) coupling between electron spins and the nuclear spins
 - (4) None of the above
- **26.** The energy separation between two consecutive stokes lines in Raman scattering depends on :
 - (1) Wavelength of the incident light
 - (2) Energy separation between vibrational levels in the excited states
 - (3) Intensity of the incident light
 - (4) Energy separation between vibrational levels in the ground state
- 27. The Debye theory of specific heat is valid at:
 - (1) room temperature
 - (2) low temperature
 - (3) intermediate temperature
 - (4) all temperature
- 28. For a bcc crystal, the first Brillouin zone is a:
 - (1) cube
 - (2) Rectangular parallelepiped
 - (3) Truncated octahedron
 - (4) Regular rhombic dodecahedron

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- **29.** Which of the following is *not* the use of Hall's effect?
 - (1) Determination of the sign of charge carriers
 - (2) Determination of number density of charge carriers
 - (3) Measurement of potential difference
 - (4) Measurement of magnetic field
- **30.** What is the behaviour of the pure Si crystal at absolute zero temperature?
 - (1) behaves as perfect conductor
 - (2) behaves as perfect insulator
 - (3) contains no electron
 - (4) none of the above
- **31.** A body starts from rest and moves with a constant acceleration. The ratio of the distance covered in *n*th second to the distance covered in *n* seconds is :

(1)
$$\frac{2}{n} - \frac{1}{n^2}$$

(2)
$$\frac{1}{n^2} - \frac{1}{n}$$

(3)
$$\frac{2}{n^2} - \frac{1}{n}$$

(4)
$$\frac{2}{n} + \frac{1}{n^2}$$

- **32.** A particle moves in a straight line so that after 't' seconds, the distance from a fixed point O on the line is given as $x = (t-2)^2(t-5)$. Then:
 - (1) after 2 sec., velocity of particle is zero
 - (2) after 2 sec., the particle reaches O
 - (3) the acceleration is negative, for t < 3 sec.
 - (4) all the three before

- **33.** A solid body rotates about a stationery axis so that its angular velocity depends on the rotational angle φ as $\omega = \omega_0 k\varphi$; ω_0 and k being positive constants & at t = 0, $\varphi = 0$. The time dependence of the rotational angle is :
 - (1) $k\omega_0 e^{-kt}$

(2) $\frac{\omega_0}{k}e^{-kt}$

 $(3) \quad \frac{\omega_0}{k} \left(1 - e^{-kt} \right)$

- $(4) \quad \frac{k}{\omega_0} \left(e^{-kt} 1 \right)$
- **34.** A particle of mass m is moving in a horizontal circle of radius r under a centripetal force $\left(-k/r^2\right)$, k being a constant, then:
 - (1) the total energy is (-k/2r)
 - (2) the kinetic energy is (k/r)
 - (3) the potential energy is (k/2r)
 - (4) the kinetic energy is (-k/r)
- **35.** An elastic string of length 'L' and force constant 'k' is stretched by a length x. Thereafter, it is further stretched by another small length 'y', then the work done in second stretching is:
 - (1) $ky^2/2$

- (2) $k(x^2+y^2)/2$
- (3) $k(x+y)^2/2$
- (4) ky(2x + y)/2
- **36.** A smooth steel ball strikes a fixed smooth steel plate at an angle '0' with the vertical. If the coefficient of restitution is 'e', the angle of rebounce will be:
 - (1)
- (2) $\tan^{-1}(\tan\theta/e)$
- (3) $e \tan \theta$

(4) $\tan^{-1}(e/\tan\theta)$

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| 37. | Four masses 1, 2, 3 and 4 kg. each are placed at the corners A, B, C and D of a square ABCD of edge 1 m. If A is taken as origin & AB and AD edges as x axis and y axis respectively, then the coordinates of the centre of mass in SI are : |
|-----|--|
| | (1) (1, 1) (2) (2.1, 3.9) (3) (0.5, 0.7) (4) (0.41, 0.93) |
| 38. | A particle of mass m' rotating in a circle of radius a' with a uniform angular speed ω_0 is viewed from a frame rotating about z axis with a uniform angular speed ω . The centrifugal force on the particle is : |
| | $(1) m\omega^2 a \qquad (2) m\omega_0^2 a$ |
| | (3) $m[(\omega + \omega_0)/2]^2 a$ (4) $m\omega\omega_0 a$ |
| 39. | A particle of mass m is free to move along x-axis has a potential energy $U(x) = k(1 - e^{-x^2})$ for $-\infty \le x \le \infty$, k being a positive constant. Then: |
| | (1) at points away from the origin, the particle is in unstable equilibrium |
| | (2) for any non zero value of x , there is a force directed away from the origin |
| | (3) if its total mechanical energy is $k/2$, it has the minimum kinetic energy at origin |
| | (4) for small displacement from $x = 0$, it executes SHM |
| 40. | If for two rings of radius R and nR made up of same material, the ratio of moment of inertia about an axis passing through the centre is 1:8, then the value of 'n' is: |
| | (1) 2 (2) $2\sqrt{2}$ (3) 4 (4) $1/2$ |
| 41. | The inside and outside temperatures of a refrigerator are 270 K and 303 K respectively. Assuming the refrigerator cycle to be reversible, for every joule of work done, the heat delivered to the surrounding is: |
| | (1) 10 J (2) 20 J (3) 30 J (4) 50 J |
| 42. | If a gas is heated at constant pressure, then what percentage of total heat supplied is used for up for external work [γ for gas = 4/3]: |
| | (1) 25% (2) 50% (3) 75% (4) 57% |

| 43. | The enthalpy of vaporization of water is 186.5 J/mol. The entropy of its vaporization will be: | | |
|------|---|--|--|
| | (1) 0.5 JK ⁻¹ mol ⁻¹ | (2) $1.0 \mathrm{JK^{-1}mol^{-1}}$ | |
| | (3) 1.5 JK ⁻¹ mol ⁻¹ | (4) 2.0 JK ⁻¹ mol ⁻¹ | |
| 44. | In a biprism experiment, if the wavelength of red light used is 6.5×10^{-7} m and that green light is 5.2×10^{-7} m, the value of 'n' for which $(n+1)$ th green bright bar coincides with n th red bright band for the same setting is given by: | | |
| | (1) 2 (2) 3 | (3) 4 (4) 1 | |
| 45. | The contrast in the fringes in any inter- | ference pattern depends on : | |
| | (1) fringe width | (2) wavelength | |
| | (3) intensity ratio of the sources | (4) distance between the sources | |
| 46. | 6. Yellow light emitted by a sodium lamp in Young's double slit experiment is repla by monochromatic blue light of the same intensity, then: | | |
| | (1) the fringe width will decrease | the and the united of the management | |
| | (2) the fringe width will increase | | |
| | (3) the fringe width will be unchanged | | |
| | (4) the intensity of the fringes will dec | rease | |
| 47. | Ratio of adiabatic elasticity to isotherm | nal elasticity is: | |
| | (1) 0 (2) 1 | (3) γ (4) 1/γ | |
| 48. | The enthalpy 'H' along an isothermal curve for an ideal gas is: | | |
| | (1) constant | (2) variable | |
| | (3) infinite | (4) unpredictable | |
| G-FF | -2016/(Physics)/(B) | | |

- **49.** A system of non-interacting Fermi particles with Fermi energy ε_f has density of states proportional to $\sqrt{\varepsilon}$, where ε is the energy of a particle. The average energy per particle at T = 0 K is :
 - (1) $\epsilon_f/6$

(2) $\varepsilon_f/5$

(3) $2\varepsilon_f/5$

- (4) $3\varepsilon_f/5$
- 50. Gibb's potential remains constant in which of the following:
 - (1) isothermal process

(2) isobaric process

(3) both (1) and (2)

- (4) adiabatic process
- **51.** The coefficient of diffusion is:
 - (1) directly proportional to pressure and inversely proportional to (temperature)²
 - (2) inversely proportional to pressure and directly proportional to (temperature)²
 - (3) directly proportional to pressure and inversely proportional to (temperature) 3/2
 - (4) inversely proportional to pressure and directly proportional to (temperature)^{3/2}
- **52.** The ratio of average speed of hydrogen and bromine gas molecules at 27° C will be $[M_{Br} = 80 \text{ M}_{H}]$
 - (1) $\sqrt{1/80}$

(2) $\sqrt{80}$

(3) $\sqrt{40}$

- (4) $\sqrt{1/40}$
- **53.** Which of the following is the correct Clapeyron's latent heat relation?
 - $(1) \quad \frac{dP}{dT} = \frac{L}{T(V_2 V_1)}$

 $(2) \quad \frac{dL}{dT} = \frac{P}{T(V_1 - V_2)}$

 $(3) \quad \frac{dV}{dT} = \frac{L}{V(P_1 - P_2)}$

(4) $\frac{dP}{dT} = \frac{L(V_2 - V_1)}{T}$

| 54. | In Fresnel's biprism experiment, the distance between the biprism and the screen is 4 m. The angle of the prism is 2×10^{-3} radian and the refractive index is 1.5. If the fringewidth on screen is 15×10^{-4} m, the number of fringes is : | | | | |
|-----|---|------|-------------|--------------------|--|
| | (1) 3 (2) 2 | (3) | 6 | (4) 8 | |
| 55. | Polarisation of light proves the: | | | | |
| | (1) corpuscular nature of light | (2) | quantum i | nature of light | |
| | (3) transverse nature of light | (4) | longitudir | al nature of light | |
| 56. | For two coherent monochromatic light each other, the maximum and minim are: | | | * | |
| | (1) $5I$ and I (2) $5I$ and $3I$ | (3) | 9I and I | (4) 9I and 3I | |
| 57. | The first diffraction minimum due to single slit diffraction is θ for incident radiation of 5000 Å. If the width of the slit is 1×10^{-4} cm, the value of θ is : | | | n | |
| | (1) 30° (2) 45° | (3) | 60° | (4) 15° | |
| 58. | Two points at a distance of 0.1 mm microscope under incident radiation 4800 Å, the limit of resolution will be | 6000 | | | |
| | (1) 0.80 mm | (2) | 0.12 mm | | |
| | (3) 0.10 mm | (4) | 0.08 mm | | |
| 59. | A ray of light is incident on the surface of a glass plate at an angle of incidence equa to Brewster's angle ϕ . If μ represents the refractive index of glass, the angle between the reflected and refracted rays is : | | | | |
| | (1) 90° + φ | (2) | sin-1(μ cos | (φ) | |

(4) $\sin^{-1}(\mu \sin \phi)$

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(3) 90°

| | | | | | 1 |
|-----|--------------------|--|----------------------|---------------------------|----------|
| 60. | | ns are first crossed tht transmitted is : | and then one of th | em is rotated through (| 60°. The |
| | (1) 1.25 | (2) 25.0 | (3) 37.5 | (4) 50.0 | |
| 61. | Select the incorre | ect statement : | | dasan da ka kata pa | |
| | (1) The angular | momentum is cons | served for systems p | oossessing rotational syn | mmetry |

- (2) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved
- (3) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved, nothing can be predicted about the corresponding linear momentum
- (4) None of these
- **62.** A drop of water is placed on a glass plate. A double convex lens having radius of curvature of each surface 20 cm is placed on it. The focal length of the water lens in meters is ($\mu_{water} = 1.33$):
 - (1) -0.20
- (2) 0.60
- (3) -0.60
- (4) 0.20
- **63.** If electric permittivity and magnetic permeability of free space are ϵ_0 and μ_0 respectively, the index of refraction of a medium with electric permittivity and magnetic permeability ϵ and μ will be :
 - (1) $(\epsilon \mu / \epsilon_0 \mu_0)$

(2) $(\epsilon \mu / \epsilon_0 \mu_0)^{1/2}$

(3) $(\epsilon_0\mu_0/\epsilon\mu)$

- (4) $(\epsilon_0 \mu_0 / \epsilon \mu)^{1/2}$
- **64.** A ray of light falls on a transparent glass slab of refractive index 1.62. If the reflected and refracted rays are mutually perpendicular, the angle of incidence is :
 - (1) tan^{-1} (1.62)

