Booklet Serial No. : 226

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TEST BOOKLET

AP (ASH) PHYSICS 2016

Time Allowed : 2 Hours] [Maximum Marks : 100

All questions carry equal marks.

INSTRUCTIONS

1. Immediately after the commencement of the examination, you should check that test booklet does not have any unprinted or torn or missing pages or items, etc. If so, get it replaced by a complete test booklet.
2. Write your Roll Number only in the box provided alongside. Do not write anything else on the Test Booklet.
3. This Test Booklet contains **100** items (questions). Each item comprises four responses (answers). Choose only one response for each item which you consider the best.
4. After the candidate has read each item in the Test Booklet and decided which of the given responses is correct or the best, he has to mark the circle containing the letter of the selected response by blackening it completely with Black or Blue ball pen. In the following example, response "C" is so marked :

5. Do the encoding carefully as given in the illustrations. While encoding your particulars or marking the answers on answer sheet, you should blacken the circle corresponding to the choice in full and no part of the circle should be left unfilled.
6. You have to mark all your responses ONLY on the ANSWER SHEET separately given according to 'INSTRUCTIONS FOR CANDIDATES' already supplied to you. *Responses marked on the Test Booklet or in any paper other than the answer sheet shall not be examined.*
7. All items carry equal marks. Attempt all items. Your total marks will depend only on the number of correct responses marked by you in the Answer Sheet. There will be no negative marking.
8. Before you proceed to mark responses in the Answer Sheet fill in the particulars in the front portion of the Answer Sheet as per the instructions sent to you.
9. After you have completed the test, hand over the Answer Sheet only, to the Invigilator.

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P.T.O.

AP (ASH) PHYSICS 2016

Time Allowed : 2 Hours] [Maximum Marks : 100

1. Calculate the amount of work done (in Joules) by the force,

$$\vec{F} = (2xy + z^2)\hat{i} + x^2\hat{j} + 2xz\hat{k} \text{ Newton,}$$

in moving a particle from (0, 1, 2) m to (5, 2, 7) m.

(A) 295 (B) 315

(C) 426 (D) 512

2. A rectangular wave guide has dimensions 2.5 cm and 5.0 cm. Determine guide wavelength at a wavelength of 4.5 cm for dominant mode.

(A) 15 cm (B) 10 cm

(C) 5 cm (D) 2.5 cm

3. For the motions :

(*i*) Motion of a body on an inclined plane under gravity.

(*ii*) A pendulum with variable length.

(*iii*) A particle moving on an ellipsoid under the influence of gravity.

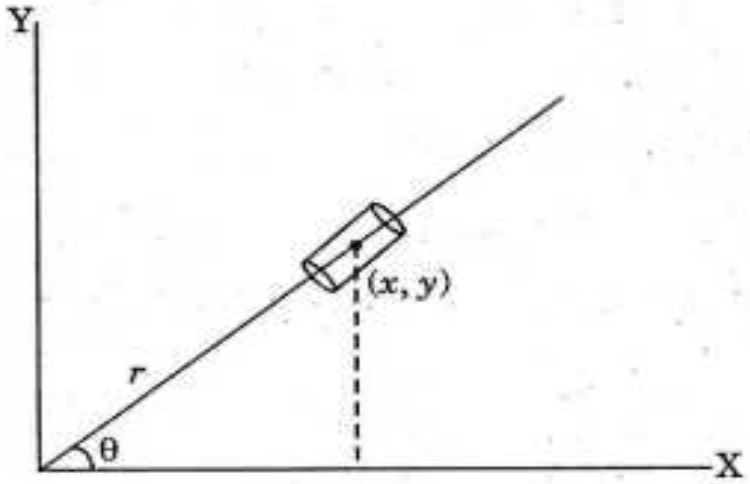
(*iv*) Rolling disc.

Which of the following is *correct* for holonomic constraints ?

(A) (*i*) and (*ii*) (B) (*i*) and (*iii*)

(C) (*ii*) and (*iii*) (D) (*iii*) and (*iv*)

4. A bead slides on a smooth rod which is rotating about one end in a vertical plane with uniform angular velocity ω (as shown). Its equation of motion is :



(A) $\frac{1}{2}m\ddot{r} - mr\dot{\theta}^2 + mg\sin\theta = 0$

(B) $m\ddot{r} - mr\dot{\theta}^2 + mg\sin\theta = 0$

(C) $\frac{3}{2}m\ddot{r} + mr\dot{\theta}^2 + mg\sin\theta = 0$

(D) $m\ddot{r} - mr\dot{\theta}^2 + mg\cos\theta = 0$

5. The Hamiltonian corresponding to the Lagrangian $L = a\dot{x}^2 + b\dot{y}^2 - kxy$ is :

(A) $\frac{p_x^2}{2a} + \frac{p_y^2}{2b} + kxy$

(B) $\frac{p_x^2}{4a} + \frac{p_y^2}{4b} - kxy$

(C) $\frac{p_x^2}{4a} + \frac{p_y^2}{4b} + kxy$

(D) $\frac{(p_x^2 + p_y^2)}{4ab} + kxy$

6. The differential and total scattering cross-sections for the scattering of a particle by a rigid sphere of radius R are, respectively :

