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ROLL No.

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TEST BOOKLET No.

1316

TEST FOR POST GRADUATE PROGRAMMES

PHYSICS

Time: 2 Hours

Maximum Marks: 450

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INSTRUCTIONS TO CANDIDATES

1. You are provided with a Test Booklet and an Optical Mark Reader (OMR) Answer Sheet to mark your responses. Do not soil the Answer Sheet. Read carefully all the instructions given on the Answer Sheet.
  2. Write your Roll Number in the space provided on the top of **this page**.
  3. Also write your Roll Number, Test Code, and Test Subject in the columns provided for the same on the **Answer Sheet**. Darken the appropriate bubbles with a **Ball Point Pen**.
  4. The paper consists of 150 objective type questions. All questions carry equal marks.
  5. Each question has four alternative responses marked **A, B, C** and **D** and you have to **darken** the bubble fully by a **Ball Point Pen** corresponding to the correct response as indicated in the example shown on the Answer Sheet.
  6. Each correct answer carries **3** marks and each wrong answer carries **1** minus mark.
  7. Please do your rough work only on the space provided for it at the end of this Test Booklet.
  8. You should return the Answer Sheet to the Invigilator before you leave the examination hall. However, you can retain the Test Booklet.
  9. Every precaution has been taken to avoid errors in the Test Booklet. In the event of such unforeseen happenings the same may be brought to the notice of the Observer/Chief Superintendent in writing. Suitable remedial measures will be taken at the time of evaluation, if necessary.
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SEAL



61312

1

PHYSICS

1. In a n-p-n transistor circuit, the collector current is 10mA. If 90% of the electrons emitted reach the collector, then
  - (A) emitter current will be 9 mA
  - (B) emitter current will be 11 mA
  - (C) base current will be 1 mA
  - (D) base current will be -1 mA
  
2. At absolute zero temperature, a crystal of pure germanium
  - (A) behaves as perfect conductor
  - (B) behaves as perfect insulator
  - (C) contains no electrons
  - (D) behaves as a semi metal
  
3. A constant force acts on a 5 kg object and reduces its velocity from 7 m/s to 3 m/s in a time of 3 s. The force acting on the object is
  - (A) - 6.7 N
  - (B) 6.7 N
  - (C) 1.33 N
  - (D) -1.33 N
  
4. A projectile is shot upward from the Earth with a speed of 20 m/s. How high is it when its speed is 8.0 m/s (ignore air friction)?
  - (A) 1.71 m
  - (B) 17.1 m
  - (C) 171 m
  - (D) 1.71 km
  
5. An 8g bullet is fired horizontally into a 9kg block of wood and sticks in it. The block which is free to move, has a velocity of 40cm/s after the impact. The initial velocity of the bullet is
  - (A) 4500 m/s
  - (B) 45 m/s
  - (C) 450 m/s
  - (D) 4.5 m/s
  
6. A motor furnishes 120 hp to a device that lifts a 5000kg load to a height of 13.9m in a time of 20s. The efficiency of the device is
  - (A) 30%
  - (B) 36%
  - (C) 40%
  - (D) 46%



61312

2

7. A fielder in a cricket match throws a ball from the boundary line to the wicket keeper. The ball describes a parabolic path. Which of the following quantities remain constant, during the ball's motion in air (ignore air resistance)?
- (A) kinetic energy                      (B) horizontal component of velocity  
(C) speed                                      (D) vertical component of velocity
8. Two bodies of masses 8kg and 4kg move along the x-axis in opposite directions with velocities of 11 m/s and  $-7$  m/s respectively. They collide and stick together. Their velocity just after collision will be
- (A) 50 m/s                                      (B) 4 m/s  
(C) 5 m/s                                      (D) 3 m/s
9. A steel tape is calibrated at  $20^{\circ}\text{C}$ . On a cold day when the temperature is  $-15^{\circ}\text{C}$ , what will be the percent error in the tape ( $\alpha$  of steel is  $1.1 \times 10^{-5}/^{\circ}\text{C}$ )?
- (A) 0.039%                                      (B)  $-0.039\%$   
(C) 3.9%                                        (D)  $-0.39\%$
10. The physics underlying the operation of a refrigerator most closely resembles the physics underlying
- (A) heat engine                                      (B) melting of ice  
(C) freezing of water                                      (D) vaporisation of water
11. A liquid with coefficient of volume expansion  $\gamma$  is filled in a container of a material having the coefficient of linear expansion  $\alpha$ . If the liquid overflows on heating, then
- (A)  $\gamma = 3\alpha$                                       (B)  $\gamma > 3\alpha$   
(C)  $\gamma < 3\alpha$                                       (D)  $\gamma = 3/\alpha$
12. Which of the following combination of properties would be most desirable for a cooking pot?
- (A) High specific heat and low conductivity  
(B) High specific heat and high conductivity  
(C) Low specific heat and high conductivity  
(D) Low specific heat and low conductivity