(2) $tan^{-1}(1/1.62)$

(3) $1/\tan^{-1}(1.62)$

 $(4) \tan^2(1.62)$

| * | | | | |
|-----|----------------------|---|------------------------|--|
| 65. | | e Q is placed at the at surface of hemispl | | nere. The electric flux passing |
| | (1) Q/ε ₀ | (2) zero | (3) $Q/2\varepsilon_0$ | (4) $Q/4\varepsilon_0$ |
| 66. | | | | v turns. The maximum torque current <i>I</i> is passed through it, |

67. A non-relativistic proton beam passes without deviation through the region of space where there are uniform transverse mutually perpendicular electric and magnetic fields with E = 120 kV/m and B = 50 mT respectively. The beam then strikes a grounded target. If the beam current is I = 80mA, the force with which the beam strikes the target will be:

(2) $4\pi IBl^2$ (3) $IBl^2/4\pi$ (4) $I^2Bl/4\pi$

- (1) $80 \,\mu\text{N}$ (2) $25 \,\mu\text{N}$ (3) $20 \,\mu\text{N}$ (4) $35 \,\mu\text{N}$
- 68. Magnetic field of an infinitely long ideal solenoid of radius R carrying current I:
 - (1) increases radially inside, zero outside
 - (2) is constant inside and zero outside
 - (3) is constant inside and decays as 1/r outside
 - (4) is constant inside and decays as $e^{-(1/r)}$ outside
- **69.** A metal rod moves at a constant velocity in a direction perpendicular to its length. A constant uniform magnetic field exists in space in a direction perpendicular to the rod as well as its velocity. In such a situation :
 - (1) the entire rod is at same potential
 - (2) there is an electric field in the rod
 - (3) the electric potential is highest at the centre of the rod and decreases towards the ends
 - (4) the electric potential is lowest at the centre of the rod and increases towards the ends

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(1) IBl^2

- 70. The average value of electric energy density in an electromagnetic wave is:
 - (1) $\varepsilon_0 E^2/2$

(2) $E^2/2\varepsilon_0$

(3) $\varepsilon_0 E^2$

- (4) $\varepsilon_0 E^2 / 4$
- 71. A highly rigid cubical block of mass 'm' and side 'L' is fixed rigidly on to another cubical block 'B' of same dimensions and lower modulus of rigidity η such that the lower face of 'A' completely covers the upper face of 'B'. The lower face of 'B' is held rigidly on a horizontal surface. A small force F is applied perpendicular to one of the side faces of 'A'. After the force is withdrawn, 'A' executes small oscillation with a time period:
 - (1) $2\pi(\eta mL)^{1/2}$

(2) $2\pi (m\eta/L)^{1/2}$

(3) $2\pi (mL/\eta)^{1/2}$

- (4) $2\pi (m/\eta L)^{1/2}$
- In a steady incomprehensible flow of a liquid:
 - (1) the speed does not change if the area of cross-section changes
 - (2) the speed increases if the area of cross-section increases
 - (3) the speed decreases if the area of cross-section increases
 - (4) bubbles are produced when the area of cross-section increases
- 73. 10000 small balls, each weighing 1g, strike one square cm of area per second with a velocity 100 m/sec. in a normal direction and rebound with same velocity. The pressure exerted on the surface is:
 - (1) $2 \times 10^3 N/m^2$

(2) $2 \times 10^5 N/m^2$

 $(3) 10^7 N/m^2$

- (4) $2 \times 10^7 N/m^2$
- 74. A magnet of magnetic moment 20 CGS units is freely suspended in a uniform field of intensity 0.3 CGS units. The amount of work done in deflecting it by an angle of 30° in CGS units will be:
- (2) $3\sqrt{3}$ (3) $3(2-\sqrt{3})$ (4) 3

An electronic transition in hydrogen atom results in the formation of H_{α} line of hydrogen in Lyman series. The energies associated with the electron in each of the orbits involved in the transition (in kcal mol⁻¹) are:

(1) -313.6, 34.84

(2) -313.6, -78.38

(3) -78.4, -34.84

(4) -78.4, -19.6

76. In case two bubbles of radii r_1 and r_2 come in contact with each other to form a single bubble, the resulting radius of curvature 'r' will be :

(1) $(r_1 + r_2)/2$

(2) $(r_1 r_2)/(r_1-r_2)$

(3) $(r_1 r_2)/(r_1+r_2)$

 $(4) (r_1r_2)^{1/2}$

If a transverse wave is represented as $y = y_0 \sin 2\pi \left(ft - \frac{x}{\lambda} \right)$, then for what value of '\lambda' the maximum particle velocity is equal to four times the wave velocity?

(1) $y_0\pi$

(2) $(y_0\pi)/2$

(3) $2y_0\pi$

(4) $(3y_0\pi)/2$

78. A drilling machine of power 10 kW is used to drill a bore in a small aluminium block of mass 8 kg. If half of the power is used up in heating of the machine or to the surroundings, the rise of temperature of the block in 2.5 minutes will be [specific heat of aluminium = $0.91 \text{ J/g}^{\circ}\text{C}$]:

(1) 103°C

(2) 130°C

(3) 105°C

(4) 30°C

79. Assuming nil loss of energy, the temperature of the mixture 'T', when two perfect monoatomic gases with n_1 and n_2 number of moles at temperatures T_1 and T_2 are mixed will be:

(1) $(n_1 T_2 + n_2 T_1)/(n_1 + n_2)$

(2) $(n_1 T_2 - n_2 T_1)/(n_1 + n_2)$

(3) $(n_1 T_1 + n_2 T_2)/(n_1 + n_2)$ (4) $(n_1 T_1 - n_2 T_2)/(n_1 - n_2)$

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| 80. | During an adiabatic process, the specific | c hea | at is: |
|------|---|-------|--|
| | (1) zero | (2) | greater than zero |
| | (3) less than zero | (4) | infinity |
| 81. | Only $1/8^{th}$ of the original amount of a The value of $t_{1/2}$ of the material is : | radi | oactive material remains after 96 minutes. |
| | (1) 12 minutes | (2) | 32 minutes |
| | (3) 24 minutes | (4) | 48 minutes |
| 82. | The weight of 1 curie $_{82}\text{Pb}^{214}$ ($t_{1/2} = 26.8$ | min | .) in grams is : |
| | (1) 3.1×10^{-8} g | (2) | $1.55 \times 10^{-8} \text{ g}$ |
| | (3) $6.2 \times 10^{-8} \text{ g}$ | (4) | $3.1 \times 10^{-10} \text{ g}$ |
| 83. | The final product, if $92U^{235}$ emits two α | and | one β particle, will be : |
| | (1) 87Ac ²²¹ | (2) | 89Ac ²³⁵ |
| | (3) 89Ac ²²⁵ | (4) | 89Ac ²²⁷ |
| 84. | Stern Gerlach experiment proves the ex | ister | nce of: |
| | (1) electronic charge | (2) | electron dipole moment |
| | (3) electron spin | (4) | electron mass |
| 85. | An electron with energy E incident upon thickness <i>l</i> , then the transmission coefficients | | potential barrier of V such that V > E and |
| | (1) is zero | | |
| | (2) proportional to l^2 | | et militar steam original specific |
| | (3) increases exponentially with thickn | ess | |
| | (4) decreases exponentially with thickr | ness | |
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| | (1) independent of r | 2) independent of | fθ | | | | | | |
|-------|---|-----------------------|-----------------------------|--|--|--|--|--|--|
| | (3) independent of φ | independent of | f all the three before | | | | | | |
| 87. | In case of a rigid rotator, the rotational fre | quency is given as | 11 | | | | | | |
| | (1) $\hbar L^2/2\pi I$ (2) $\hbar L/2\pi I$ (3) | 3) $\hbar L/2\pi I^2$ | (4) $\hbar L/2\pi(2I+1)$ | | | | | | |
| 88. | The energy between two adjacent levels is | given by : | | | | | | | |
| | (1) (2n + 1) times the zero point energy | | | | | | | | |
| | (2) (2n – 1) times the zero point energy | | | | | | | | |
| | (3) 2n ² times the zero point energy | | | | | | | | |
| | (4) n² times the zero point energy | | | | | | | | |
| | , | | | | | | | | |
| 89. | The ionization potential of Li+2 ions using | Bohr's theory is: | | | | | | | |
| | (1) 13.6 eV (2) 27.2 eV (3 | 6) 40.8 eV | (4) 122.4 eV | | | | | | |
| 90. | The wave function considered to be $\psi(x) = \sqrt{2/L} \sin(\pi x/L)$ in the region $0 < x$ in the region $0 < x < L/2$ is: | | | | | | | | |
| | (1) 0 (2) 1/2 (3 |) 1 | (4) 0.66 | | | | | | |
| 91. | Which of the following statements is corre | ct? | | | | | | | |
| | (1) the displacement current is produced | only by varying m | nagnetic field | | | | | | |
| | (2) the displacement current is produced | only by varying el | ectric field | | | | | | |
| | (3) the displacement current is produced by varying magnetic field as well as varying electric field | | | | | | | | |
| | (4) the displacement current is produced varying electric field | neither by varyi | ing magnetic field nor by | | | | | | |
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86. The probability of finding an electron in a hydrogen atom is:

92. Two wires one of copper and another of steel having the same cross-sectional area and lengths 1.0 and 0.5 m respectively, are fastened end to end and stretched by a load M. If copper wire is stretched by 1 mm, the total extension of the combination is:

[$Y_{\text{copper}} = 1 \times 10^{11} \text{n/m}^2$, $Y_{\text{steel}} = 2 \times 10^{11} \text{n/m}^2$]

(1) 0.125 cm

(2) 0.20 cm

(3) 0.120 cm

- (4) 0.25 cm
- **93.** If one litre of a perfect gas at a pressure of 72 cm of mercury is compressed isothermally to 900 cc, the resulting stress is :
 - (1) $9.88 \times 10^3 \text{ N/m}^2$
- (2) $10.88 \times 10^3 \text{ N/m}^2$
- (3) $1.088 \times 10^3 \text{ N/m}^2$

- $(4) 4.48 \times 10^3 \text{ N/m}^2$
- **94.** Which of the following is correct order in respect of r.m.s. velocity (v_{rms}) , average velocity (v_{av}) and most probable velocity (v_{mp}) ?
 - $(1) \quad v_{mp} > v_{av} > v_{rms}$

 $(2) \quad v_{rms} > v_{av} > v_{mp}$

(3) $v_{av} > v_{mp} > v_{rms}$

- $(4) \quad v_{mp} > v_{rms} > v_{av}$
- **95.** 12 gms of a gas occupy a volume of 4×10^{-3} m³ at a temperature of 7°C. If the gas is heated at constant pressure, its density becomes 6×10^{-4} g/cm³. The temperature to which the gas is heated is:
 - (1) 1000 K
- (2) 1400 K
- (3) 1200 K

- (4) 800 K
- **96.** If rest mass of an electron is 9.1×10^{-31} kg, then its mass equivalent energy is :
 - (1) 0.511 erg

(2) 0.511 J

(3) 0.511 eV

(4) 0.511 MeV

|) | |
|------|--|
| 97. | A reference frame attached to the earth: |
| | (1) is an inertial frame by definition |
| | (2) can not be an inertial frame because the earth is revolving round the sun |
| | (3) is an inertial frame as Newton's laws are applicable |
| | (4) can not be an inertial frame because the earth is rotating about its own axis |
| 98. | A particle with a mean proper life of 1 μ s moves through the laboratory with a velocity 2.7×10^{10} cm/sec. Its lifetime as measured by an observer in the laboratory is : |
| | (1) more than one micro-second (2) $1.0 \mu sec$ |
| | (3) less than one micro-second (4) $0.09 \mu \text{ sec}$ |
| 99. | In an L-C circuit: |
| | (1) the energy stored in L as well as in C is magnetic energy |
| | (2) the energy stored in L is magnetic but in C it is electrical energy |
| | (3) the energy stored in L is electrical but in C it is magnetic energy |
| | (4) the energy stored in L as well as in C is electrical energy |
| 100. | A short circuited coil is placed in a time-varying magnetic field. Electrical power is dissipated due to current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be: |
| | (1) halved (2) the same |

(4) quadrupled

(3) doubled

Total No. of Printed Pages: 21

(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

PG-EE-2016 V

SUBJECT: Physics

| C | | 11895 Sr. No |
|------------------------------|---------------------|----------------------------|
| Time: 11/4 Hours | Max. Marks: 100 | Total Questions : 100 |
| Roll No. (in figures) | (in words) | 1 |
| Name | Father's Name | 0 |
| Mother's Name | Date of Examination | |
| (Signature of the Candidate) | 1, 1 / 12 | nature of the Invigilator) |

CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

- 1. All questions are compulsory
- 2. The candidates *must return* the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means/misbehaviour will be registered against him/her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
- 3. In case there is any discrepancy in any question(s) in the Question Booklet, the same may be brought to the notice of the Controller of Examinations in writing within two hours after the test is over. No such complaint(s) will be entertained thereafter.
- 4. The candidate **must not** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers **must not** be ticked in the question booklet.
- 5. There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.
- 6. Use only Black or Blue Ball Point Pen of good quality in the OMR Answer-Sheet.
- 7. Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained 30 minutes after starting of the examination.