(A) $\frac{R^2}{4}, \pi R^2$

(B) $\frac{\pi R^2}{2}, \pi R^2$

(C) $\pi R^2, \frac{R^2}{4}$

(D) $\frac{3R^2}{2}, \frac{R^2}{2}$

7. The moment of inertia tensor for the system of four point masses 1 gm, 2 gm, 3 gm and 4 gm, located at (1, 0, 0), (1, 1, 0), (1, 1, 1) and (1, 1, −1), respectively, is :

(A) $\begin{pmatrix} 1 & 16 & 1 \\ 1 & 1 & 17 \\ -9 & 19 & 1 \end{pmatrix}$

(B) $\begin{pmatrix} 19 & 16 & 1 \\ 16 & -9 & 1 \\ 1 & 1 & 17 \end{pmatrix}$

(C) $\begin{pmatrix} -9 & 16 & 1 \\ 16 & 17 & 1 \\ 1 & 1 & 19 \end{pmatrix}$

(D) $\begin{pmatrix} 16 & -9 & 1 \\ -9 & 17 & 1 \\ 1 & 1 & 19 \end{pmatrix}$

8. The spectral line of $\lambda = 5000$ Å in the light coming from a distant star is observed at 5200 Å. Find the distance of the star. (Hubble constant = 3×10^{-18}/s) :

(A) 4×10^{24} m

(B) 5×10^{25} m

(C) 6×10^{26} m

(D) 4×10^{27} m

9. The rest mass of a particle of momentum p and kinetic energy T is given by :

(A) $\frac{p^2c^2 - T^2}{2Tc^2}$

(B) $\frac{pc - T}{2Tc}$

(C) $\frac{p^2c^2 - T^2}{3Tc^2}$

(D) $\frac{p^2c^2 - T^2}{Tc^2}$

10. If the power radiated by the sun is 3.8×10^{26} W, the value of Poynting vector at the surface of the sun is (Given, radius of sun = 7×10^8 m) :

(A) 3.1×10^{10} W/m^2

(B) 4.6×10^9 W/m^2

(C) 3.6×10^8 W/m^2

(D) 6.2×10^7 W/m^2

11. Find the plasma frequency, if the average density of electrons in ionosphere is 6×10^{10} electrons/m^3.

(A) 8.6×10^6 Hz

(B) 2.2×10^6 Hz

(C) 2.2×10^7 Hz

(D) 3.6×10^7 Hz

12. For normal incidence of electromagnetic waves at the glass-air interface, the reflection and transmission coefficients are, respectively :

(A) 0.04, 0.96 (B) 0.02, 0.09

(C) 0.04, 0.76 (D) 0.96, 0.04

13. A metallic sodium surface is kept at a distance of 1.0 m from a 100 W bulb, emitting light in all directions. Find the time needed by an electron in a sodium atom to receive energy of 1.0 eV. Assume that all the energy is absorbed by the top layer of the surface and all the energy given to sodium atom is taken by one electron :

(A) 1.3 s (B) 0.82 s

(C) 0.6 s (D) 0.4 s

14. An X-ray tube passes 10.0 mA current if the voltage applied is 20 kV. How much power is radiated if the efficiency is 0.2% ?

(A) 0.4 W (B) 0.6 W

(C) 0.8 W (D) 1.1 W

15. How much electron energy is required in an electron microscope to create the same resolving power as that of a gamma ray microscope designed to 0.1 gamma rays ?

(A) 0.002 MeV

(B) 0.005 MeV

(C) 0.007 MeV

(D) 0.009 MeV

16. An electron has a de Broglie wavelength equal to that of a photon. If the photon has an energy of 100 keV, what is the kinetic energy of the electron ?

(A) 10^3 eV

(B) 3×10^3 eV

(C) 6×10^3 eV

(D) 10^4 eV

17. For which of the following cubes, the number of nearest neighbours (coordination number) is 8 ?

(A) Diamond cube

(B) Simple cube

(C) Body-centred cube

(D) Face-centred cube

18. Assuming that the lattice points of lattice parameter 'a' in a bcc structure are occupied by spherical atoms of radius r. Find the free volume per unit cell.

(A) $a^3\left[1-\frac{\pi\sqrt{3}}{8}\right]$ (B) $\frac{2a^3}{3}\left[1-\frac{\pi\sqrt{3}}{8}\right]$

(C) $a^3\left[1-\frac{\pi}{8}\right]$ (D) $\frac{1}{3}a^3\left[1-\frac{\pi}{8}\right]$

19. In a tetragonal lattice, $a = b = 0.25$ nm and $c = 0.18$ nm. Find the spacing between (1 1 1) planes :

(A) 0.13 nm (B) 0.29 nm

(C) 0.36 nm (D) 0.52 nm

20. The density, resistivity and atomic weight of copper are 8920 kg/m^3, 1.73×10^{-8} Ωm and 63.5, respectively. Find the average time of collision of the electrons obeying classical laws.

(A) 0.43×10^{-8} s (B) 0.98×10^{-10} s

(C) 1.21×10^{-12} s (D) 2.43×10^{-14} s

21. Evaluate the normalization constant, N, for the following wave function :

$$\psi(x) = Ne^{-ikx}; \; -a < x < a.$$

(A) 1 (B) $\sqrt{2a}$

(C) $\frac{1}{2a}$ (D) $\frac{1}{\sqrt{2a}}$

22. Calculate the energy difference between the $n_x = n_y = n_z = 1$ level and the next higher energy level for free electrons in a solid cube of side 10 mm.