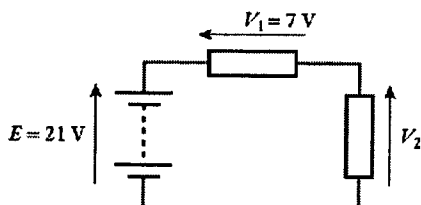


61312

3

13. If an electron has an initial velocity in the direction different from that of an electric field, the path of the electron is
- (A) straight line (B) parabola  
(C) circle (D) ellipse
14. A parallel plate condenser is immersed in an oil of dielectric constant 2. The field between the plates
- (A) increases proportional to 2 (B) increases proportional to  $\sqrt{2}$   
(C) decreases proportional to  $1/2$  (D) decreases proportional to  $1/\sqrt{2}$
15. A magnetic needle is kept in a non uniform magnetic field. It experiences
- (A) a force and a torque (B) a torque but not a force  
(C) a force but not a torque (D) neither force nor torque
16. If L and R denote inductance and resistance respectively, then the dimensions of L/R are
- (A)  $M^0L^0T^0$  (B)  $M^0L^0T$   
(C)  $M^0L^0T^2$  (D)  $MLT^2$
17. A 10H inductor is carrying a current of 2.0A. At what rate this current should be changed so that an emf of 100 volt is induced in the inductor?
- (A) 20A/s (B) 5 A/s  
(C) 50 A/s (D) 10 A/s
18. A convex lens is placed in contact with a mirror. If the space between them is filled with water, its power
- (A) will increase  
(B) can increase or decrease depending on its focal length  
(C) remains unchanged  
(D) will decrease

19. What is the magnitude of  $V_2$  in the following circuit?



- (A)  $-14\text{ V}$  (B)  $28\text{ V}$   
 (C)  $-28\text{ V}$  (D)  $14\text{ V}$
20. A piece of wire vibrates with a fundamental frequency of  $450\text{ Hz}$  under a tension of  $9\text{ kg}$  weight. What will be the tension at which the fundamental frequency becomes  $900\text{ Hz}$ ?
- (A)  $36\text{ kg}$  weight (B)  $72\text{ kg}$  weight  
 (C)  $18\text{ kg}$  weight (D)  $4.5\text{ kg}$  weight
21. In Huygen's eye piece
- (A) the cross wires are outside the eye piece  
 (B) condition for achromatism is satisfied  
 (C) condition for minimum spherical aberration is not satisfied  
 (D) the image formed by the objective is a virtual image
22. A bar magnet of moment of inertia  $49 \times 10^{-2}\text{ kgm}^2$  vibrates in a magnetic field of induction  $0.5 \times 10^{-4}\text{ Tesla}$ . The time period of vibration is  $8.8\text{ sec}$ . The magnetic moment of the bar magnet is
- (A)  $350\text{ Am}^2$  (B)  $490\text{ Am}^2$   
 (C)  $5000\text{ Am}^2$  (D)  $3500\text{ Am}^2$
23. Two wires A and B are of lengths  $40\text{ cm}$  and  $30\text{ cm}$ . A is bent into a circle of radius  $r$  and B into an arc of radius  $R$ . A current  $I_A$  is passed through A and a current of  $I_B$  is passed through B. To have same magnetic induction at the centre, the ratio of  $I_A : I_B$  is
- (A)  $4:3$  (B)  $3:4$   
 (C)  $2:3$  (D)  $3:2$



61312

5

24. A glass tube is bent into the form of U. A 50 cm height of olive oil in one arm is found to balance 46 cm of water in the other. What is the density of olive oil?
- (A)  $920 \text{ kg/m}^3$  (B)  $1080 \text{ kg/m}^3$   
(C)  $0.920 \text{ kg/m}^3$  (D)  $1.092 \text{ kg/m}^3$
25. A sphere of 3 cm radius acts like a blackbody. It is in equilibrium with its surroundings and absorbs 30 kW of power radiated to it from the surroundings. What is the temperature of the sphere?
- (A)  $2600^\circ\text{K}$  (B)  $2600^\circ\text{C}$   
(C)  $900^\circ\text{K}$  (D)  $1600^\circ\text{K}$
26. To break a chemical bond in the molecules of human skin and thus cause sunburn, a photon energy of about 3.5 eV is required. To what wavelength does this correspond?
- (A) 255 nm (B) 300 nm  
(C) 355 nm (D) 260 nm
27. Two copper spheres A(hollow) and B(solid) are charged to the same potential. Which of the two holds more energy?
- (A) A (B) Both will have same energy  
(C) B (D) Can not be predicted
28. The first law of thermodynamics is  $\Delta Q = \Delta U + \Delta W$ . For an isothermal process in an ideal gas
- (A)  $\Delta Q$  is negative (B)  $\Delta U = 0$   
(C)  $\Delta W = 0$  (D)  $\Delta U$  is positive
29. The meniscus of a liquid contained in one of the limbs of a narrow U-tube is placed between the pole pieces of an electromagnet with the meniscus in line with the field. The liquid is seen to rise in the limb. It indicates that the liquid is
- (A) paramagnetic (B) diamagnetic  
(C) ferromagnetic (D) non magnetic