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SEAL

- 1. Select the *incorrect* statement:
 - (1) The angular momentum is conserved for systems possessing rotational symmetry
 - (2) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved
 - (3) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved, nothing can be predicted about the corresponding linear momentum
 - (4) None of these
- **2.** A drop of water is placed on a glass plate. A double convex lens having radius of curvature of each surface 20 cm is placed on it. The focal length of the water lens in meters is ($\mu_{water} = 1.33$):
 - (1) -0.20
- (2) 0:60
- (3) -0.60
- (4) 0.20
- 3. If electric permittivity and magnetic permeability of free space are ϵ_0 and μ_0 respectively, the index of refraction of a medium with electric permittivity and magnetic permeability ϵ and μ will be :
 - (1) $(\epsilon \mu / \epsilon_0 \mu_0)$

(2) $(\epsilon \mu / \epsilon_0 \mu_0)^{1/2}$

(3) $(\epsilon_0 \mu_0 / \epsilon \mu)$

- (4) $(\epsilon_0 \mu_0 / \epsilon_\mu)^{1/2}$
- **4.** A ray of light falls on a transparent glass slab of refractive index 1.62. If the reflected and refracted rays are mutually perpendicular, the angle of incidence is:
 - (1) tan^{-1} (1.62)

(2) $tan^{-1}(1/1.62)$

- (3) $1/\tan^{-1}(1.62)$
- (4) $\tan^2(1.62)$
- **5.** A point charge Q is placed at the centre of a hemisphere. The electric flux passing through the flat surface of hemisphere is:
 - (1) Q/ϵ_0

(2) zero

(3) $Q/2\varepsilon_0$

(4) $Q/4\varepsilon_0$

will be:

(1) IBl^2

| | fields with $E = 120 \text{ kV/m}$ and $B = 50 \text{ mT}$ respectively. The beam then strikes a grounded target. If the beam current is $I = 80\text{mA}$, the force with which the beam strikes the target will be: |
|-------|--|
| | (1) $80 \mu\text{N}$ (2) $25 \mu\text{N}$ (3) $20 \mu\text{N}$ (4) $35 \mu\text{N}$ |
| 8. | Magnetic field of an infinitely long ideal solenoid of radius R carrying current I: |
| | (1) increases radially inside, zero outside |
| | (2) is constant inside and zero outside |
| | (3) is constant inside and decays as $1/r$ outside |
| | (4) is constant inside and decays as $e^{-(1/r)}$ outside |
| 9. | A metal rod moves at a constant velocity in a direction perpendicular to its length. A constant uniform magnetic field exists in space in a direction perpendicular to the rod as well as its velocity. In such a situation: |
| | (1) the entire rod is at same potential |
| | (2) there is an electric field in the rod |
| | (3) the electric potential is highest at the centre of the rod and decreases towards the ends |
| | (4) the electric potential is lowest at the centre of the rod and increases towards the ends |
| 10. | The average value of electric energy density in an electromagnetic wave is: |
| | (1) $\epsilon_0 E^2 / 2$ (2) $E^2 / 2\epsilon_0$ (3) $\epsilon_0 E^2$ (4) $\epsilon_0 E^2 / 4$ |
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6. A length '*l*' of a wire is bent to form a circular coil of few turns. The maximum torque acting on the coil it is placed in a magnetic field *B* and a current *I* is passed through it,

7. A non-relativistic proton beam passes without deviation through the region of space where there are uniform transverse mutually perpendicular electric and magnetic

(2) $4\pi IBl^2$ (3) $IBl^2/4\pi$ (4) $I^2Bl/4\pi$

| | | | | | | | | 3 |
|----|--|------------------|--------------------------------|------|--|------------------------------------|---|----------|
| 1. | The inside and respectively. Assudone, the heat del | iming th | ne refrigerator | cycl | e to be reversib | are 270 ble, for ever | K and 303 y joule of wo | K |
| | (1) 10 J | (2) 20 | 0 Ј | (3) | 30 J | (4) 50 J | nakas od I | |
| 2. | If a gas is heated used for up for ex | | | | | ge of total h | neat supplied | is |
| | (1) 25% | (2) 50 | 0% | (3) | 75% | (4) 57% | | |
| 3. | The enthalpy of v will be: | aporizat | tion of water is | 186 | 6.5 J/mol. The 6 | entropy of i | its vaporizatio | n |
| | (1) 0.5 JK ⁻¹ mol ⁻¹ | | | (2) | 1.0 JK ⁻¹ mol ⁻¹ | | | |
| | (3) $1.5 \mathrm{JK}^{-1} \mathrm{mol}^{-1}$ | | | (4) | 2.0 JK ⁻¹ mol ⁻¹ | e (15) _{Los} Establica | | |
| 4. | In a biprism exper green light is 5.2 coincides with n th | $\times 10^{-7}$ | m, the value | of | 'n' for which (| (n+1) th gree | ⁻⁷ m and that en bright bar | of nd |
| | (1) 2 | (2) 3 | | (3) | 4 | (4) 1 | | |
| 5. | The contrast in the | e fringes | s in any interfer | enc | e pattern deper | nds on: | kans in | |
| | (1) fringe width | | allendos (a) | (2) | wavelength | | | |
| | (3) intensity ratio | of the se | ources | (4) | distance betwe | en the sour | ces | |
| 6. | Yellow light emitt by monochromati | ed by a | sodium lamp ght of the same | in Y | oung's double ensity, then : | slit experim | nent is replace | ed |
| | (1) the fringe wid | th will d | decrease | | | | | |

- (2) the fringe width will increase
- (3) the fringe width will be unchanged
- (4) the intensity of the fringes will decrease

| 17. | Ratio of adiabatic elasticity to isothermal elasticity is: | | | | | |
|------|--|--|--|---------------|-------------------------------------|---|
| | (1) | 0 | (2) 1 | (3) | γ | (4) 1/γ |
| 18. | The | e enthalpy 'H' al | ong an isothermal cu | ırve | for an ideal gas i | is: |
| | (1) | constant | in a second disconsistence | (2) | variable | |
| | (3) | infinite | Little 10 | (4) | unpredictable | |
| 19. | pro | ystem of non-in portional to \sqrt{s} ticle at T = 0 K i | ε , where ε is the en | icles nerg | with Fermi ener y of a particle. | gy ϵ_f has density of state. The average energy pe |
| | (1) | $\epsilon_{\rm f}/6$ | (2) ε _f /5 | (3) | $2\epsilon_{\rm f}/5$ | (4) 3ε _f /5 |
| 20. | Gib | b's potential rer | nains constant in wh | ich (| of the following : | |
| | (1) | isothermal prod | cess | (2) | isobaric process | |
| | (3) | both (1) and (2) | ldg-back one at a | (4) | adiabatic proces | ss · · · · · · · · · · · · · · · · · · |
| 21. | Onl The | y $1/8^{th}$ of the or value of $t_{1/2}$ of | riginal amount of a the material is: | radi | oactive material | remains after 96 minutes |
| | (1) | 12 minutes | | (2) | 32 minutes | |
| | (3) | 24 minutes | | (4) | 48 minutes | rice state on |
| 22. | The | weight of 1 cur | ie $_{82}\text{Pb}^{214}$ ($t_{1/2} = 26.8$ s | min. |) in grams is: | |
| | (1) | $3.1 \times 10^{-8} \text{ g}$ | | (2) | $1.55 \times 10^{-8} \text{ g}$ | |
| | (3) | $6.2 \times 10^{-8} \text{ g}$ | | (4) | $3.1 \times 10^{-10} \text{ g}$ | |
| 23. | The | final product, if | $f_{92}U^{235}$ emits two α a | nd c | one β particle, wi | ll be : |
| | (1) | ₈₇ Ac ²²¹ | | (2) | 89Ac ²³⁵ | |
| | (3) | ₈₉ Ac ²²⁵ | | (4) | 89Ac ²²⁷ | |
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| 24. | Stern | Gerlach | experiment | proves | the | existence | of: | |
|-----|--------|---------|---------------|--------|-----|-----------|-----|--|
| | CCCTTC | CLITTCH | C'I CTITICITE | P10.00 | | CHICKETTE | O | |

(1) electronic charge

(2) electron dipole moment

(3) electron spin

- (4) electron mass
- **25.** An electron with energy E incident upon a potential barrier of V such that V > E and thickness *l*, then the transmission coefficient :
 - (1) is zero
 - (2) proportional to l^2
 - (3) increases exponentially with thickness
 - (4) decreases exponentially with thickness
- **26.** The probability of finding an electron in a hydrogen atom is:
 - (1) independent of r

(2) independent of θ

(3) independent of φ

- (4) independent of all the three before
- 27. In case of a rigid rotator, the rotational frequency is given as:
 - (1) $\hbar L^2/2\pi I$

(2) $\hbar L/2\pi I$

(3) $\hbar L/2\pi I^2$

- (4) $\hbar L/2\pi(2I + 1)$
- **28.** The energy between two adjacent levels is given by :
 - (1) (2n + 1) times the zero point energy
 - (2) (2n-1) times the zero point energy
 - (3) 2n² times the zero point energy
 - (4) n² times the zero point energy

| 29. | The ionization potential of Li ⁺² ions using Bohr's theory is: | | | | | | | | | |
|-------|---|--|--|--|--|--|--|--|--|--|
| | (1) 13.6 eV | (2) 27.2 eV | | | | | | | | |
| | (3) 40.8 eV | (4) 122.4 eV | | | | | | | | |
| 30. | The wave function considered to be confined within a box of length L is $\psi(x) = \sqrt{2/L} \sin(\pi x/L)$ in the region $0 < x < L$. The probability of finding the particle in the region $0 < x < L/2$ is : | | | | | | | | | |
| | (1) 0 | (2) 1/2 | | | | | | | | |
| | (3) 1 | (4) 0.66 | | | | | | | | |
| 31. | The ratio of de-Broglie wavelength or energy is: | f an α -particle and a proton of same kinetic | | | | | | | | |
| | (1) 1:2 | (2) 1:1 | | | | | | | | |
| | (3) $1:\sqrt{2}$ | (4) 4:1 | | | | | | | | |
| 32. | X-rays are used for structural analysis of | of crystals as these : | | | | | | | | |
| | (1) have the wavelength of the order of | f the inter-atomic spacing | | | | | | | | |
| | (2) are highly penetrating radiations | | | | | | | | | |
| | (3) have the wavelength of the order of | f the nuclear size | | | | | | | | |
| | (4) are highly coherent in nature | | | | | | | | | |
| 33. | A radioactive nuclide is emitting beta particles at a certain rate. When this nuclide is heated to a very high temperature, the rate of emission will: | | | | | | | | | |
| | (1) increase | (2) decrease | | | | | | | | |
| | (3) remain the same | (4) fluctuate | | | | | | | | |
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- 34. The fission of uranium nuclide:
 - (1) always leads to same pair of fission products, say barium and krypton
 - (2) does not always produce barium and krypton but different pair of fission products
 - (3) produces barium and any other fission product
 - (4) always produces at least one radioactive fission product
- 35. Mirror nuclei are those which have:
 - (1) the same number of protons
 - (2) the same number of neutrons
 - (3) the number of protons equal to the number of neutrons
 - (4) the number of neutrons in one equal to the number of protons in the other
- 36. Beta rays emitted in a radioactive material are:
 - (1) electromagnetic radiations
 - (2) electrons orbiting around the nucleus
 - (3) charged particles emitted by the nucleus
 - (4) neutral particles in the nucleus
- **37.** The radio active decay of an element X to elements Y and K is represented by the equation $\frac{A}{Z}X \to \frac{A}{Z+1}Y \to \frac{A-4}{Z-1}K \to \frac{A-4}{Z-1}K$. The sequence of emitted radiations is:
 - (1) α, β, γ