(A) 2.69×10^{-16} eV (B) 1.13×10^{-14} eV

(C) 3.12×10^{-12} eV (D) 5.16×10^{-8} eV

23. An alloy of a metal is found to have a resistivity of 10^{-6} Ωm at 0°C. When it is heated to a temperature of 700°C, the resistivity increases by 8%. Find the resistivity of the alloy.

(A) 0.97×10^{-6} Ωm (B) 0.95×10^{-5} Ωm

(C) 0.83×10^{-7} Ωm (D) 0.79×10^{-4} Ωm

24. The variation of conductivity (σ) of a semiconductor with temperature (T) is given as :

$\frac{1}{T}(K^{-1})$	ln σ
2.6×10^{-3}	3.58
2.2×10^{-3}	5.099
1.8×10^{-3}	6.645
1.4×10^{-3}	8.202

Find the band gap.

(Given : $k_B = 1.38 \times 10^{-23}$ J/K)

(A) 0.39 eV (B) 0.42 eV

(C) 0.64 eV (D) 0.96 eV

25. Find the diffusion coefficient of electrons of a silicon single crystal at 27°C if the mobility of electrons is 0.17 $m^2V^{-1}s^{-1}$ at 27°C :

(A) 4.4×10^{-3} m^2s^{-1} (B) 3.2×10^{-4} m^2s^{-1}

(C) 4.4×10^{-4} m^2s^{-1} (D) 1.9×10^{-5} m^2s^{-1}

26. An atom of oxygen on being polarized produces a dipole moment of 0.5×10^{-22} C-m. If the distance of the centre of negative charge cloud from the nucleus is 4.0×10^{-17} m, find the polarizability of the oxygen atom. (Given, $\varepsilon_0 = 8.8 \times 10^{-12}$ F/m)

(A) 3.6×10^{-36} F m^2 (B) 2.6×10^{-40} F m^2

(C) 1.9×10^{-45} F m^2 (D) 4.9×10^{-46} F m^2

27. The exciting line in an experiment is 546 nm and the Stoke line is at 552 nm. Find the wavelength of anti-Stoke line :

(A) 5400 Å (B) 5600 Å

(C) 5800 Å (D) 6000 Å

28. Before emerging from a cyclotron, deuterons describe a circle of radius 0.32 m. The frequency of the applied voltage is 10 MHz. Find the speed of the deuteron emerging from the cyclotron.

(A) 0.96×10^4 m/s (B) 1.6×10^5 m/s

(C) 3.1×10^6 m/s (D) 2.0×10^7 m/s

29. For stationary states, the wave function takes the form :

(A) $\psi(x, t) = e^{\alpha x} e^{-iEt/\hbar}$

(B) $\psi(x, t) = \psi(x) e^{-iEt/\hbar}$

(C) $\psi(x, t) = \psi(t) e^{-Ex/\hbar}$

(D) $\psi(x, t) = e^{-\alpha x} e^{-Et/\hbar}$

30. The possible eigen values of the operator, $\hat{Q} = i\frac{d}{d\varphi}$, are :

(A) all integers

(B) positive integers only, excluding zero

(C) all negative integers, including zero

(D) none of the above

31. Suppose a spin-1/2 particle is in the state $= \frac{1}{\sqrt{6}}\begin{pmatrix} 1+i \\ 2 \end{pmatrix}$. What are the probabilities of getting $+\hbar/2$ and $-\hbar/2$, if you measure S_z ?

(A) 2/3, 1/3

(B) 1/3, 2/3

(C) 1/3, 1/3

(D) 2/3, 2/3

32. Lamb shift is of the order of :

(A) $\alpha^2 mc^2$

(B) $\alpha^4 mc^2$

(C) $\alpha^5 mc^2$

(D) $\alpha^4 m^2 c^2 / m_p$

33. Radius of a typical nucleus of mass ~ 200 is of the order of 0.6×10^{-14} m. Estimate the kinetic energy of a nucleon inside the nucleus.

(A) 3.2 MeV (B) 4.3 MeV

(C) 5.9 MeV (D) 7.0 MeV

34. Find the energy (in Joules) required to break $^{12}_{6}C$ nucleus into three α-particles. (Take $m_{^{12}_{6}C} = 12$ amu and $m_{\alpha} = 4.0026$ amu) :

(A) 6.1×10^{-6} (B) 4.2×10^{-8}

(C) 3.9×10^{-10} (D) 1.2×10^{-12}

35. The volume, surface, Coulomb and asymmetry energies (in MeV) of ^{40}Ca nucleus are, respectively :

(A) 620, –196, –80, 0 (B) 520, –178, –80, 0

(C) –620, –196, 80, 0 (D) –520, 178, –80, 0

36. According to the shell model, the predicted spin of $^{61}_{28}Ni_{33}$ is :

(A) 7/2 (B) 5/2

(C) 3/2 (D) 1/2

37. A 0.01 mm thick $^{7}_{3}Li$ target is bombarded with a beam of flux of 10^{13} particles/ cm^2-s. As a result 10^8 neutrons/s are produced. Calculate the cross-section for this reaction. (Given, density of lithium = 500 kg/m^3)

(A) 0.91 b

(B) 0.62 b

(C) 0.42 b

(D) 0.23 b

38. The ratio of radiation losses and ionization losses for 0.97 MeV β-particles in $^{208}_{82}Pb$ is :

(A) 0.01

(B) 0.06

(C) 0.15

(D) 0.35

39. Half-thickness of an absorber of γ-rays is 5.0 mm. What is the percentage loss of intensity of these γ-rays in travelling 20 mm thickness of the absorber ?