61312

6

30. A player caught a cricket ball of mass 150 g moving at a rate of 20 m/s. If the catching process is completed in 0.1 s, the force of the blow exerted by the ball on the hand of the player is equal to
- (A) 300 N (B) 150 N  
(C) 3 N (D) 30 N
31. In a N type semiconductor, the Fermi level
- (A) is lower than the centre of the energy gap  
(B) is at the centre of the energy gap  
(C) is higher than the centre of the energy gap  
(D) can be any where depending on the doping concentration
32. The work done by a gas is equal in magnitude and opposite in sign to the change in internal energy. The change involved is
- (A) isothermal (B) adiabatic  
(C) isobaric (D) isometric
33. Bohr magnetron is equal to
- (A) half the spin magnetic moment of an electron  
(B) spin magnetic moment of the electron  
(C) twice the spin magnetic moment of an electron  
(D) four times the spin magnetic moment of an electron
34. The binary number 110000111101 corresponds to the hexa decimal number
- (A) CFD (B) D3C  
(C) DBF (D) C3D
35. Two laser beams of same wavelength and intensities  $9I$  and  $I$  are superposed. The minimum and maximum intensities of the resultant beam are
- (A)  $8I$  and  $10I$  (B)  $0$  and  $10I$   
(C)  $4I$  and  $16I$  (D)  $0I$  and  $16I$



61312

7

36. Water rises in a capillary tube to a length  $h$ . It will rise to a height more than  $h$
- (A) on the surface of the Sun
  - (B) at the poles
  - (C) in a lift moving down with acceleration
  - (D) in a lift moving up
37. If  $A$  is the gain of internal amplifier and  $B$  is the feed back coefficient, Barkhausen criterion of oscillations is
- (A)  $AB < 1$
  - (B)  $AB = 1$
  - (C)  $AB > 1$
  - (D)  $AB = 0$
38. Twenty seven spherical drops of mercury of equal size merge into a big drop. The volume of the bigger drop compared to the smaller drops is
- (A) 27 times
  - (B) 9 times
  - (C) 3 times
  - (D) 18 times
39. If white light is used for the formation of interference fringes in Fresnel's biprism experiment, the colour of the central fringe is
- (A) black
  - (B) white
  - (C) green
  - (D) yellow
40. A liquid takes 5 minutes to cool from  $70^\circ\text{C}$  to  $45^\circ\text{C}$ . How much time it will take to cool from  $60^\circ\text{C}$  to  $30^\circ\text{C}$ , if its surrounding temperature is  $20^\circ\text{C}$ ?
- (A) 6 minutes
  - (B) 8 minutes
  - (C) 10 minutes
  - (D) 12 minutes
41. Why Michelson-Morley experiment is considered important?
- (A) It proves the existence of aether
  - (B) It suggests that light is an electromagnetic wave
  - (C) It indicates that light can exhibit interference effects
  - (D) It provides experimental support to the theory of relativity





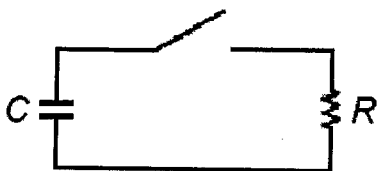
42. The temperature of a metal is reduced. Which of the following statements explain the change in electrical resistance of the metal?
- (A) Electrical resistance increases because the metal freezes
  - (B) Electrical resistance decreases because of more number of free electrons available
  - (C) Electrical resistance increases because electrons move more slowly
  - (D) Electrical resistance reduces because of reduced lattice vibrations
43. When a magnet is placed above a superconductor cooled below its critical temperature, the magnetic lines hovers above the superconductor. This explains that
- (A) the net force is zero due to electrostatic repulsion
  - (B) the magnetic field freezes at low temperatures
  - (C) the net force is zero due to repulsion between cooper pairs
  - (D) the superconductor excludes magnetic field at low temperature
44. Which of the following is necessary for the operation of an induction motor?
- (A) A fixed magnetic field in the motor
  - (B) A direct current supply to the motor
  - (C) A changing magnetic field to the motor
  - (D) Split rings conducting current to the motor
45. An electron in a hydrogen atom is in fifth excited state. The maximum number of spectral lines emitted are
- (A) 6
  - (B) 10
  - (C) 15
  - (D) 20
46. If one mole of an ideal gas doubles its volume as it undergoes an isothermal expansion, its pressure is
- (A) doubled
  - (B) quadrupled
  - (C) unchanged
  - (D) halved
47. A capacitor loses half of its charge every second. If its charge is  $q$  after 5 seconds, its initial charge was
- (A)  $32q$
  - (B)  $4q$
  - (C)  $16q$
  - (D)  $8q$



48. A material has a band gap of 8.0 eV. It means that

- (A) it is transparent in the uv region only
- (B) it is transparent in the uv and visible regions
- (C) it is transparent in visible region only
- (D) it is opaque in visible region

49. The capacitor shown in the circuit is initially charged. After closing the switch, how much time elapses until one half of the capacitor's initial stored energy is displaced?



- (A)  $RC$
- (B)  $RC/2$
- (C)  $RC\ln(2)/2$
- (D)  $2RC\ln(2)$

50. A body of mass  $m$  with specific heat  $c$  at a temperature of 500K is brought into contact with another identical body at temperature 100K. If the two are isolated from the surroundings, the change in entropy of the system is equal to

- (A)  $(4/3)mc$
- (B)  $mc \ln(9/5)$
- (C)  $mc \ln(3)$
- (D)  $-mc \ln(5/3)$

51. In experiments located deep underground, the two types of radiations that most commonly reach experimental apparatus are

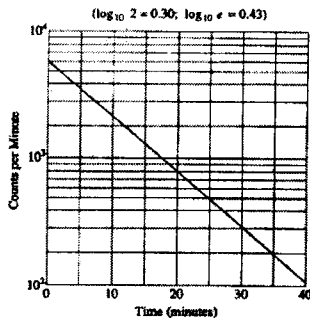
- (A) alpha particles and neutrons
- (B) iron nuclei and carbon nuclei
- (C) protons and electrons
- (D) muons and neutrinos