(2) β, α, γ

(3) γ, α, β

(4) β, γ, α

- 38. Atomic explosion is the result of:
 - (1) uncontrolled chain reaction in fission
 - (2) controlled chain reaction in fusion
 - (3) uncontrolled chain reaction in fusion
 - (4) controlled chain reaction in fission
- X-rays of wavelength λ are incident on a crystal and the second order reflection on diffraction from the crystal is observed at an angle of 45°. The lattice constant of the crystal is:
 - (1) $\lambda/\sqrt{2}$ (2) $\sqrt{2}\lambda$
- $(3) \lambda$
- (4) 2λ
- The amount of a substance that gives 3.7×10^7 disintegration per second (dps) is:
 - (1) one becquerel
- (2) one curie

(3) one mili-curie

- (4) one rutherford
- A body starts from rest and moves with a constant acceleration. The ratio of the distance covered in *n*th second to the distance covered in *n* seconds is :
 - (1) $\frac{2}{n} \frac{1}{n^2}$

(2) $\frac{1}{n^2} - \frac{1}{n}$

(3) $\frac{2}{n^2} - \frac{1}{n}$

- (4) $\frac{2}{n} + \frac{1}{n^2}$
- A particle moves in a straight line so that after 't' seconds, the distance from a fixed point O on the line is given as $x = (t-2)^2(t-5)$. Then:
 - (1) after 2 sec., velocity of particle is zero
 - (2) after 2 sec., the particle reaches O
 - (3) the acceleration is negative, for t < 3 sec.
 - (4) all the three before

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- 43. A solid body rotates about a stationery axis so that its angular velocity depends on the rotational angle φ as $\omega = \omega_0 - k\varphi$; ω_0 and k being positive constants & at t = 0, $\varphi = 0$. The time dependence of the rotational angle is:
 - (1) $k\omega_0 e^{-kt}$

(3) $\frac{\omega_0}{k} \left(1 - e^{-kt} \right)$

- (2) $\frac{\omega_0}{k}e^{-kt}$ (4) $\frac{k}{\omega_0}\left(e^{-kt}-1\right)$
- A particle of mass m is moving in a horizontal circle of radius r under a centripetal force $(-k/r^2)$, k being a constant, then:
 - (1) the total energy is (-k/2r)
- (2) the kinetic energy is (k/r)
- (3) the potential energy is (k/2r)
- (4) the kinetic energy is (-k/r)
- An elastic string of length L' and force constant k' is stretched by a length x. Thereafter, it is further stretched by another small length 'y', then the work done in second stretching is:
 - (1) $ky^2/2$

(2) $k(x^2 + y^2)/2$ (4) ky(2x + y)/2

(3) $k(x+y)^2/2$

- **46.** A smooth steel ball strikes a fixed smooth steel plate at an angle 'θ' with the vertical. If the coefficient of restitution is 'e', the angle of rebounce will be:
 - $(1) \theta$

(2) $\tan^{-1}(\tan\theta/e)$

(3) $e \tan \theta$

- (4) $\tan^{-1}(e/\tan\theta)$
- Four masses 1, 2, 3 and 4 kg. each are placed at the corners A, B, C and D of a square ABCD of edge 1 m. If A is taken as origin & AB and AD edges as x axis and y axis respectively, then the coordinates of the centre of mass in SI are:
 - (1) (1,1)

(2) (2.1, 3.9)

(3) (0.5, 0.7)

(4) (0.41, 0.93)

| 0 | |
|-----|---|
| 48. | A particle of mass 'm' rotating in a circle of radius 'a' with a uniform angular speed ω_0 is viewed from a frame rotating about z axis with a uniform angular speed ω . The centrifugal force on the particle is : |
| | $(1) m\omega^2 a \qquad \qquad (2) m\omega_0^2 a$ |
| | (3) $m[(\omega + \omega_0)/2]^2 a$ (4) $m\omega\omega_0 a$ |
| 49. | A particle of mass m is free to move along x-axis has a potential energy $U(x) = k(1 - e^{-x^2})$ for $-\infty \le x \le \infty$, k being a positive constant. Then: |

- (1) at points away from the origin, the particle is in unstable equilibrium
- (2) for any non zero value of x, there is a force directed away from the origin
- (3) if its total mechanical energy is k/2, it has the minimum kinetic energy at origin
- (4) for small displacement from x = 0, it executes SHM
- **50.** If for two rings of radius R and nR made up of same material, the ratio of moment of inertia about an axis passing through the centre is 1 : 8, then the value of 'n' is :
 - (1) 2
- (2) $2\sqrt{2}$
- (3) 4
- (4) 1/2
- **51.** Which of the following statements is *correct*?
 - (1) the displacement current is produced only by varying magnetic field
 - (2) the displacement current is produced only by varying electric field
 - (3) the displacement current is produced by varying magnetic field as well as varying electric field
 - (4) the displacement current is produced neither by varying magnetic field nor by varying electric field

[
$$Y_{\text{copper}} = 1 \times 10^{11} \text{n/m}^2$$
, $Y_{\text{steel}} = 2 \times 10^{11} \text{n/m}^2$]

(1) 0.125 cm

(2) 0.20 cm

(3) 0.120 cm

(4) 0.25 cm

53. If one litre of a perfect gas at a pressure of 72 cm of mercury is compressed isothermally to 900 cc, the resulting stress is:

- (1) $9.88 \times 10^3 \text{ N/m}^2$
- (2) $10.88 \times 10^3 \text{ N/m}^2$
- (3) $1.088 \times 10^3 \text{ N/m}^2$

(4) $4.48 \times 10^3 \text{ N/m}^2$

54. Which of the following is correct order in respect of r.m.s. velocity (v_{rms}) , average velocity (v_{av}) and most probable velocity (v_{mp}) ?

 $(1) \quad v_{mp} > v_{av} > v_{rms}$

 $(2) \quad v_{rms} > v_{av} > v_{mp}$

 $(3) \quad v_{av} > v_{mp} > v_{rms}$

 $(4) \quad v_{mp} > v_{rms} > v_{av}$

55. 12 gms of a gas occupy a volume of 4×10^{-3} m³ at a temperature of 7°C. If the gas is heated at constant pressure, its density becomes 6×10^{-4} g/cm³. The temperature to which the gas is heated is:

(1) 1000 K

(2) 1400 K

(3) 1200 K

(4) 800 K

56. If rest mass of an electron is 9.1×10^{-31} kg, then its mass equivalent energy is :

(1) 0.511 erg

(2) 0.511 J

(3) 0.511 eV

(4) 0.511 MeV

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P. T. O.

| _ | | | | | | | | | |
|-----|--|--|--|--|--|--|--|--|--|
| 57. | A reference frame attached to the earth: | | | | | | | | |
| | (1) is an inertial frame by definition | | | | | | | | |
| | (2) can not be an inertial frame because the earth is revolving round the sun | | | | | | | | |
| | (3) is an inertial frame as Newton's laws are applicable | | | | | | | | |
| | (4) can not be an inertial frame because the earth is rotating about its own axis | | | | | | | | |
| 58. | A particle with a mean proper life of 1 μ s moves through the laboratory with a velocity 2.7×10^{10} cm/sec. Its lifetime as measured by an observer in the laboratory is : | | | | | | | | |
| | (1) more than one micro-second (2) $1.0 \mu sec$ | | | | | | | | |
| | (3) less than one micro-second (4) $0.09 \mu \text{ sec}$ | | | | | | | | |
| 59. | In an L-C circuit: | | | | | | | | |
| | (1) the energy stored in L as well as in C is magnetic energy | | | | | | | | |
| | (2) the energy stored in L is magnetic but in C it is electrical energy | | | | | | | | |
| | (3) the energy stored in L is electrical but in C it is magnetic energy | | | | | | | | |
| | (4) the energy stored in L as well as in C is electrical energy | | | | | | | | |
| 60. | A short circuited coil is placed in a time-varying magnetic field. Electrical power is dissipated due to current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be: | | | | | | | | |
| | (1) halved (2) the same (3) doubled (4) quadrupled | | | | | | | | |
| 61. | A highly rigid cubical block of mass 'm' and side 'L' is fixed rigidly on to another cubical block 'B' of same dimensions and lower modulus of rigidity η such that the | | | | | | | | |

61. A highly rigid cubical block of mass m' and side L' is fixed rigidly on to another cubical block 'B' of same dimensions and lower modulus of rigidity η such that the lower face of 'A' completely covers the upper face of 'B'. The lower face of 'B' is held rigidly on a horizontal surface. A small force E is applied perpendicular to one of the side faces of 'A'. After the force is withdrawn, 'A' executes small oscillation with a time period:

(1) $2\pi(\eta mL)^{1/2}$ (2) $2\pi(m\eta/L)^{1/2}$ (3) $2\pi(mL/\eta)^{1/2}$ (4) $2\pi(m/\eta L)^{1/2}$

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- **62.** In a steady incomprehensible flow of a liquid:
 - (1) the speed does not change if the area of cross-section changes
 - (2) the speed increases if the area of cross-section increases
 - (3) the speed decreases if the area of cross-section increases
 - (4) bubbles are produced when the area of cross-section increases
- **63.** 10000 small balls, each weighing 1g, strike one square cm of area per second with a velocity 100 m/sec. in a normal direction and rebound with same velocity. The pressure exerted on the surface is:

(1)
$$2 \times 10^3 N/m^2$$

(2)
$$2 \times 10^5 N/m^2$$

(3)
$$10^7 N/m^2$$

(4)
$$2 \times 10^7 N/m^2$$

64. A magnet of magnetic moment 20 CGS units is freely suspended in a uniform field of intensity 0.3 CGS units. The amount of work done in deflecting it by an angle of 30° in CGS units will be:

(2)
$$3\sqrt{3}$$

(3)
$$3(2-\sqrt{3})$$

65. An electronic transition in hydrogen atom results in the formation of H_{α} line of hydrogen in Lyman series. The energies associated with the electron in each of the orbits involved in the transition (in kcal mol⁻¹) are:

$$(1)$$
 $-313.6, 34.84$

$$(2)$$
 $-313.6, -78.38$

$$(3)$$
 $-78.4, -34.84$

$$(4)$$
 $-78.4, -19.6$

66. In case two bubbles of radii r_1 and r_2 come in contact with each other to form a single bubble, the resulting radius of curvature r will be:

(1)
$$(r_1 + r_2)/2$$

(2)
$$(r_1 r_2)/(r_1-r_2)$$

(3)
$$(r_1 r_2)/(r_1+r_2)$$

(4)
$$(r_1r_2)^{1/2}$$

67. If a transverse wave is represented as $y = y_0 \sin 2\pi \left(ft - \frac{x}{\lambda} \right)$, then for what value of '\lambda' the maximum particle velocity is equal to four times the wave velocity?