(A) 5.32%

(B) 6.25%

(C) 7.35%

(D) 8.19%

40. A cyclotron oscillating frequency of 1.0 MHz is used to accelerate protons. If the radius of the dee is 60 cm, find the magnetic field.

(A) 1.06 T (B) 0.09 T

(C) 0.06 T (D) 0.01 T

41. Which of the following is *true* for Scintillation detectors ?

(A) Inorganic Scintillation detectors are used to measure the energy of α- and β-particles

(B) Organic Scintillation detectors are used to detect X-and γ-rays

(C) They generally have low efficiency

(D) They have very short dead time ($\sim 10^{-9}$ s) permitting very high counting rates

42. Quark composition of Σ^+ is :

(A) uud (B) udd

(C) uds (D) uus

43. A particle X has two decay modes with partial decay rates $r_1 s^{-1}$ and $r_2 s^{-1}$.

What is the inherent uncertainty in the mass of particle X ?

(A) $\hbar\sqrt{r_1^2 + r_2^2}$ (B) $\hbar(r_1 + r_2)$

(C) $\hbar\sqrt{r_1^2 - r_2^2}$ (D) $\hbar(r_1 - r_2)$

44. The eigen value of a commutator, $\left[\frac{d}{dx}, \hat{x}\right]$ is :

(A) zero (B) 1

(C) –1 (D) $\hbar$

45. At time $t = 0$, the wave function of hydrogen atom is given by :

$$\psi(r, 0) = \frac{1}{\sqrt{10}}(2\psi_{100} + \psi_{210} + \sqrt{2}\psi_{211} + \sqrt{3}\psi_{21,-1}).$$

Find the expectation value for the energy of the system :

(A) –13.6 eV (B) –3.4 eV

(C) –7.5 eV (D) –10.2 eV

46. What is the value of the uncertainty product $(\Delta L_x)(\Delta L_y)$ in a representation in which L^2 and L_z have simultaneous eigen functions ?

(A) $(\Delta L_x)(\Delta L_y) \geq \frac{\hbar}{2}$

(B) $(\Delta L_x)(\Delta L_y) \geq \frac{m\hbar^2}{2}$

(C) $(\Delta L_x)(\Delta L_y) \geq m\hbar$

(D) $(\Delta L_x)(\Delta L_y) \geq \frac{m^2\hbar^2}{4}$

47. The unperturbed wave functions of a particle trapped in an infinite square well of bottom 'a' are $\psi_n = \sqrt{\frac{2}{a}} \sin\frac{n\pi x}{a}$. If the system is perturbed by raising the floor of the well by a constant amount V_0, then the second order correction to the energy of the nth state is :

(A) nV_0

(B) V_0

(C) zero

(D) V_0^2

48. Which of the following electric dipole transitions is *not* allowed ?

(A) $1s \rightarrow 2p$

(B) $2p \rightarrow 3d$

(C) $3s \rightarrow 5d$

(D) $1s \rightarrow 1f$

49. Which of the following is *correct* for Dirac matrices ?

(A) $\alpha_x\alpha_y + \alpha_y\alpha_x = \hat{I}$

(B) $\alpha_x\alpha_y + \alpha_y\alpha_x = \hat{0}$

(C) $\alpha_x\alpha_y + \alpha_y\alpha_x = \hbar\hat{I}$

(D) $\alpha_x\alpha_y + \alpha_y\alpha_x = \alpha_z$

50. A stationary body explodes into two fragments each of mass 1.0 kg that move apart at speeds of 0.6c relative to the original body. Find the mass of the original body.

(A) 3.5 kg

(B) 3.0 kg

(C) 2.5 kg

(D) 2.0 kg

51. An electron and a positron, moving side by side in the +X direction at 0.5c, annihilate each other. If two photons are produced, what is the energy of each photon ?