52. The approximate number of photons in a femto second ( $10^{-15}$ s) pulse of laser of 600 nm wavelength working at 10 kW peak power is

- (A)  $10^3$
- (B)  $10^7$
- (C)  $10^{11}$
- (D)  $10^{15}$



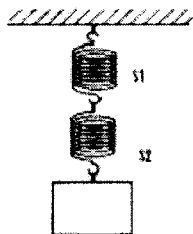
53. A ball is dropped from a height  $h$ . As it bounces off the floor, its speed is 80 percent of what it was just before it hit the floor. The ball will rise to height of most nearly
- (A)  $0.94h$  (B)  $0.80h$   
(C)  $0.75h$  (D)  $0.64h$
54. Light of wavelength 500 nm is incident on Sodium (work function 2.28 eV). What is the maximum kinetic energy of the emitted photoelectrons?
- (A) 0.03 eV (B) 0.2 eV  
(C) 0.6 eV (D) 1.3 eV
55. In the spectrum of hydrogen, the ratio of the longest wavelength in the Lyman series ( $n_f = 1$ ) to the longest wavelength in Balmer series ( $n_f = 2$ ) is approximately
- (A)  $5/27$  (B)  $1/3$   
(C)  $4/9$  (D)  $3/2$
56. An electron in a metal has an effective mass  $m^* = 0.1 m_e$ . If this metal is placed in a magnetic field of 1 Tesla, the cyclotron frequency  $\omega_c$  is most nearly
- (A) 930 rad/s (B)  $8.5 \times 10^6$  rad/s  
(C)  $2.8 \times 10^{11}$  rad/s (D)  $1.8 \times 10^{12}$  rad/s
57. A radioactive nucleus decays, with the activity shown in the figure below. The half life of the nucleus is



- (A) 2 min (B) 7 min  
(C) 11 min (D) 18 min



58. Two springs S1 and S2 have negligible masses and the spring constant of S1 is  $1/3$  that of S2. When a block is hung from the springs as shown in the figure below, and the springs come to equilibrium, then the ratio of work done in stretching S1 to the work done in stretching S2 is



- (A)  $1/9$  (B)  $1/3$   
(C) 1 (D) 3
59. Which of the following properties of Hydrogen atom can be predicted most accurately from Bohr atomic model?
- (A) Energy differences between states  
(B) Angular momentum of ground state  
(C) Degeneracy of states  
(D) Transition probabilities
60. A magnetised wire of magnetic moment  $M$  and length  $L$  is bent in the form of a semi circle of radius  $r$ . The new magnetic moment is
- (A)  $2M/\pi$  (B)  $\pi/2M$   
(C)  $M/rL$  (D)  $M/2\pi$
61. The cloud formation in dust free ionised gas in Wilson's technique is due to
- (A) adiabatic expansion (B) isothermal expansion  
(C) adiabatic compression (D) isothermal compression
62. Five positive charges of magnitude  $q$  are arranged symmetrically around the circumference of a circle of radius  $r$ . What is the magnitude of the electric field at the centre of the circle?
- (A) 0 (B)  $kq/r^2$   
(C)  $5kq/r^2$  (D)  $(kq/r^2) \cos 2\pi/5$

63. A metal block is suspended in an empty tank from a scale indicating a weight of  $W$ . The tank is then filled with water until the block is immersed. If the density of the metal is three times that of water, what will be the apparent weight indicated by the scale?
- (A)  $(1/2)W$  (B)  $(2/3)W$   
 (C)  $3W$  (D)  $(1/3)W$
64. A  $36\Omega$  galvanometer is shunted by a resistance of  $4\Omega$ . What part of the total current will pass through the instrument?
- (A) 0.10 (B) 0.20  
 (C) full current (D) 0.9
65. Poise is the unit of
- (A) viscosity (B) surface tension  
 (C) Young's modulus (D) fluid flow
66. Two identical springs with spring constant  $k$  are connected to identical masses of mass  $M$ , as shown in the figures below. The ratio of the period for the springs connected in parallel (Figure 1) to the period for the springs connected in series (Figure 2) is

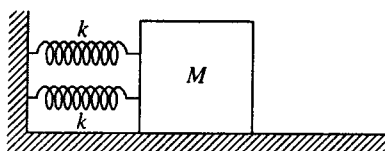


Figure 1

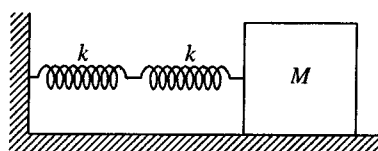


Figure 2

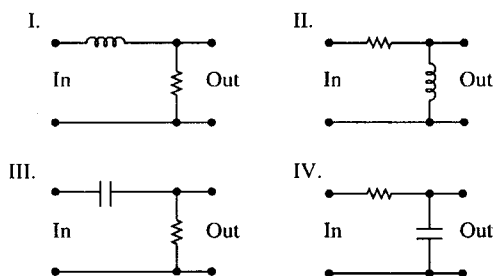
- (A)  $1/2$  (B)  $1/\sqrt{2}$   
 (C) 1 (D)  $\sqrt{2}$
67. One end of a Nichrome wire of length  $2L$  and cross sectional area  $A$  is attached to an end of another Nichrome wire of length  $L$  and cross sectional area  $2A$ . If the free end of the longer wire is at an electric potential of 8.0 volts, and the free end of the shorter wire is at an electric potential of 1.0 volt, the potential at the junction of the two wires is most nearly equal to
- (A) 2.4 V (B) 3.3 V  
 (C) 4.5 V (D) 5.7 V



68. A gaseous mixture of  $O_2$  (molecular mass 32 u) and  $N_2$  (molecular mass 28 u) is maintained at constant temperature. What is the ratio  $v_{\text{rms}}(N_2) / v_{\text{rms}}(O_2)$  of the root-mean-square speeds of the molecules?