(1) $y_0\pi$

(2) $(y_0\pi)/2$

(3) $2y_0\pi$

(4) $(3y_0\pi)/2$

68. A drilling machine of power 10 kW is used to drill a bore in a small aluminium block of mass 8 kg. If half of the power is used up in heating of the machine or to the surroundings, the rise of temperature of the block in 2.5 minutes will be [specific heat of aluminium = $0.91 \text{ J/g}^{\circ}\text{C}$]:

(1) 103°C

(2) 130°C

(3) 105°C

(4) 30°C

69. Assuming nil loss of energy, the temperature of the mixture T, when two perfect monoatomic gases with n_1 and n_2 number of moles at temperatures T_1 and T_2 are mixed will be:

(1) $(n_1 T_2 + n_2 T_1)/(n_1 + n_2)$

(2) $(n_1 T_2 - n_2 T_1)/(n_1 + n_2)$

(3) $(n_1 T_1 + n_2 T_2)/(n_1 + n_2)$

(4) $(n_1 T_1 - n_2 T_2)/(n_1 - n_2)$

70. During an adiabatic process, the specific heat is:

(1) zero

(2) greater than zero

(3) less than zero

(4) infinity

71. The depletion region of a junction diode is formed:

(1) when forward bias is applied to it

(2) when the temperature of the junction is reduced

(3) under reverse bias

(4) during the manufacturing process

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| | | | | | | 15 |
|-----|---|-------|--------------------------------|--------|----------------------------|-----|
| 72. | In a full wave rectifier with R – C filter, | the | conduction angle | of the | he diode is: | |
| | (1) 0 (2) $<\pi$ | (3) | > π | (4) | $=\pi$ | |
| 73. | A BJT with h_{FE} value of 100 is found to The transistor is operating in the : | o be | e operating at I _B | = 10 | $00 \mu A$ and $I_C = 5 r$ | nA. |
| | (1) active region | (2) | active or saturat | ion | region | |
| | (3) saturation region | (4) | cut-off region | | | |
| 74. | Faster switching OFF of a p-n junction : | | | | Self court | |
| | (1) requires zero current in the reverse | dire | ction | | | |
| | (2) requires reverse saturation current i | n th | e reverse directio | n | | |
| | (3) requires a large current in the revers | se di | irection | | | |
| | (4) is independent of the reverse curren | nt | | | | |
| 75. | The collector to base bias method in amp | plifi | er circuit : | | | |
| | (1) requires low dc supply | | | | | |
| | (2) requires high dc supply | | | | | |
| | (3) makes operating point independent | of v | variation in Ico | | | |
| | (4) makes operating point independent | of v | variation in β | | | |
| 76. | In a R-C coupled CE amplifier, emitter l | ead | resistance R _E is t | ısed | l to: | |
| | (1) increase the load | (2) | decrease the load | d | | |
| | (3) attain proper stability factor | (4) | decrease V _{CE} vo | oltag | ge | |
| 77. | In a multi stage amplifier, on increasir product: | ng tl | ne number of sta | ges, | , the gain-bandwi | dth |
| | (1) remains constant | (2) | increases | | | |

(4) becomes zero

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(3) decreases

| 78. | 3. A common collector amplifier has : | | |
|-------|--|----------------------------|-----------|
| | (1) high voltage gain but low current gain | | C |
| | (2) low voltage gain and low current gain | | |
| | (3) high output impedance but low input i | mpedance | |
| | (4) low output impedance but high input impedance | | |
| 79. | Which of the following is most suitable for generating 1 kHz frequency? | | |
| | (1) Wien bridge oscillator (2) | Colpitt's oscillator | |
| | (3) Hartley oscillator (4) | Tuned collector oscillator | un (42) |
| 80. | During an isothermal expansion of an ideal gas : | | |
| | (1) its internal energy decreases | | |
| | (2) its internal energy does not change | | |
| | (3) the work done by the gas is equal to the quantity of heat absorbed by it | | it |
| | (4) both (2) and (3) are correct | | |
| 81. | The axial parameter $a = b \neq c$ and $\alpha = \beta = 90^{\circ}$, $\gamma = 120^{\circ}$ correspond to the following system : | | |
| | (1) Tetragonal (2) | Cubic | |
| | (3) Hexagonal (4) | Rhombohedral | |
| 82. | If the Lagrangian L is not an explicit function of time, the Hamiltonian H is: | | s: |
| | (1) Zero (2) | Constant of motion | orificing |
| | (3) Infinity (4) | Variable with motion | |
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- 83. For Bose-Einstein condensation to happen, which of the following is true?
 - (1) Number of particles decreases rapidly in lower energy levels at high temperatures and low pressures
 - (2) Number of particles increases rapidly in lower energy levels at high temperatures and low pressures
 - (3) Number of particles decreases rapidly in lower energy levels at low temperatures and high pressures
 - (4) Number of particles increases rapidly in lower energy levels at low temperatures and high pressures
- **84.** The value of radius of the Fermi sphere of a degenerate free electron gas at zero temperature, having N particles contained in volume V is given as:
 - (1) $(3\pi^2)^{1/3}(N/V)^{2/3}\hbar$

(2) $(3\pi^2)^{1/3}(N/V)^{1/6}\hbar$

(3) $(3\pi^2)^{1/3}(N/V)^{1/3}\hbar$

- (4) $(3\pi^2)^{1/3}(N/V)^{1/2}\hbar$
- 85. The hyperfine splitting of spectral lines of an atom is due to:
 - (1) coupling between spins of two or more electrons
 - (2) coupling between spins and orbital angular momenta of the electrons
 - (3) coupling between electron spins and the nuclear spins
 - (4) None of the above
- **86.** The energy separation between two consecutive stokes lines in Raman scattering depends on :
 - (1) Wavelength of the incident light
 - (2) Energy separation between vibrational levels in the excited states
 - (3) Intensity of the incident light
 - (4) Energy separation between vibrational levels in the ground state

| 87. | The Debye theory of specific heat is val | id at: |
|-----|---|--|
| | (1) room temperature | . (2) low temperature |
| | (3) intermediate temperature | (4) all temperature |
| 88. | For a bcc crystal, the first Brillouin zone | e is a: |
| | (1) cube | (2) Rectangular parallelepiped |
| | (3) Truncated octahedron | (4) Regular rhombic dodecahedron |
| 89. | Which of the following is <i>not</i> the use of | f Hall's effect ? |
| | (1) Determination of the sign of charge | carriers |
| | (2) Determination of number density of | of charge carriers |
| | (3) Measurement of potential difference | ce control of the con |
| | (4) Measurement of magnetic field | |
| 90. | What is the behaviour of the pure Si cry | ystal at absolute zero temperature ? |
| | (1) behaves as perfect conductor | |
| | (2) behaves as perfect insulator | and the company of the broad of the broad of the company of the broad |
| | (3) contains no electron | tions and a rough term of the spoker of the |
| | (4) none of the above | The second secon |
| 91. | The coefficient of diffusion is: | est a na 196 nationale (grade gi) |
| | (1) directly proportional to pressure an | nd inversely proportional to (temperature) 2 |
| | (2) inversely proportional to pressure | and directly proportional to (temperature) ² |
| | (3) directly proportional to pressure as | nd inversely proportional to (temperature) 3/ |

(4) inversely proportional to pressure and directly proportional to (temperature)^{3/2}

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- 92. The ratio of average speed of hydrogen and bromine gas molecules at 27°C will be $[M_{Br} = 80 \text{ M}_{H}]$
 - (1) $\sqrt{1/80}$

(2) $\sqrt{80}$

(3) $\sqrt{40}$

- (4) $\sqrt{1/40}$
- 93. Which of the following is the correct Clapeyron's latent heat relation?
 - $(1) \quad \frac{dP}{dT} = \frac{L}{T(V_2 V_1)}$

 $(2) \quad \frac{dL}{dT} = \frac{P}{T(V_1 - V_2)}$

(3) $\frac{dV}{dT} = \frac{L}{V(P_1 - P_2)}$

- $(4) \quad \frac{dP}{dT} = \frac{L(V_2 V_1)}{T}$
- **94.** In Fresnel's biprism experiment, the distance between the biprism and the screen is 4 m. The angle of the prism is 2×10^{-3} radian and the refractive index is 1.5. If the fringewidth on screen is 15×10^{-4} m, the number of fringes is :
 - (1) 3
- (2) 2
- (3) 6
- (4) 8

- 95. Polarisation of light proves the:
 - (1) corpuscular nature of light
- (2) quantum nature of light
 - (3) transverse nature of light
- (4) longitudinal nature of light
- **96.** For two coherent monochromatic light beams of intensities *I* and 4*I* super imposed on each other, the maximum and minimum possible intensities in the resulting beams are:
 - (1) 5I and I

(2) 5I and 3I

(3) 9I and I

- (4) 9I and 3I
- **97.** The first diffraction minimum due to single slit diffraction is θ for incident radiation of 5000 Å. If the width of the slit is 1×10^{-4} cm, the value of θ is:
 - (1) 30°
- (2) 45°
- (3) 60°
- (4) 15°

- **98.** Two points at a distance of 0.1 mm from each other can just be inspected in a microscope under incident radiation 6000 Å. If instead the radiation is changed to 4800 Å, the limit of resolution will be:
 - (1) 0.80 mm

(2) 0.12 mm

(3) 0.10 mm

(4) 0.08 mm

- **99.** A ray of light is incident on the surface of a glass plate at an angle of incidence equal to Brewster's angle ϕ . If μ represents the refractive index of glass, the angle between the reflected and refracted rays is :
 - (1) $90^{\circ} + \varphi$

(2) $\sin^{-1}(\mu \cos \phi)$

(3) 90°

(4) $\sin^{-1}(\mu \sin \varphi)$

100. Two Nicol prisms are first crossed and then one of them is rotated through 60°. The percentage of light transmitted is:

(1) 1.25

(2) 25.0

(3) 37.5

(4) 50.0

Total No. of Printed Pages: 21

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PG-EE-2016

SUBJECT: Physics

| D | 3 11892 Sr. No. |
|------------------------------|--------------------------------------|
| Time: 11/4 Hours | Max. Marks: 100 Total Questions: 100 |
| Roll No. (in figures) | (in words) |
| Name | Father's Name |
| Mother's Name | Date of Examination |
| (Signature of the Candidate) | (Signature of the Invigilator) |

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- 1. All questions are compulsory.
- 2. The candidates *must return* the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means/misbehaviour will be registered against him/her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
- 3. In case there is any discrepancy in any question(s) in the Question Booklet, the same may be brought to the notice of the Controller of Examinations in writing within two hours after the test is over. No such complaint(s) will be entertained thereafter.
- 4. The candidate **must not** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers **must not** be ticked in the question booklet.
- 5. There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.
- 6. Use only Black or Blue Ball Point Pen of good quality in the OMR Answer-Sheet.
- 7. Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained 30 minutes after starting of the examination.

PG-EE-2016/(Physics)/(D)

| 1. | |
|----|--|
| | system: special in of the months for each of own to entry the array group (1) |
| | (1) Tetragonal (2) Cubic |
| | (3) Hexagonal (4) Rhombohedral |
| 2. | If the Lagrangian L is not an explicit function of time, the Hamiltonian H is: |
| | (1) Zero (2) Constant of motion |
| | (3) Infinity (4) Variable with motion |
| 3. | For Bose-Einstein condensation to happen, which of the following is <i>true</i> ? |
| | (1) Number of particles decreases rapidly in lower energy levels at high temperatures and low pressures |
| | (2) Number of particles increases rapidly in lower energy levels at high temperatures |
| | and low pressures |
| | (3) Number of particles decreases rapidly in lower energy levels at low temperatures and high pressures |
| | and high pressures |
| r | (4) Number of particles increases rapidly in lower energy levels at low temperatures and high pressures |
| | But the agent comes and a some minutes that are a some and a soft a |
| 4. | The value of radius of the Fermi sphere of a degenerate free electron gas at zero temperature, having N particles contained in volume V is given as: |
| | (1) $(3\pi^2)^{1/3}(N/V)^{2/3}\hbar$ (2) $(3\pi^2)^{1/3}(N/V)^{1/6}\hbar$ |
| | |

(3) $(3\pi^2)^{1/3}(N/V)^{1/3}\hbar$

(4) $(3\pi^2)^{1/3}(N/V)^{1/2}\hbar$

- 5. The hyperfine splitting of spectral lines of an atom is due to:
 - (1) coupling between spins of two or more electrons
 - (2) coupling between spins and orbital angular momenta of the electrons
 - (3) coupling between electron spins and the nuclear spins
 - (4) None of the above
- 6. The energy separation between two consecutive stokes lines in Raman scattering depends on:
 - (1) Wavelength of the incident light
 - (2) Energy separation between vibrational levels in the excited states
 - (3) Intensity of the incident light
 - (4) Energy separation between vibrational levels in the ground state
- 7. The Debye theory of specific heat is valid at:
 - (1) room temperature
 - (2) low temperature
 - (3) intermediate temperature
 - (4) all temperature
- **8.** For a bcc crystal, the first Brillouin zone is a :
 - (1) cube the series of the series of the series of the series to suite
 - (2) Rectangular parallelepiped
 - (3) Truncated octahedron
 - (4) Regular rhombic dodecahedron