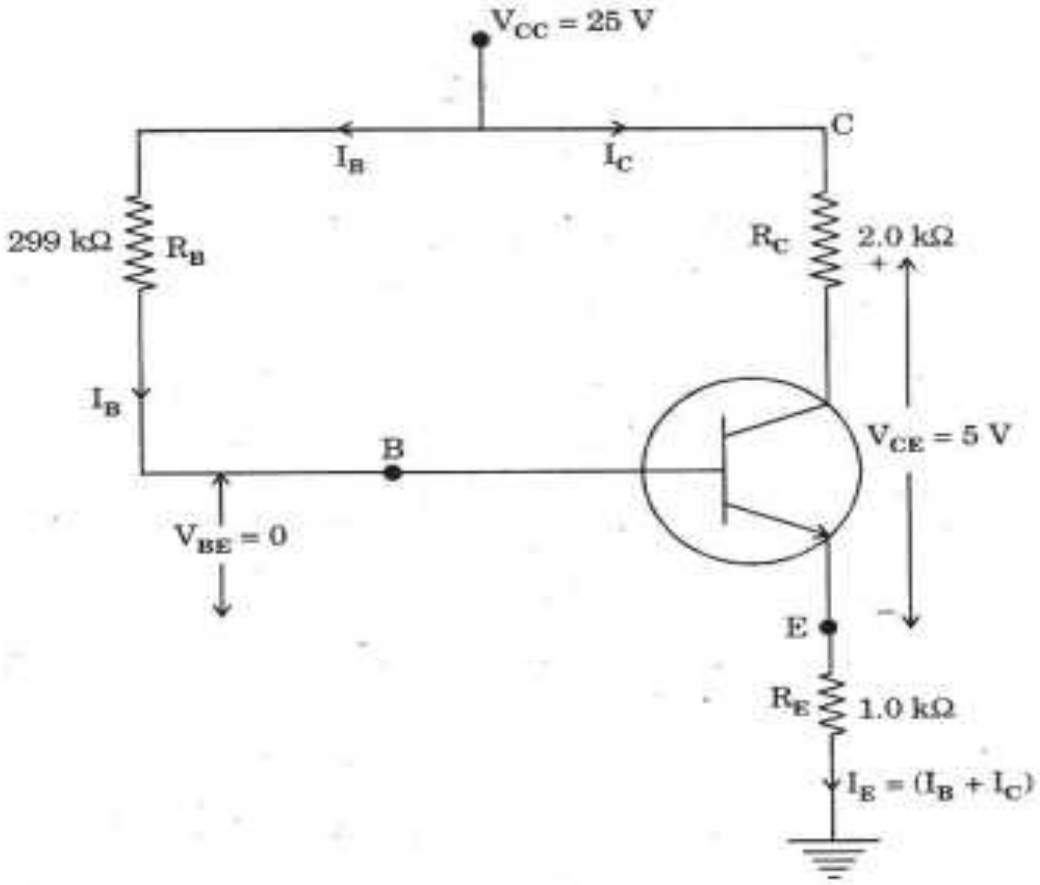
(A) 0.885 MeV, 0.295 MeV

(B) 0.500 MeV, 0.500 MeV

(C) 0.250 MeV, 0.295 MeV

(D) 0.295 MeV, 0.313 MeV

52. In a transistor amplifier circuit (as shown), find the base current I_B :



(A) 40 μA (B) 50 μA

(C) 65 μA (D) 80 μA

53. Find the barrier potential for Si junction at 0°C if its value at 25°C is 0.7 V :

(A) 0.7 V (B) 0.75 V

(C) 0.80 V (D) 0.85 V

54. In an AM wave, calculate the power saving when the carrier and one sideband are suppressed corresponding to $m = 1$.

(A) 83%
(B) 73%
(C) 69%
(D) 56%

55. Convert 25.625_{10} into its binary equivalent :

(A) 10011.001_2
(B) 11001.101_2
(C) 11100.110_2
(D) 00111.001_2

56. Two electrical signals 101101 and 110101 are applied to an AND gate. Find the output of the AND gate.

(A) 100101_2
(B) 101101_2
(C) 110101_2
(D) 101100_2

57. A train of light pulses is transmitted through a 500 m fibre with $n_1 = 1.4$ and $n_2 = 1.35$. Find the total dispersion assuming input pulse of zero line width.

(A) 102 ns
(B) 83 ns
(C) 75 ns
(D) 36 ns

58. In an N type semiconductor, the Fermi level lies 0.5 eV below the conduction band. If the concentration of donor atoms is tripled, find the new position of the Fermi level. (Take, $k_B T = 0.03$ eV) :

(A) 0.18 eV below the conduction band

(B) 0.28 eV below the conduction band

(C) 0.47 eV below the conduction band

(D) 1.2 eV below the conduction band

59. In a single stage transistor used in common emitter (CE) configuration, the collector resistance $R_C = 10$ kΩ, the load resistance $R_L = 10$ kΩ, $\beta = 100$ and the input resistance $R_i = 2.5$ kΩ. Find the output voltage if the input is 2 mV.

(A) 0.1 V

(B) 0.2 V

(C) 0.3 V

(D) 0.4 V

60. When a sinusoidal signal is fed to an amplifier, the output current is given by :

$$i_c = 15 \sin 400t + 1.5 \sin 800t + 1.2 \sin 1200t + 0.5 \sin 1600t.$$

Find the percentage increase in power due to distortion.

(A) 5.34%

(B) 3.97%

(C) 1.74%

(D) 0.8%

61. The circuit of SCR half wave rectifier is adjusted so that the gate current is 1.0 mA. The forward breakdown voltage of SCR at the gate current is 100 V. If a sinusoidal voltage of 200 V peak is applied, find the conduction angle :

(A) 30°
(B) 60°
(C) 90°
(D) 150°

62. Find the wavelength of a photon so that it converts into an $e^- - e^+$ pair.

(A) 2.3×10^{-15} m
(B) 3.2×10^{-13} m
(C) 1.2×10^{-12} m
(D) 6.3×10^{-10} m

63. For a Gaussian wave packet :

(A) $\Delta x \cdot \Delta p_x \geq \hbar/2$
(B) $\Delta x \cdot \Delta p_x \leq \hbar$
(C) $\Delta x \cdot \Delta p_x = \hbar/2$
(D) $\Delta x \cdot \Delta p_x = 0$

64. A neutron is confined in space to 10^{-14} m. Find the time its wave packet will take to spread to four times its original size.