- (A)  $7/8$  (B)  $\sqrt{7/8}$   
(C)  $\sqrt{8/7}$  (D)  $(8/7)^2$

69. Which of the following circuits are high pass filters?



- (A) I and II (B) I and III  
(C) I and IV (D) II and III

70. In a Joule Thomson experiment

- (A) ideal gases can not be cooled for any P and T values  
(B) ideal gases can be cooled for certain P and T values  
(C) the inversion temperature is the same for all real gases  
(D) the inversion temperature is independent of the density of the real gas

71. The exponential function  $q = q_0 e^{-t/RC}$  describes

- (A) capacitor charging and discharging  
(B) capacitor charging  
(C) capacitor discharging  
(D) inductor current build up

72. Silicon (atomic no.14) has two electrons in the unfilled 3p shell. According to Hund's rule, the ground state of Si is

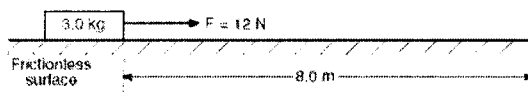
- (A)  $^1P_1$  (B)  $^3S_1$   
(C)  $^3D_3$  (D)  $^3D_1$



73. A planet is moving around the Sun in a circular orbit of circumference  $C$ . The work done on the planet by the gravitational force  $F$  of Sun is

(A)  $FC$  (B)  $FC/2$   
(C)  $F/C$  (D) zero

74. A 3.0 kilogram block is initially at rest on a frictionless, horizontal surface. The block is moved 8.0 meters in 2.0 seconds by the application of a 12 Newton horizontal force, as shown in the figure below. What is the average power developed while moving the block?



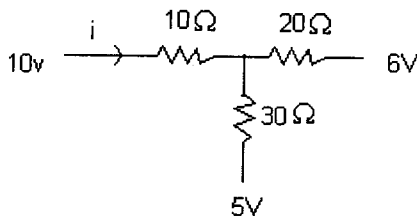
- (A) 24 W (B) 96 W  
(C) 32 W (D) 48 W
75. Moving  $2.5 \times 10^{-6}$  coulomb of charge from point A to point B in an electric field requires  $6.3 \times 10^{-4}$  joule of work. The potential difference between points A and B is approximately

(A)  $1.6 \times 10^{-9}$  V (B)  $4.0 \times 10^{-3}$  V  
(C)  $2.5 \times 10^{-2}$  V (D)  $1.0 \times 10^{-6}$  V





80. The acceleration of the particle executing SHM at its mean position is
- (A) infinity (B) varies  
(C) maximum (D) zero
81. An observer moves towards a stationary source of sound with one-fifth of the speed of sound. The wavelength and frequency of the source emitted are  $\lambda$  and  $f$  respectively. The apparent frequency and wavelength recorded by the observer are
- (A)  $0.85f, 0.8\lambda$  (B)  $1.2f, 1.2\lambda$   
(C)  $1.2f, \lambda$  (D)  $f, 1.2\lambda$
82. A charge  $Q$  is uniformly distributed over a large plastic plate. The electric field at point  $P$ , close to the centre of the plate is  $10\text{V/m}$ . If the plastic plate is replaced by a copper plate of the same dimensions and carrying same charge  $Q$  then the electric field at the point  $P$  will be
- (A) zero (B)  $5\text{V/m}$   
(C)  $10\text{V/m}$  (D)  $20\text{V/m}$
83. A parallel plate capacitor of capacitance  $C$  is charged using a battery of emf  $V$ . After the capacitor is charged, the battery is removed and the distance between the capacitors is doubled. What is the new energy stored?
- (A)  $CV^2/2$  (B)  $CV^2/4$   
(C)  $CV^2$  (D)  $2CV^2$
84. Current 'i' in the given circuit is



- (A)  $0.2\text{A}$  (B)  $0\text{A}$   
(C)  $9.1\text{A}$  (D)  $6\text{A}$



61312

85. An ammeter reads up to 1A. Its internal resistance is  $0.81\Omega$ . To increase the range to 10A, the value of the required shunt is
- (A)  $0.3\Omega$  (B)  $0.9\Omega$   
(C)  $0.09\Omega$  (D)  $0.03\Omega$
86. A steel wire and copper wire of equal length and equal cross-section are connected (i) in series (ii) in parallel to a battery. The power consumed in copper wire is more
- (A) in series (B) in parallel  
(C) equal in two cases (D) insufficient data to reply
87. A charged particle is accelerated through a potential difference 12kV and acquires a speed of  $10^6$  m/s. It is projected perpendicularly into a magnetic field of strength 0.2 T. The radius of circle described is
- (A) 24 cm (B) 18 cm  
(C) 12 cm (D) 6 cm
88. If relative permeability of a substance is 0.89, then it is
- (A) ferromagnetic (B) paramagnetic  
(C) antiferromagnetic (D) diamagnetic
89. The electric bulb is designed to operate at 12V DC. It is connected to AC and gives same brightness. Then peak AC voltage is
- (A) 12V (B) 24V  
(C)  $12\sqrt{2}$  V (D)  $12/\sqrt{2}$  V
90. A 100 ohms resistor, a  $0.1\mu\text{F}$  capacitor and a 0.1 Henry inductor are connected in parallel to a 100v supply. The resonant frequency is
- (A) 1392 Hz (B) 1492 Hz  
(C) 1592 Hz (D) 1292 Hz