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- **9.** Which of the following is *not* the use of Hall's effect?
 - (1) Determination of the sign of charge carriers
 - (2) Determination of number density of charge carriers
 - (3) Measurement of potential difference
 - (4) Measurement of magnetic field
- **10.** What is the behaviour of the pure *Si* crystal at absolute zero temperature?
 - (1) behaves as perfect conductor
 - (2) behaves as perfect insulator
 - (3) contains no electron
 - (4) none of the above
- 11. Which of the following statements is correct?
 - (1) the displacement current is produced only by varying magnetic field
 - (2) the displacement current is produced only by varying electric field
 - (3) the displacement current is produced by varying magnetic field as well as varying electric field
 - (4) the displacement current is produced neither by varying magnetic field nor by varying electric field
- **12.** Two wires one of copper and another of steel having the same cross-sectional area and lengths 1.0 and 0.5 m respectively, are fastened end to end and stretched by a load M. If copper wire is stretched by 1 mm, the total extension of the combination is:

[
$$Y_{\text{copper}} = 1 \times 10^{11} \text{n/m}^2$$
, $Y_{\text{steel}} = 2 \times 10^{11} \text{n/m}^2$]

(1) 0.125 cm

(2) 0.20 cm

(3) 0.120 cm

(4) 0.25 cm

- **13.** If one litre of a perfect gas at a pressure of 72 cm of mercury is compressed isothermally to 900 cc, the resulting stress is :
 - (1) $9.88 \times 10^3 \text{ N/m}^2$

(2) $10.88 \times 10^3 \text{ N/m}^2$

(3) $1.088 \times 10^3 \,\text{N/m}^2$

- (4) $4.48 \times 10^3 \text{ N/m}^2$
- 14. Which of the following is correct order in respect of r.m.s. velocity (v_{rms}) , average velocity (v_{av}) and most probable velocity (v_{mp}) ?
 - $(1) \quad v_{mp} > v_{av} > v_{rms}$

 $(2) \quad v_{rms} > v_{av} > v_{mp}$

 $(3) \quad v_{av} > v_{mp} > v_{rms}$

- $(4) \quad v_{mp} > v_{rms} > v_{av}$
- **15.** 12 gms of a gas occupy a volume of 4×10^{-3} m³ at a temperature of 7°C. If the gas is heated at constant pressure, its density becomes 6×10^{-4} g/cm³. The temperature to which the gas is heated is :
 - (1) 1000 K

(2) 1400 K

(3) 1200 K

- (4) 800 K
- **16.** If rest mass of an electron is 9.1×10^{-31} kg, then its mass equivalent energy is :
 - (1) 0.511 erg

(2) 0.511 J

(3) 0.511 eV

- (4) 0.511 MeV
- **17.** A reference frame attached to the earth:
 - (1) is an inertial frame by definition
 - (2) can not be an inertial frame because the earth is revolving round the sun
 - (3) is an inertial frame as Newton's laws are applicable
 - (4) can not be an inertial frame because the earth is rotating about its own axis

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| 18. | | f 1 μs moves through the laboratory with a |
|------|--|--|
| | velocity 2.7 × 10 ⁻² cm/sec. Its lifetime as | measured by an observer in the laboratory is: |
| | (1) more than one micro-second | (2) 1.0 μ sec |
| | (3) less than one micro-second | (4) 0.09 μ sec |
| 19. | In an L-C circuit: | |
| | (1) the energy stored in L as well as in | |
| | (2) the energy stored in L is magnetic b | out in C it is electrical energy |
| | (3) the energy stored in L is electrical b | ut in C it is magnetic energy |
| | (4) the energy stored in L as well as in | C is electrical energy |
| 20. | A short circuited coil is placed in a time-varying magnetic field. Electrical power is dissipated due to current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be: | |
| | (1) halved | (2) the same |
| | (3) doubled | (4) quadrupled |
| 21. | The ratio of de-Broglie wavelength of energy is: | f an α -particle and a proton of same kinetic |
| | (1) 1:2 | (2) 1:1 |
| | (3) $1:\sqrt{2}$ | (4) 4:1 |
| 22. | X-rays are used for structural analysis of | of crystals as these: |
| | (1) have the wavelength of the order of | |
| | | the fitter atomic spacing |
| ** | (2) are highly penetrating radiations | i yan acam te fearat as iliku in masa ng i |
| | (3) have the wavelength of the order of | the nuclear size |
| | (4) are highly coherent in nature | |
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- **23.** A radioactive nuclide is emitting beta particles at a certain rate. When this nuclide is heated to a very high temperature, the rate of emission will:
 - (1) increase

(2) decrease

(3) remain the same

- (4) fluctuate
- 24. The fission of uranium nuclide:
 - (1) always leads to same pair of fission products, say barium and krypton
 - (2) does not always produce barium and krypton but different pair of fission products
 - (3) produces barium and any other fission product
 - (4) always produces at least one radioactive fission product
- 25. Mirror nuclei are those which have:
 - (1) the same number of protons
 - (2) the same number of neutrons
 - (3) the number of protons equal to the number of neutrons
 - (4) the number of neutrons in one equal to the number of protons in the other
- **26.** Beta rays emitted in a radioactive material are:
 - (1) electromagnetic radiations
 - (2) electrons orbiting around the nucleus
 - (3) charged particles emitted by the nucleus
 - (4) neutral particles in the nucleus

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| 27. | The radio active decay of an element X to elements Y and K is represented by the |
|-----|---|
| | equation $\frac{A}{Z}X \to \frac{A}{Z+1}Y \to \frac{A-4}{Z-1}K \to \frac{A-4}{Z-1}K$. The sequence of emitted radiations is: |

- (1) α, β, γ
- (2) β, α, γ
- (3) γ , α , β
- (4) β, γ, α

Atomic explosion is the result of:

- (1) uncontrolled chain reaction in fission
- (2) controlled chain reaction in fusion
- (3) uncontrolled chain reaction in fusion
- (4) controlled chain reaction in fission
- X-rays of wavelength λ are incident on a crystal and the second order reflection on diffraction from the crystal is observed at an angle of 45°. The lattice constant of the crystal is:
 - (1) $\lambda/\sqrt{2}$ (2) $\sqrt{2}\lambda$
- $(3) \lambda$
- (4) 2λ

The amount of a substance that gives 3.7×10^7 disintegration per second (dps) is:

(1) one becquerel

(2) one curie

(3) one mili-curie

(4) one rutherford

31. Select the *incorrect* statement:

- (1) The angular momentum is conserved for systems possessing rotational symmetry
- (2) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved
- (3) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved, nothing can be predicted about the corresponding linear momentum
- (4) None of these

- **32.** A drop of water is placed on a glass plate. A double convex lens having radius of curvature of each surface 20 cm is placed on it. The focal length of the water lens in meters is ($\mu_{water} = 1.33$):
 - (1) -0.20
- (2) 0.60
- (3) -0.60
- (4) 0.20
- **33.** If electric permittivity and magnetic permeability of free space are ϵ_0 and μ_0 respectively, the index of refraction of a medium with electric permittivity and magnetic permeability ϵ and μ will be :
 - (1) $(\epsilon \mu / \epsilon_0 \mu_0)$

(2) $(\epsilon \mu / \epsilon_0 \mu_0)^{1/2}$

(3) $(\epsilon_0 \mu_0 / \epsilon \mu)$

- (4) $(\epsilon_0 \mu_0 / \epsilon \mu)^{1/2}$
- **34.** A ray of light falls on a transparent glass slab of refractive index 1.62. If the reflected and refracted rays are mutually perpendicular, the angle of incidence is :
 - (1) tan^{-1} (1.62)

(2) $tan^{-1}(1/1.62)$

(3) $1/\tan^{-1}(1.62)$

- $(4) \tan^2(1.62)$
- **35.** A point charge Q is placed at the centre of a hemisphere. The electric flux passing through the flat surface of hemisphere is :
 - (1) Q/ϵ_0
- (2) zero
- (3) $Q/2\varepsilon_0$
- (4) $Q/4\varepsilon_0$
- **36.** A length '*l*' of a wire is bent to form a circular coil of few turns. The maximum torque acting on the coil it is placed in a magnetic field *B* and a current *I* is passed through it, will be:
 - (1) IBl^2
- (2) $4\pi IBl^2$
- (3) $IBl^2/4\pi$
 - (4) $I^2Bl/4\pi$
- **37.** A non-relativistic proton beam passes without deviation through the region of space where there are uniform transverse mutually perpendicular electric and magnetic fields with E = 120 kV/m and B = 50 mT respectively. The beam then strikes a grounded target. If the beam current is I = 80mA, the force with which the beam strikes the target will be:
 - (1) 80 μN
- (2) 25 μN
- (3) .20 μN
- (4) 35 μN

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- **38.** Magnetic field of an infinitely long ideal solenoid of radius R carrying current I:
 - (1) increases radially inside, zero outside
 - (2) is constant inside and zero outside
 - (3) is constant inside and decays as 1/r outside
 - (4) is constant inside and decays as $e^{-(1/r)}$ outside
- A metal rod moves at a constant velocity in a direction perpendicular to its length. A constant uniform magnetic field exists in space in a direction perpendicular to the rod as well as its velocity. In such a situation:
 - (1) the entire rod is at same potential
 - (2) there is an electric field in the rod
 - (3) the electric potential is highest at the centre of the rod and decreases towards the ends
 - (4) the electric potential is lowest at the centre of the rod and increases towards the ends
- The average value of electric energy density in an electromagnetic wave is:
 - (1) $\varepsilon_0 E^2 / 2$ (2) $E^2 / 2\varepsilon_0$ (3) $\varepsilon_0 E^2$
- (4) $\varepsilon_0 E^2 / 4$

- The coefficient of diffusion is:
 - (1) directly proportional to pressure and inversely proportional to (temperature)²
 - (2) inversely proportional to pressure and directly proportional to (temperature) 2
 - (3) directly proportional to pressure and inversely proportional to (temperature) 3/2
 - (4) inversely proportional to pressure and directly proportional to (temperature)^{3/2}
- The ratio of average speed of hydrogen and bromine gas molecules at 27°C will be $[M_{Br} = 80 M_{H}]$
 - (1) $\sqrt{1/80}$ (2) $\sqrt{80}$

- (3) $\sqrt{40}$ (4) $\sqrt{1/40}$

- **43.** Which of the following is the correct Clapeyron's latent heat relation?
 - (1) $\frac{dP}{dT} = \frac{L}{T(V_2 V_1)}$

 $(2) \quad \frac{dL}{dT} = \frac{P}{T(V_1 - V_2)}$

(3) $\frac{dV}{dT} = \frac{L}{V(P_1 - P_2)}$

- (4) $\frac{dP}{dT} = \frac{L(V_2 V_1)}{T}$
- 44. In Fresnel's biprism experiment, the distance between the biprism and the screen is 4 m. The angle of the prism is 2×10^{-3} radian and the refractive index is 1.5. If the fringewidth on screen is 15×10^{-4} m, the number of fringes is :
 - (1) 3
- (2) 2
- (3) 6 (4) 8

- Polarisation of light proves the:
 - (1) corpuscular nature of light
- (2) quantum nature of light
- (3) transverse nature of light
- (4) longitudinal nature of light
- For two coherent monochromatic light beams of intensities I and 4I super imposed on each other, the maximum and minimum possible intensities in the resulting beams are:
 - (1) 5I and I
- (2) 5I and 3I
- (3) 9I and I
- (4) 9I and 3I
- The first diffraction minimum due to single slit diffraction is θ for incident radiation of 5000 Å. If the width of the slit is 1×10^{-4} cm, the value of θ is :
 - (1) 30°
- (2) 45°
- (3) 60°
- (4) 15°
- 48. Two points at a distance of 0.1 mm from each other can just be inspected in a microscope under incident radiation 6000 Å. If instead the radiation is changed to 4800 Å, the limit of resolution will be:
 - (1) 0.80 mm