(A) 1.2×10^{-20} s

(B) 2.3×10^{-21} s

(C) 1.6×10^{-22} s

(D) 2.9×10^{-23} s

65. Consider a state $|\psi> = \frac{1}{\sqrt{2}}|\varphi_1> + \frac{1}{\sqrt{5}}|\varphi_2> + \frac{1}{\sqrt{10}}|\varphi_3>$ which consists of three orthonormal states $|\varphi_1>, |\varphi_2>$ and $|\varphi_3>$. If $\hat{B}|\varphi_n> = n^2|\varphi_n>$, find the expectation value of $\hat{B}$ for the state $|\psi>$.

(A) $\frac{22}{10}$

(B) $\frac{8}{10}$

(C) $\frac{11}{4}$

(D) $\frac{11}{5}$

66. Which of the following matrices is an element of the group SU(2) ?

(A) $\begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$

(B) $\begin{pmatrix} \frac{1+i}{\sqrt{3}} & \frac{-1}{\sqrt{3}} \\ \frac{1}{\sqrt{3}} & \frac{1-i}{\sqrt{3}} \end{pmatrix}$

(C) $\begin{pmatrix} 2+i & i \\ 3 & 1+i \end{pmatrix}$

(D) $\begin{pmatrix} \frac{1}{2} & \frac{\sqrt{3}}{2} \\ \frac{\sqrt{3}}{2} & \frac{1}{2} \end{pmatrix}$

67. The equation of the plane that is tangent to the surface $xyz = 8$ at the point (1, 2, 4) is :

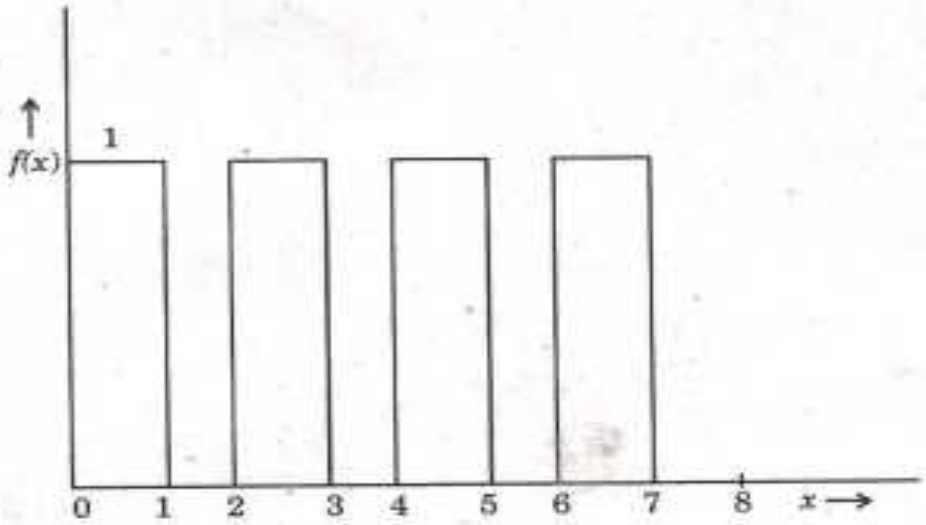
(A) $x + 2y + 4z = 12$

(B) $x + 4y + 2z = 0$

(C) $x + y + z = 7$

(D) $4x + 2y + z = 12$

68. The Laplace transform of the function $f(x)$ (shown below) is :



(A) $\frac{1 + e^{-s}}{s}$

(B) $\frac{1 - e^{-s}}{s}$

(C) $\frac{1}{s(1 + e^{-s})}$

(D) $\frac{1}{s(1 - e^{-s})}$

69. If A, B and C are non-zero Hermitian operators, which of the following relations must be false ?

(A) $A + B = C$

(B) $ABA = C$

(C) $AB + BA = C$

(D) $[A, B] = C$

70. The degeneracy of an excited state of nitrogen atom having electronic configuration $1s^2 2s^2 2p^2 3d^1$ is :

(A) 6

(B) 10

(C) 15

(D) 150

71. If the hyperfine interaction in an atom is given by $H = a\vec{S}_e \cdot \vec{S}_p$, where $\vec{S}_e$ and $\vec{S}_p$ are the spins of electron and proton, respectively, the splitting between $^3S_1$ and $^3S_0$ states is :

(A) $a\hbar^2$

(B) $a\hbar^2/2$

(C) $a\hbar^2/\sqrt{2}$

(D) $2a\hbar^2$

72. Identify the nature of interactions for the following reactions ?

(*i*) $K^- + p \rightarrow \Sigma^- + \pi^+$ (*ii*) $\mu^- + \mu^+ \rightarrow K^- + K^+$