91. A lens has focal length 10cm. An object is placed 15 cm in front of it. Where should a convex mirror be placed so that image is formed at the object itself? Focal length of the convex mirror is 12 cm
- (A) 6 cm from lens (B) 8 cm from lens  
(C) 5 cm from lens (D) 4 cm from lens
92. The wavelength of sodium light in air is  $5890 \text{ \AA}$ , the velocity of light in air is  $3 \times 10^8 \text{ m/s}$ . The wavelength of sodium light in glass ( $\mu = 1.6$ ) is
- (A)  $5890 \text{ \AA}$  (B)  $3680 \text{ \AA}$   
(C)  $9424 \text{ \AA}$  (D) None of the above
93. To demonstrate the phenomenon of interference we require two sources that emit radiation
- (A) of same frequency  
(B) different wavelength  
(C) of the same frequency and having definite phase relationship  
(D) of nearly the same frequency
94. A double slit experiment is performed with  $\lambda = 500 \text{ nm}$ . A thin film of thickness  $2 \text{ \mu m}$ , and refractive index of 1.5 is introduced in the path of upper beam. The location of central maxima
- (A) will remain unshifted  
(B) shifts downwards by nearly 2 fringes  
(C) shifts upward by nearly 2 fringes  
(D) shifts downward by 10 fringes
95. A monochromatic source of light operating at 200 W emits  $4 \times 10^{20}$  photon per second. ( $h = 6.63 \times 10^{-34}$ ). The wavelength of the light is
- (A) 400 nm (B) 460 nm  
(C) 500nm (D) 540 nm
96. An energy of 24.6 eV is required to remove one of the electrons from a neutral He atom. The energy in eV to remove both the electrons from a neutral He atom is
- (A) 38.2 eV (B) 49.2 eV  
(C) 51.8 eV (D) 79.0eV



61312

97. Which of the following transitions will have the highest emission wavelength?
- (A)  $n = 1$  to  $n = 2$                       (B)  $n = 2$  to  $n = 1$   
(C)  $n = 5$  to  $n = 2$                       (D)  $n = 2$  to  $n = 5$
98. The potential difference applied to an X-ray tube is increased, as a result in the emitted radiation
- (A) the minimum wavelength decreases  
(B) the minimum wavelength increases  
(C) the intensity remains unchanged  
(D) the intensity decreases
99. Freshly prepared radioactive sample of half-life 1 h emits radiations that are 128 times as intense as the permissible safe limit. The minimum time after which the sample can be safely used is
- (A) 14 h    (B) 7 h  
(C) 128 h    (D) 256 h
100. In the middle of the depletion layer of a reverse biased pn junction the
- (A) potential is maximum                      (B) electric field is maximum  
(C) potential is zero                              (D) electric field is zero
101. A transistor amplifier has  $h_{FE} = 75$ ;  $R_L = 5 \text{ k}\Omega$ , internal resistance of the base is  $2.5 \text{ k}\Omega$ , then the voltage gain of the CE amplifier is
- (A) 75    (B) 37.5  
(C) 150    (D) 375
102. A fermion is a particle
- (A) which follows Maxwell's statistics  
(B) which follows Pauli's exclusions principle  
(C) having integral spin  
(D) having half integral spin



103. When a balloon is at a height of 80 m, ascending with a velocity 10 m/s and acceleration  $1.2 \text{ m/s}^2$ , drops a packet. Find the time taken by the packet to reach ground. Take  $g=10\text{m/s}^2$ .
- (A) 6.2 s (B) 5.2 s  
(C) 4.18 s (D) 3.21 s
104. When equal volumes of two metals are mixed together, the specific gravity of alloy is 4. When equal masses of the same metals are mixed together the specific gravity of the alloy is 3. Calculate the specific gravity of each metal.
- (A) 2,6 (B) 3,5  
(C) 4,2 (D) 3,4
105. A body dropped from a tower with zero velocity, reaches ground in 4 s. The height of the tower is about
- (A) 80 m (B) 20 m  
(C) 160 m (D) 40 m
106. A rod of length 1.4 m and negligible mass has two masses of 0.3kg and 0.7kg tied to its two ends. Find the location of the point on this rod where the rotational energy is minimum when the rod is rotated about that point
- (A) 0.98 m from 0.38 kg (B) 0.7 m from 0.3 kg  
(C) 0.98 m from 0.7 kg (D) 0.7 m from 0.7 kg
107. Which of the following is true?
- (A) Neither momentum nor kinetic energy is conserved in inelastic collisions  
(B) Momentum is conserved in all collisions but kinetic energy is conserved only in inelastic collisions  
(C) Momentum is conserved in all collisions but not kinetic energy  
(D) Both momentum and kinetic energy are conserved in all collisions