(2) 0.12 mm

(3) 0.10 mm

(4) 0.08 mm

| 49. | | | glass plate at an angle of incidence equal fractive index of glass, the angle between |
|-----|---|-------|---|
| | (1) 90° + φ | (2) | $\sin^{-1}(\mu \cos \phi)$ |
| | (3) 90° | (4) | $\sin^{-1}(\mu \sin \phi)$ |
| 50. | Two Nicol prisms are first crossed and percentage of light transmitted is: | the | n one of them is rotated through 60°. The |
| | (1) 1.25 | (2) | 25.0 |
| | (3) 37.5 | (4) | 50.0 |
| 51. | Only $1/8^{th}$ of the original amount of a The value of $t_{1/2}$ of the material is : | radi | oactive material remains after 96 minutes. |
| | (1) 12 minutes | (2) | 32 minutes |
| | (3) 24 minutes | (4) | 48 minutes |
| 52. | The weight of 1 curie $_{82}\text{Pb}^{214}$ ($t_{1/2} = 26.8$ | min | .) in grams is : |
| | (1) 3.1×10^{-8} g | (2) | $1.55 \times 10^{-8} \mathrm{g}$ |
| | (3) $6.2 \times 10^{-8} \text{ g}$ | (4) | $3.1 \times 10^{-10} \text{ g}$ |
| 53. | The final product, if $_{92}U^{235}$ emits two α | and | one β particle, will be : |
| | (1) 87Ac ²²¹ | | 89Ac ²³⁵ |
| | (3) 89Ac ²²⁵ | (4) | 89Ac ²²⁷ |
| 54. | Stern Gerlach experiment proves the ex | ciste | nce of: |
| | (1) electronic charge | (2) | electron dipole moment |

(4) electron mass

(3) electron spin

- An electron with energy E incident upon a potential barrier of V such that V > E and thickness *l*, then the transmission coefficient : (1) is zero (2) proportional to l^2 (3) increases exponentially with thickness (4) decreases exponentially with thickness The probability of finding an electron in a hydrogen atom is: (1) independent of r(2) independent of θ (3) independent of φ (4) independent of all the three before In case of a rigid rotator, the rotational frequency is given as: (1) $\hbar L^2/2\pi I$ (2) $\hbar L/2\pi I$ (3) $\hbar L/2\pi I^2$ (4) $\hbar L/2\pi(2I+1)$ The energy between two adjacent levels is given by: (1) (2n + 1) times the zero point energy (2) (2n-1) times the zero point energy (3) 2n² times the zero point energy (4) n² times the zero point energy
- The ionization potential of Li⁺² ions using Bohr's theory is: 59.
 - (1) 13.6 eV

(2) 27.2 eV

(3) 40.8 eV

(4) 122.4 eV

| 60. | The wave function considered to be confined within a box of length L is $\psi(x) = \sqrt{2/L} \sin(\pi x/L)$ in the region $0 < x < L$. The probability of finding the particle in the region $0 < x < L/2$ is : |
|------|---|
| | (1) 0 (2) 1/2 (3) 1 (4) 0.66 |
| 61. | The depletion region of a junction diode is formed: |
| | (1) when forward bias is applied to it |
| | (2) when the temperature of the junction is reduced |
| | (3) under reverse bias |
| | (4) during the manufacturing process |
| 62. | In a full wave rectifier with R – C filter, the conduction angle of the diode is : |
| | (1) 0 (2) $<\pi$ (3) $>\pi$ (4) $=\pi$ |
| 63. | A BJT with h_{FE} value of 100 is found to be operating at I_B = 100 μA and I_C = 5 mA. The transistor is operating in the : |
| | (1) active region (2) active or saturation region |
| | (3) saturation region (4) cut-off region |
| 64. | Faster switching OFF of a p-n junction: |
| | (1) requires zero current in the reverse direction |
| | (2) requires reverse saturation current in the reverse direction |
| | (3) requires a large current in the reverse direction |
| | (4) is independent of the reverse current |
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| 65. | The collector to base bias method in amp | Dlifter circuit: |
|------|---|--|
| | (1) requires low dc supply | Province and the Communication of the Communication |
| | (2) requires high dc supply | |
| | (3) makes operating point independent | of variation in I _{co} |
| | (4) makes operating point independent | of variation in β |
| 66. | In a R-C coupled CE amplifier, emitter le | ead resistance R _E is used to: |
| | (1) increase the load | (2) decrease the load |
| | (3) attain proper stability factor | (4) decrease V _{CE} voltage |
| 67. | In a multi stage amplifier, on increasir product: | ng the number of stages, the gain-bandwidth |
| | (1) remains constant | (2) increases |
| | (3) decreases | (4) becomes zero |
| 68. | . A common collector amplifier has: | |
| | (1) high voltage gain but low current ga | ain |
| | (2) low voltage gain and low current ga | tin |
| | (3) high output impedance but low inp | ut impedance |
| | (4) low output impedance but high inp | ut impedance |
| 69. | . Which of the following is most suitable | for generating 1 kHz frequency? |
| | (1) Wien bridge oscillator | (2) Colpitt's oscillator |
| | (3) Hartley oscillator | (4) Tuned collector oscillator |
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| 70. | During an isomermal expansion of an i | deai | gas: | angerian special up and | | | | | | | | |
|------|--|-------|--|-----------------------------|--|--|--|--|--|--|--|--|
| | (1) its internal energy decreases | | | | | | | | | | | |
| | (2) its internal energy does not change | | | | | | | | | | | |
| | (3) the work done by the gas is equal to the quantity of heat absorbed by it | | | | | | | | | | | |
| | (4) both (2) and (3) are correct | | | | | | | | | | | |
| 71. | The inside and outside temperature respectively. Assuming the refrigerator done, the heat delivered to the surround | r cyc | ele to be reversible | | | | | | | | | |
| | (1) 10 J (2) 20 J | (3) | 30 J | (4) 50 J | | | | | | | | |
| 72. | If a gas is heated at constant pressure, used for up for external work [γ for gas | | | e of total heat supplied is | | | | | | | | |
| | (1) 25% (2) 50% | (3) | 75% | (4) 57% | | | | | | | | |
| 73. | The enthalpy of vaporization of water will be: | is 18 | 66.5 J/mol. The en | ntropy of its vaporization | | | | | | | | |
| | (1) 0.5 JK ⁻¹ mol ⁻¹ | (2) | 1.0 JK ⁻¹ mol ⁻¹ | | | | | | | | | |
| | (3) $1.5 \mathrm{JK^{-1}mol^{-1}}$ | (4) | 2.0 JK ⁻¹ mol ⁻¹ | | | | | | | | | |
| 74. | In a biprism experiment, if the wavelengreen light is 5.2×10^{-7} m, the value coincides with n th red bright band for the | e of | 'n' for which (1 | 1+1)th green bright band | | | | | | | | |
| | (1) 2 (2) 3 | (3) | 4 | (4) 1 | | | | | | | | |
| 75. | The contrast in the fringes in any interfe | eren | ce pattern depend | ds on: | | | | | | | | |
| | (1) fringe width | (2) | wavelength | | | | | | | | | |
| | (3) intensity ratio of the sources | (4) | distance betwee | en the sources | | | | | | | | |
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| | | | | | | | | | | | | |

- **76.** Yellow light emitted by a sodium lamp in Young's double slit experiment is replaced by monochromatic blue light of the same intensity, then:
 - (1) the fringe width will decrease
 - (2) the fringe width will increase
 - (3) the fringe width will be unchanged
 - (4) the intensity of the fringes will decrease
- 77. Ratio of adiabatic elasticity to isothermal elasticity is:
 - (1) 0
- (2) 1
- (3) y
- $(4) 1/\gamma$
- 78. The enthalpy 'H' along an isothermal curve for an ideal gas is:
 - (1) constant
- (2) variable
- (3) infinite
- (4) unpredictable
- **79.** A system of non-interacting Fermi particles with Fermi energy ε_f has density of states proportional to $\sqrt{\varepsilon_f}$ where ε_f is the energy of a particle. The average energy per particle at T=0 K is :
 - (1) $\epsilon_f/6$
- (2) $\varepsilon_f/5$
- (3) $2\varepsilon_f/5$
- (4) $3\varepsilon_f/5$
- **80.** Gibb's potential remains constant in which of the following:
 - (1) isothermal process

(2) isobaric process

(3) both (1) and (2)

- (4) adiabatic process
- **81.** A body starts from rest and moves with a constant acceleration. The ratio of the distance covered in *n*th second to the distance covered in *n* seconds is:
 - (1) $\frac{2}{n} \frac{1}{n^2}$

(2) $\frac{1}{n^2} - \frac{1}{n}$

(3) $\frac{2}{n^2} - \frac{1}{n}$

(4) $\frac{2}{n} + \frac{1}{n^2}$

- **82.** A particle moves in a straight line so that after 't' seconds, the distance from a fixed point O on the line is given as $x = (t-2)^2(t-5)$. Then:
 - (1) after 2 sec., velocity of particle is zero
 - (2) after 2 sec., the particle reaches O
 - (3) the acceleration is negative, for t < 3 sec.
 - (4) all the three before
- **83.** A solid body rotates about a stationery axis so that its angular velocity depends on the rotational angle φ as $\omega = \omega_0 k\varphi$; ω_0 and k being positive constants & at t = 0, $\varphi = 0$. The time dependence of the rotational angle is :
 - (1) $k\omega_0 e^{-kt}$

 $(2) \quad \frac{\omega_0}{k} e^{-kt}$

 $(3) \quad \frac{\omega_0}{k} \left(1 - e^{-kt} \right)$

- $(4) \quad \frac{k}{\omega_0} \left(e^{-kt} 1 \right)$
- **84.** A particle of mass m is moving in a horizontal circle of radius r under a centripetal force $\left(-k/r^2\right)$, k being a constant, then:
 - (1) the total energy is (-k/2r)
 - (2) the kinetic energy is (k/r)
 - (3) the potential energy is (k/2r)
 - (4) the kinetic energy is (-k/r)
- **85.** An elastic string of length L' and force constant L' is stretched by a length L'. Thereafter, it is further stretched by another small length L', then the work done in second stretching is:
 - (1) $ky^2/2$

 $(2) k(x^2+y^2)/2$

(3) $k(x+y)^2/2$

(4) ky(2x + y)/2

- **86.** A smooth steel ball strikes a fixed smooth steel plate at an angle ' θ ' with the vertical. If the coefficient of restitution is 'e', the angle of rebounce will be :
 - $(1) \theta$

(2) $\tan^{-1}(\tan\theta/e)$

(3) $e \tan \theta$

- (4) $\tan^{-1}(e/\tan\theta)$
- **87.** Four masses 1, 2, 3 and 4 kg. each are placed at the corners A, B, C and D of a square ABCD of edge 1 m. If A is taken as origin & AB and AD edges as x axis and y axis respectively, then the coordinates of the centre of mass in SI are:
 - (1) (1,1)

(2) (2.1, 3.9)

(3) (0.5, 0.7)

- (4) (0.41, 0.93)
- **88.** A particle of mass 'm' rotating in a circle of radius 'a' with a uniform angular speed ω_0 is viewed from a frame rotating about z axis with a uniform angular speed ω . The centrifugal force on the particle is:
 - (1) $m\omega^2 a$

(2) $m\omega_0^2 a$

(3) $m[(\omega + \omega_0)/2]^2 a$

- (4) $m\omega\omega_0 a$
- **89.** A particle of mass m is free to move along x-axis has a potential energy $U(x) = k(1 e^{-x^2})$ for $-\infty \le x \le \infty$, k being a positive constant. Then:
 - (1) at points away from the origin, the particle is in unstable equilibrium
 - (2) for any non zero value of x, there is a force directed away from the origin
 - (3) if its total mechanical energy is k/2, it has the minimum kinetic energy at origin
 - (4) for small displacement from x = 0, it executes SHM
- **90.** If for two rings of radius R and nR made up of same material, the ratio of moment of inertia about an axis passing through the centre is 1:8, then the value of 'n' is:
 - (1) 2
- (2) $2\sqrt{2}$
- (3) 4
- (4) 1/2

91. A highly rigid cubical block of mass m' and side L' is fixed rigidly on to another cubical block 'B' of same dimensions and lower modulus of rigidity η such that the lower face of 'A' completely covers the upper face of 'B'. The lower face of 'B' is held rigidly on a horizontal surface. A small force F is applied perpendicular to one of the side faces of 'A'. After the force is withdrawn, 'A' executes small oscillation with a time period :