(*iii*) $\Sigma^+ \rightarrow p + \pi^0$

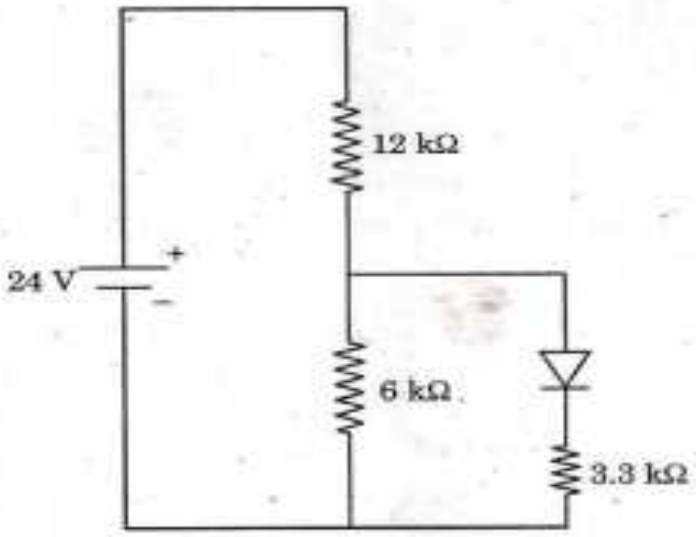
(A) (*i*) : strong, (*ii*) : electromagnetic, (*iii*) : weak

(B) (*i*) : strong, (*ii*) : weak, (*iii*) : electromagnetic

(C) (*i*) : weak, (*ii*) : electromagnetic, (*iii*) : strong

(D) (*i*) : weak, (*ii*) : electromagnetic, (*iii*) : weak

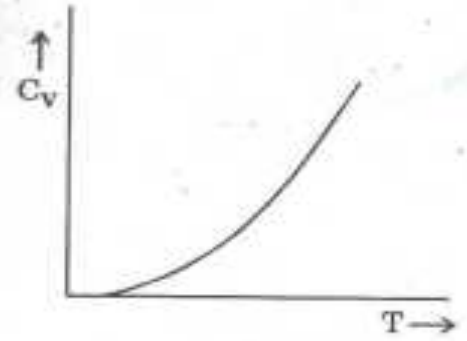
73. In the circuit shown, the voltage drop across the diode in forward bias condition is 0.7 V. The current passing through the diode is :

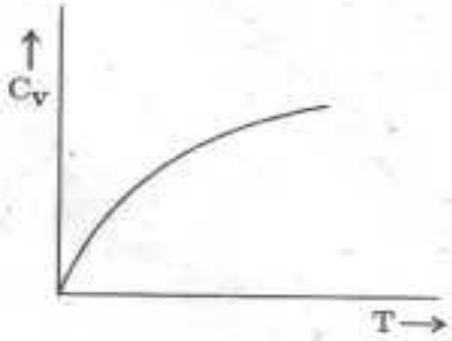


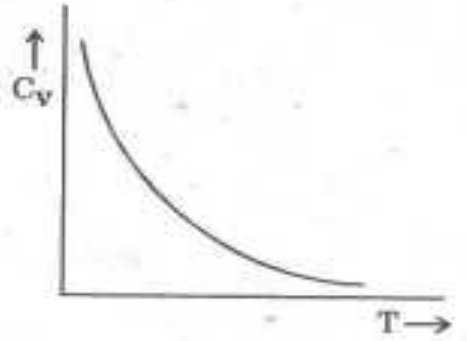
(A) 0.5 mA (B) 1.0 mA

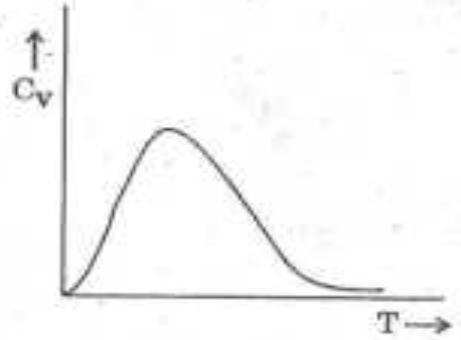
(C) 1.5 mA (D) 2.0 mA

74. The specific heat of the photon gas varies with temperature as :

(A) 

(B) 

(C) 

(D) 

75. The first three energy levels of a system lie at 0, E and 2E. The energy level E is 2-fold degenerate, whereas the other two are non-degenerate. The partition function of the system with $\beta = (k_B T)^{-1}$ is given by :

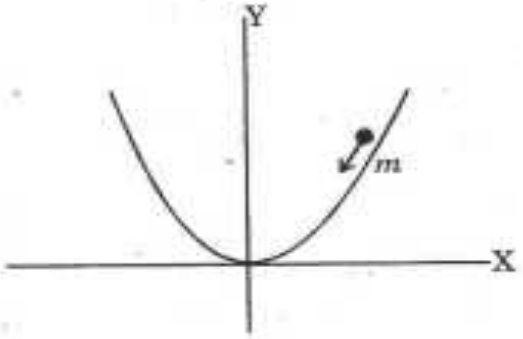
(A) $1 + 2e^{-\beta E}$

(B) $2e^{-\beta E} + e^{\beta E}$

(C) $(1 + e^{-\beta E})^2$

(D) $1 + e^{-\beta E} + e^{-2\beta E}$

76. A particle of mass m slides under the gravity along the parabolic path $y = ax^2$ (as shown). The Lagrangian of the particle is given by :



(A) $L = \frac{1}{2}m\dot{x}^2 - mgax^2$

(B) $L = \frac{1}{2}m(1 + 4a^2x^2)\dot{x}^2 - mgax^2$

(C) $L = \frac{1}{2}m\dot{x}^2 + mgax^2$

(D) $L = \frac{1}{2}m(1 + 4a^2x^2)\dot{x}^2 + mgax^2$

77. Which of the following *cannot* be explained by considering a harmonic approximation for the lattice vibrations in solids ?