61312

108. A charged particle moves through a magnetic field in a direction perpendicular to it. Then the
- (A) velocity remains unchanged
  - (B) speed remains unchanged
  - (C) direction remains unchanged
  - (D) acceleration remains unchanged
109. Which of the following statements is correct for ferromagnetic materials?
- (A) Their magnetic susceptibility becomes 0 at Curie temperature
  - (B) These become diamagnetic at Curie temperature
  - (C) Its magnetic properties are explained on the basis of electron principle
  - (D) These become paramagnetic at Curie Temperature
110. If  $\nu$  is the frequency and  $h$  is Planck's constant, the ground state energy of one dimensional quantum mechanical oscillator is
- (A) 0
  - (B)  $h\nu/3$
  - (C)  $h\nu/2$
  - (D)  $h\nu$
111. If in an AC circuit  $X_L = X_C$ , then the value of power factor will be
- (A) 0
  - (B)  $\frac{1}{2}$
  - (C) 1
  - (D)  $\alpha$
112. If a tank circuit is used as resonance circuit, then
- (A) impedance is maximum at resonance
  - (B) impedance is minimum at resonance
  - (C) impedance becomes maximum
  - (D) impedance becomes zero
113. A convex lens is dipped in a liquid whose refractive index is equal to refractive index of the lens. Then its focal length will
- (A) remain unchanged
  - (B) 0
  - (C)  $\alpha$
  - (D) small but non zero



114. The eye specialist prescribes spectacles having a combination of convex lens of focal length 40 cm and a concave lens of  $-25$  cm. The power of lens combination is
- (A)  $+1.5$  D (B)  $-1.5$  D  
(C)  $+6.67$  D (D)  $-6.67$  D
115. Threshold frequency for photoelectric effect on sodium corresponds to a wavelength 500 nm. Its work function is
- (A) 15 J (B)  $10 \times 10^{-19}$  J  
(C)  $4 \times 10^{-19}$  J (D)  $3.2 \times 10^{-19}$  J
116. An achromatic combination of lenses is formed by joining
- (A) 2 convex lenses (B) 2 concave lenses  
(C) 1 convex, 1 concave (D) convex and plane mirror
117. When light falls on a given plate at an angle of incidence of  $60^\circ$ , the reflected and refracted rays are found to be normal to each other. The refractive index of the material of the plate is then
- (A) 0.86 (B) 1.5  
(C) 1.732 (D) 2
118. An electron in a hydrogen atom is in fourth excited state. The maximum number of spectral lines emitted is
- (A) 6 (B) 8  
(C) 10 (D) 15
119. The product of  $\psi\psi^*$ , where  $\psi$  is wave function, represents
- (A) probability of finding an electron  
(B) probability of finding a proton  
(C) probability of transition to occur  
(D) absorption probability



61312

120. A free atom of iron emits X-ray of energy 6.4 keV. Mass of iron atom is  $9.3 \times 10^{-26}$  kg. The recoil energy of the atom is
- (A)  $3.9 \times 10^{-4}$  eV                      (B)  $3.9 \times 10^4$   
(C)  $2.13 \times 10^{-24}$                       (D)  $3.9 \times 10^{-19}$
121. Drift current is less than diffusion current in a pn junction in magnitude. This means
- (A) pn junction is forward biased      (B) pn junction is reverse biased  
(C) pn junction is unbiased              (D) it is a zener diode
122. For a common base amplifier, the value of resistance gain and voltage gain are 300 and 280 respectively. The current gain will be
- (A) 0.63                                      (B) 0.73  
(C) 0.83                                      (D) 0.93
123. Ionisation potential of hydrogen atom is 13.6 V. The least energy of photon in Balmer series is
- (A) 3.4 eV                                      (B) 6.8 eV  
(C) 10.2 eV                                      (D) 8.5 eV
124. The number densities of electrons and holes in pure silicon at  $27^\circ\text{C}$  are equal and its value is  $1.5 \times 10^{16} \text{m}^{-3}$ . On doping with indium, the hole density increases to  $4.5 \times 10^{22} \text{m}^{-3}$ . The electron density in doped silicon will be
- (A)  $10^8 \text{m}^{-3}$                                       (B)  $10^7 \text{m}^{-3}$   
(C)  $50 \times 10^9 \text{m}^{-3}$                                       (D)  $5 \times 10^9 \text{m}^{-3}$
125. An 800W/220V kettle and three 100 W/220 V bulbs are connected in parallel. The current drawn from the source is
- (A) 3.8 A                                      (B) 6.9A  
(C) 4.15 A                                      (D) 5 A