(1) $2\pi(\eta mL)^{1/2}$

(2) $2\pi (m\eta/L)^{1/2}$

(3) $2\pi (mL/\eta)^{1/2}$

(4) $2\pi (m/\eta L)^{1/2}$

- 92. In a steady incomprehensible flow of a liquid:
 - (1) the speed does not change if the area of cross-section changes
 - (2) the speed increases if the area of cross-section increases
 - (3) the speed decreases if the area of cross-section increases
 - (4) bubbles are produced when the area of cross-section increases
- **93.** 10000 small balls, each weighing 1g, strike one square cm of area per second with a velocity 100 m/sec. in a normal direction and rebound with same velocity. The pressure exerted on the surface is:

(1) $2 \times 10^3 N/m^2$

(2) $2 \times 10^5 N/m^2$

(3) $10^7 N/m^2$

(4) $2 \times 10^7 N/m^2$

94. A magnet of magnetic moment 20 CGS units is freely suspended in a uniform field of intensity 0.3 CGS units. The amount of work done in deflecting it by an angle of 30° in CGS units will be:

(1) 6

(2) $3\sqrt{3}$

(3) $3(2-\sqrt{3})$

(4) 3

95. An electronic transition in hydrogen atom results in the formation of H_{α} line of hydrogen in Lyman series. The energies associated with the electron in each of the orbits involved in the transition (in kcal mol⁻¹) are:

(1) -313.6, 34.84

(2) -313.6, -78.38

(3) -78.4, -34.84

(4) -78.4, -19.6

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| 96. | In case two bubbles of radii r_1 and r_2 come in contact with each other to form a |
|-----|--|
| | single bubble, the resulting radius of curvature 'r' will be: |

- (2) $(r_1 r_2)/(r_1-r_2)$
- (3) $(r_1 r_2)/(r_1+r_2)$ (4) $(r_1 r_2)^{1/2}$

97. If a transverse wave is represented as $y = y_0 \sin 2\pi \left(ft - \frac{x}{\lambda} \right)$, then for what value of '\lambda' the maximum particle velocity is equal to four times the wave velocity?

- (1) $y_0\pi$

- (2) $(y_0\pi)/2$ (3) $2y_0\pi$ (4) $(3y_0\pi)/2$

A drilling machine of power 10 kW is used to drill a bore in a small aluminium block of mass 8 kg. If half of the power is used up in heating of the machine or to the surroundings, the rise of temperature of the block in 2.5 minutes will be [specific heat of aluminium = $0.91 \text{ J/g}^{\circ}\text{C}$]:

- (1) 103°C (2) 130°C (3) 105°C (4) 30°C

99. Assuming nil loss of energy, the temperature of the mixture 'T', when two perfect monoatomic gases with n_1 and n_2 number of moles at temperatures T_1 and T_2 are mixed will be:

- (1) $(n_1 T_2 + n_2 T_1)/(n_1 + n_2)$
- (2) $(n_1 T_2 n_2 T_1)/(n_1 + n_2)$
- (3) $(n_1 T_1 + n_2 T_2)/(n_1 + n_2)$ (4) $(n_1 T_1 n_2 T_2)/(n_1 n_2)$

100. During an adiabatic process, the specific heat is:

(1) zero

(2) greater than zero

- (3) less than zero
- (4) infinity (1) The same of the street of t

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|-----|---|-----|---|-----|---|-----|------|------|---|-----|-----|------|---|
| 1. | 1 | 16. | 2 | 31. | 3 | 46. | 3 | 61. | 4 | 76. | 3 | 91. | 3 |
| 2. | 4 | 17. | 2 | 32. | 1 | 47. | 1 | 62. | 2 | 77. | 2 | 92. | 2 |
| 3. | 3 | 18. | 1 | 33. | 2 | 48. | 4 | 63. | 1 | 78. | 1 | 93. | 4 |
| 4. | 1 | 19. | 3 | 34. | 2 | 49. | 1 | 64. | 3 | 79. | 2 | 94. | 1 |
| 5. | 4 | 20. | 1 | 35. | 2 | 50. | 4 | 65. | 3 | 80. | 3 | 95. | 3 |
| 6. | 2 | 21. | 3 | 36. | 4 | 51. | 1 | 66. | 3 | 81. | 2 | 96. | 2 |
| 7. | 3 | 22. | 3 | 37. | 1 | 52. | 1 | 67. | 1 | 82. | 1 | 97. | 2 |
| 8. | 2 | 23. | 2 | 38. | 1 | 53. | 1 | 68. | 4 | 83. | 4 | 98. | 4 |
| 9. | 4 | 24. | 1 | 39. | 2 | 54. | 3 | 69. | 3 | 84. | 3 | 99. | 3 |
| 10. | 1 | 25. | 3 | 40. | 4 | 55. | 3 | 70. | 4 | 85. | 1 | 100. | 2 |
| 11. | 4 | 26. | 3 | 41. | 4 | 56. | 1 | 71. | 1 | 86. | 3 | | |
| 12. | 3 | 27. | 3 | 42. | 2 | 57. | 3 | 72. | 1 | 87. | 2 | | |
| 13. | 4 | 28. | 2 | 43. | 3 | 58. | 1 | 73. | 3 | 88. | 1 | | |
| 14. | 3 | 29. | 2 | 44. | 3 | 59. | 4 | 74. | 2 | 89. | 4 | | |
| 15. | 2 | 30. | 1 | 45. | 3 | 60. | 3 | 75. | 4 | 90. | 2 | | |

SET : B

| ==== | ==== | | | | ==== | ==== | -=== | | | -=== | === | ===== | |
|------|------|-----|---|-----|------|------|------|-----|---|------|-----|-------|---|
| 1. | 4 | 16. | 3 | 31. | 1 | 46. | 1 | 61. | 3 | 76. | 2 | 91. | 3 |
| 2. | 2 | 17. | 2 | 32. | 4 | 47. | 3 | 62. | 3 | 77. | 2 | 92. | 1 |
| 3. | 3 | 18. | 1 | 33. | 3 | 48. | 1 | 63. | 2 | 78. | 1 | 93. | 2 |
| 4. | 3 | 19. | 2 | 34. | 1 | 49. | 4 | 64. | 1 | 79. | 3 | 94. | 2 |
| 5. | 3 | 20. | 3 | 35. | 4 | 50. | 3 | 65. | 3 | 80. | 1 | 95. | |
| 6. | 3 | 21. | 3 | 36. | 2 | 51. | 4 | 66. | 3 | 81. | 2 | 96. | 4 |
| 7. | 1 | 22. | 2 | 37. | 3 | 52. | 2 | 67. | 3 | 82. | 1 | 97. | 1 |
| 8. | 4 | 23. | 4 | 38. | 2 | 53. | 1 | 68. | 2 | 83. | 4 | 98. | 1 |
| 9. | 1 | 24. | 1 | 39. | 4 | 54. | 3 | 69. | 2 | 84. | 3 | 99. | 2 |
| 10. | 4 | 25. | 3 | 40. | 1 | 55. | 3 | 70. | 1 | 85. | 1 | 100. | 4 |
| 11. | 1 | 26. | 2 | 41. | 1 | 56. | 3 | 71. | 4 | 86. | 3 | | |
| 12. | 1 | 27. | 2 | 42. | 1 | 57. | 1 | 72. | 3 | 87. | 2 | | |
| 13. | 3 | 28. | 4 | 43. | 1 | 58. | 4 | 73. | 4 | 88. | 1 | | |
| 14. | 2 | 29. | 3 | 44. | 3 | 59. | 3 | 74. | 3 | 89. | 4 | | |
| 15. | 4 | 30. | 2 | 45. | 3 | 60. | 4 | 75. | 2 | 90. | 2 | | |

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SET : C

| ====: | ==== | ==== | ==== | ==== | ==== | ==== | ==== | ==== | ==== | ==== | === | ===== | |
|-------|------|------|------|------|------|------|------|------|------|------|-----|-------|---|
| 1. | 3 | 16. | 1 | 31. | 1 | 46. | 2 | 61. | 4 | 76. | 3 | 91. | 4 |
| 2. | 3 | 17. | 3 | 32. | 1 | 47. | 3 | 62. | 3 | 77. | 1 | 92. | 2 |
| 3. | 2 | 18. | 1 | 33. | 3 | 48. | 2 | 63. | 4 | 78. | 4 | 93. | 1 |
| 4. | 1 | 19. | 4 | 34. | 2 | 49. | 4 | 64. | 3 | 79. | 1 | 94. | 3 |
| 5. | 3 | 20. | 3 | 35. | 4 | 50. | 1 | 65. | 2 | 80. | 4 | 95. | 3 |
| 6. | 3 | 21. | 2 | 36. | 3 | 51. | 3 | 66. | 2 | 81. | 3 | 96. | 3 |
| 7. | 3 | 22. | 1 | 37. | 2 | 52. | 1 | 67. | 2 | 82. | 2 | 97. | 1 |
| 8. | 2 | 23. | 4 | 38. | 1 | 53. | 2 | 68. | 1 | 83. | 4 | 98. | 4 |
| 9. | 2 | 24. | 3 | 39. | 2 | 54. | 2 | 69. | 3 | 84. | 1 | 99. | 3 |
| 10. | 1 | 25. | 1 | 40. | 3 | 55. | 2 | 70. | 1 | 85. | 3 | 100. | 4 |
| 11. | 1 | 26. | 3 | 41. | 1 | 56. | 4 | 71. | 4 | 86. | 2 | | |
| 12. | 1 | 27. | 2 | 42. | 4 | 57. | 1 | 72. | 2 | 87. | 2 | | |
| 13. | 1 | 28. | 1 | 43. | 3 | 58. | 1 | 73. | 3 | 88. | 4 | | |
| 14. | 3 | 29. | 4 | 44. | 1 | 59. | 2 | 74. | 3 | 89. | 3 | | |
| 15. | 3 | 30. | 2 | 45. | 4 | 60. | 4 | 75. | 3 | 90. | 2 | | |
| | | | | | | | | | | | | | |

M.SC. PHYSICS Page: 4

SET : D

| ===== | | | | | | | ==== | ==== | | ==== | | ====: | |
|-------|---|-----|---|-----|---|-----|------|------|---|------|---|-------|---|
| 1. | 3 | 16. | 4 | 31. | 3 | 46. | 3 | 61. | 4 | 76. | 1 | 91. | 4 |
| 2. | 2 | 17. | 1 | 32. | 3 | 47. | 1 | 62. | 2 | 77. | 3 | 92. | 3 |
| 3. | 4 | 18. | 1 | 33. | 2 | 48. | 4 | 63. | 3 | 78. | 1 | 93. | 4 |
| 4. | 1 | 19. | 2 | 34. | 1 | 49. | 3 | 64. | 3 | 79. | 4 | 94. | 3 |
| 5. | 3 | 20. | 4 | 35. | 3 | 50. | 4 | 65. | 3 | 80. | 3 | 95. | 2 |
| 6. | 2 | 21. | 1 | 36. | 3 | 51. | 2 | 66. | 3 | 81. | 1 | 96. | 2 |
| 7. | 2 | 22. | 1 | 37. | 3 | 52. | 1 | 67. | 1 | 82. | 4 | 97. | 2 |
| 8. | 4 | 23. | 3 | 38. | 2 | 53. | 4 | 68. | 4 | 83. | 3 | 98. | 1 |
| 9. | 3 | 24. | 2 | 39. | 2 | 54. | 3 | 69. | 1 | 84. | 1 | 99. | 3 |
| 10. | 2 | 25. | 4 | 40. | 1 | 55. | 1 | 70. | 4 | 85. | 4 | 100. | 1 |
| 11. | 3 | 26. | 3 | 41. | 4 | 56. | 3 | 71. | 1 | 86. | 2 | | |
| 12. | 1 | 27. | 2 | 42. | 2 | 57. | 2 | 72. | 1 | 87. | 3 | | |
| 13. | 2 | 28. | 1 | 43. | 1 | 58. | 1 | 73. | 1 | 88. | 2 | | |
| 14. | 2 | 29. | 2 | 44. | 3 | 59. | 4 | 74. | 3 | 89. | 4 | | |
| 15. | 2 | 30. | 3 | 45. | 3 | 60. | 2 | 75. | 3 | 90. | 1 | | |
| | | | | | | | | | | | | | |