(A) Deby's T^3 law

(B) Thermal expansion

(C) Dulong-Petit's law

(D) Optical branches in lattices

78. If L_x, L_y and L_z are, respectively, the x, y and z components of angular momentum operator $\vec{L}$, the commutator $[L_xL_y, L_z]$ will be :

(A) $i\hbar(L_x^2 + L_y^2)$

(B) $2i\hbar L_z$

(C) $i\hbar(L_x^2 - L_y^2)$

(D) null-operator

79. If the spatial part of the wave function of a two fermion system is given by :

$$\psi(\vec{r_1}, \vec{r_2}) = \frac{1}{\sqrt{2}}[\varphi_1(\vec{r_1})\,\varphi_2(\vec{r_2}) + \varphi_2(\vec{r_1})\,\varphi_1(\vec{r_2})],$$

The spin part of the wave function should be :

(A) $\frac{1}{\sqrt{2}}(\alpha\beta + \beta\alpha)$

(B) $\frac{1}{\sqrt{2}}(\alpha\beta - \beta\alpha)$

(C) $\frac{1}{\sqrt{2}}\alpha\beta$

(D) $\frac{1}{\sqrt{2}}(\alpha - \beta)$

80. The wave function of a particle moving in free space is given by $\psi = e^{ikx} + 3e^{-ikx}$.

The energy of the particle is :

(A) $\frac{5\hbar^2k^2}{2m}$

(B) $\frac{4\hbar^2k^2}{2m}$

(C) $\frac{3\hbar^2k^2}{2m}$

(D) $\frac{\hbar^2k^2}{2m}$

81. Around which year did the Chinese pilgrim, Hiuen Tsang, visit India ?

(A) 629 BC

(B) 292 BC

(C) 629 AD

(D) 922 AD

82. At which place in Chamba District of H.P. is Shakti Devi temple ?

(A) Chhatrari

(B) Bharmaur

(C) Mani Mahesh

(D) Saho

83. According to the 2011 census which District of H.P. has the lowest sex ratio ?

(A) Lahaul-Spiti

(B) Solan

(C) Sirmaur

(D) Kinnaur

84. Who was the first Sikh Chieftain to invade the Kangra princely state ?

(A) Jai Singh

(B) Jassa Singh

(C) Ranjit Singh

(D) Dhian Singh

85. In which princely state was '*Bhai Do Na Pai Do*' movement launched ?

(A) Bilaspur (B) Mandi

(C) Bushahar (D) Sirmaur

86. In which District of H.P. is Ghadasaru lake ?

(A) Chamba (B) Kangra

(C) Kullu (D) Shimla

87. Where do the people of Bilaspur region of H.P. go for holy dip on Baishaki Day ?

(A) Markanda (B) Ghagas

(C) Samoh (D) Hatwar

88. At which place around Kotgarh is the HPMC up-grading its packing house ?

(A) Nankhari (B) Jarol Tikkar

(C) Khadrala (D) Baghi

89. Which country is assisting in Swan river Integrated Watershed Management Project in Una District of H.P. ?

(A) France
(B) Germany
(C) Japan
(D) Korea

90. In which river basin is Thirot hydel project ?

(A) Ravi
(B) Chenab
(C) Satluj
(D) Beas

91. Who is the Chief Justice of India ?

(A) Justice H.L. Dattu
(B) Justice Joseph Kurian
(C) Justice Tirath Singh Thakur
(D) Justice R.M. Lodha

92. To which state did Sharad Joshi, who died recently, belong ?

(A) UP
(B) Maharashtra
(C) Punjab
(D) Haryana

93. With which of the following was Virendra Nath Mishra associated ?

(A) Medicine
(B) Archaeology
(C) Economics
(D) Sports

94. Which is Indian Navy's latest stealth destroyer ?

(A) INS Kuthar
(B) INS Mysore
(C) INS Delhi
(D) INS Kochi

95. Who has been named as India's richest person by the Forbes Magazine ?

(A) Jagmohan Dalmia
(B) Mukesh Ambani
(C) Azim Premji
(D) K.K. Birla

96. To which country does economist Angus Deaton, who got the 2015 Nobel Prize belong ?

(A) USA
(B) Britain
(C) Germany
(D) France

97. Who is Bindhya Bhandari ?

(A) President of Nepal

(B) Speaker of Odisha Assembly

(C) Governor of Jharkhand

(D) Communist leader of Pashchim Banga

98. In which country is Antalya, which was the venue of G-20 summit held in November, 2015 ?

(A) Brazil

(B) Turkey

(C) Russia

(D) Canada

99. Who is Justin Trudeau ?

(A) President of Maldives

(B) President of South Korea

(C) Prime Minister of Canada

(D) Prime Minister of Romania

100. Who has been elected as the President of Guatemala recently ?

(A) Ahmed Chalabi

(B) Dilima Rousseff

(C) Alexis Tsipras

(D) Jimy Morales