126. A silver and copper voltmeter is connected across a 6 V battery of negligible resistance. In half an hour 1 g of Cu and 2 g of silver are deposited. Given ece of Cu =  $3.294 \times 10^{-4}$  g/C and ece of Ag =  $1.118 \times 10^{-3}$  g/C. The energy supplied by the battery is nearly
- (A) 8 W (B) 4 W  
(C) 16 W (D) 12 W
127. An electron accelerated by 200V enters in magnetic field. If its velocity is 100m/s, then (e/m) for it will be
- (A)  $1.75 \times 10^{10}$  (B)  $1.75 \times 10^{11}$   
(C)  $1.75 \times 10^9$  (D)  $1.75 \times 10^6$
128. Which of the following is used to make half adder?
- (A) XOR (B) AND  
(C) OR (D) NOT
129. The diffusion current in a pn junction is
- (A) from n to p side  
(B) from p to n side  
(C) n to p side if forward biased and p to n side if reverse biased  
(D) p to n side if forward biased and n to p side if reverse biased
130. In a Ge sample traces of Ga are added as impurity. The resulting sample would behave like
- (A) a conductor (B) a p type semiconductor  
(C) an n type semiconductor (D) an insulator
131. With rise in temperature, the electrical conductivity of intrinsic semiconductor
- (A) first increases and then decreases (B) increases  
(C) first decreases and then increases (D) decreases
132. The concentration of acceptor atom in a p type germanium crystal is  $4 \times 10^{17}/\text{cm}^3$ . If  $\mu_p = 1900 \text{ cm}^2/\text{V-s}$  at 300K, then its conductivity will be
- (A)  $1.126 \times 10^{-10}$  mho/cm (B)  $11.26 \times 10^{-10}$  mho/cm  
(C)  $1.1216 \times 10^{-10}$  milli mho/cm (D) zero



61312

25

133. The length of a spaceship is measured to be exactly half its proper length. The velocity of the space ship is
- (A)  $c$  (B)  $0.56 c$   
(C)  $0.752 c$  (D)  $0.866 c$
134. Two monoatomic ideal gases 1 and 2 of molecular masses  $m_1$  and  $m_2$  respectively and enclosed in separate containers are kept at the same temperature. The ratio of the speed of sound in gas 1 to that in gas 2 is given by
- (A)  $\sqrt{(m_1/m_2)}$  (B)  $\sqrt{(m_2/m_1)}$   
(C)  $m_1/m_2$  (D)  $m_2/m_1$
135. The plots of intensity versus wavelength for three black bodies at temperature  $T_1$ ,  $T_2$  and  $T_3$  respectively are as shown. Their temperatures are such that
- 
- (A)  $T_1 > T_2 > T_3$  (B)  $T_1 > T_3 > T_2$   
(C)  $T_2 > T_3 > T_1$  (D)  $T_1 < T_3 < T_2$
136. A star is receding away from Earth with a velocity of  $10^5$  m/s. If the wavelength of its spectral line is  $5700 \text{ \AA}$ , then Doppler shift will be
- (A)  $0.2 \text{ \AA}$  (B)  $1.9 \text{ \AA}$   
(C)  $20 \text{ \AA}$  (D)  $200 \text{ \AA}$
137. A truck's speed increases uniformly from  $15 \text{ km/hr}$  to  $60 \text{ km/hr}$  in  $20 \text{ s}$ . The average speed will be
- (A)  $10.4 \text{ m/s}$  (B)  $104 \text{ m/s}$   
(C)  $10.4 \text{ km/hr}$  (D)  $37.5 \text{ km/hr}$





61312

27

143. The maximum possible efficiency of an engine operating between temperature  $400^{\circ}\text{C}$  and  $100^{\circ}\text{C}$  is
- (A) 85% (B) 60%  
(C) 6.4% (D) 4.6%
144. The Bragg experiment used X-rays to investigate crystal structure. Which statement best describes the results of this experiment?
- (A) X-rays are scattered from the crystal and form interference pattern  
(B) X-rays penetrate the crystal and form an interference pattern behind it  
(C) X-rays are absorbed and re-emitted equally in all directions by the crystal  
(D) X-rays are absorbed by the crystal produce minima and those reflected produce maxima
145. Listed below are Maxwell's equations of electromagnetism. If magnetic monopoles exist, which of these equations will not be correct?
- I  $\text{Curl } \mathbf{H} = \mathbf{J} + d\mathbf{D}/dt$   
II  $\text{Curl } \mathbf{E} = -d\mathbf{B}/dt$   
III  $\text{div } \mathbf{D} = \rho$   
IV  $\text{div } \mathbf{B} = 0$
- (A) I only (B) I and II  
(C) I and III (D) II and IV
146. In a voltage amplifier, which of the following is not usually a result of introducing negative feed back?
- (A) Increased amplification (B) Increased stability  
(C) Increased bandwidth (D) Decreased voltage gain
147. Light of wavelength  $520 \text{ nm}$  is incident normally on a transmission diffraction grating with 2000 lines per centimeter. The first order diffraction maximum is at an angle, with respect to the incident beam, which is nearly equal to
- (A)  $3^{\circ}$  (B)  $6^{\circ}$   
(C)  $9^{\circ}$  (D)  $12^{\circ}$



61312

28

148. A balloon is to be filled with helium and used to suspend a mass of 300 kilograms in air. If the mass of the balloon is neglected, which of the following gives the approximate volume of helium required? (The density of air is 1.29 kilograms per cubic meter and the density of helium is 0.18 kilogram per cubic meter.)
- (A)  $50 \text{ m}^3$  (B)  $95 \text{ m}^3$   
(C)  $135 \text{ m}^3$  (D)  $270 \text{ m}^3$
149. For a given set of values of  $n$ ,  $L$  and  $m$ , the maximum number of electrons is
- (A)  $2n^2$  (B)  $(n+L)m$   
(C)  $2L+1$  (D)  $2n$
150. When the pressure on any part of a confined fluid is changed, the pressure on every other part of the fluid is also changed by the same amount. This is
- (A) Pascal's principle (B) Archimedes' principle  
(C) Reynold's principle (D) Poiseuille's principle

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