VIDYASAGAR UNIVERSITY
MIDNAPORE

COMMON ENTRANCE TEST FOR PG ADMISSION, 2019

Question Booklet No. 2518326 Full Marks : 200

Subject: PHYSICS **Question Booklet Series: C**

Subject Code No.: 25

Answer all the questions. Each question has the same weightage.

Read the following instructions carefully before you start answering.

INSTRUCTIONS

1. The question Booklet is printed in four Series e.g. (A), (B), (C) and (D). The candidate has to indicate the Series of the question booklet in the space provided in the OMR Answer Sheet . For example, if the candidate gets Series (A) booklet, he / she has to indicate on the front side of the OMR Answer Sheet with Black ink ball point pen only as indicated below:

2. There are 50 questions inside this question booklet. Immediately after you have been instructed to open this question booklet, ensure that any page / question is not missing / not printed / torn /repeated. In case you find any defect anywhere in the question booklet, immediately get it replaced by the Invigilator.

3. Each question carries 4 marks. 1(one) mark will be deducted for each wrong answer(negative marking).

4. Write your Form No and put signature in the space provided.

5. Before answering, write down the necessary information on the OMR Answer Sheet as per your Application Form and Admit Card in the specific space provided.

6. With each question you will find 4 possible answers marked by the letters A, B, C & D. Read each question carefully and find out which answer, according to you, is correct / most appropriate / best. Indicate your answer by darkening the appropriate circle completely in the OMR Answer Sheet corresponding to the question. For marking answers, use black ink ball pen only. If 'B' is the correct answer in a case, mark as below:

7. Do not fold or make any stray marks on the OMR Answer Sheet.

8. You can use the blank space of the last page for rough work. Do not tear it off from the Question Booklet.

9. After the examination has been over, you must submit OMR Answer Sheet to the Invigilator.

10. OMR Answer Sheet is designed for computer evaluation. If you do not follow the instructions given above and shown in the OMR Answer Sheet, it may make evaluation by computer difficult. Any resultant loss to the candidate on the above account shall be of the candidate only.

11. No candidate shall be allowed to use Mobile phone. Log tables or Calculator of any description in the examination hall / room.

1. Consider a particle of mass m following a trajectory given by $x = x_0 \cos \omega_1 t$ and $y = y_0 \cos \omega_2 t$, where x_0, y_0, ω_1 and ω_2 are constants of appropriate dimension. The force on the particle is
   (A) Central only if ω_1 and ω_2
   (B) Central only if $x_0 = y_0$ and $\omega_1 = \omega_2$
   (C) Always central
   (D) Central only if $x_0 = y_0$ and $\omega_1 \neq \omega_2$

2. The minimum number of flip-flops required for a synchronous decade counter is-
   (A) 1 (B) 2 (C) 4 (D) 10

3. The purpose of the clock input to a flip-flop is to
   (A) Clear the device
   (B) Set the device
   (C) Always cause the output to change state
   (D) Cause the output to assume a state dependent on the controlling (S-R, J-K, D)

4. The travelling pulse is given by $f(x,t) = A\, exp\left(\frac{2abxt - a^2x^2 - b^2t^2}{c^2}\right)$, where A, a, b and c are positive constants of appropriate dimensions. The speed of the pulse is
   (A) $\frac{b}{a}$ (B) $\frac{2b}{a}$ (C) $\frac{bc}{a}$ (D) $\frac{b}{2a}$

5. A cyclotron having segments of radius $0.4\,m$ is adjusted for accelerating hydrogen nuclei. The polarity is reversed 3×10^7 times a second. Mass of a proton is $= 1.67 \times 10^{-27} kg$. The energy of the particles in the issuing beam is
   (A) 100 MeV (B) 10 MeV (C) 1000 MeV (D) 1000 KeV

6. A zener diode works on the principle of__
   (A) tunneling of charge carriers across the junction
   (B) thermionic emission
   (C) diffusion of charge carriers across the junction
   (D) hopping of charge carriers across the junction

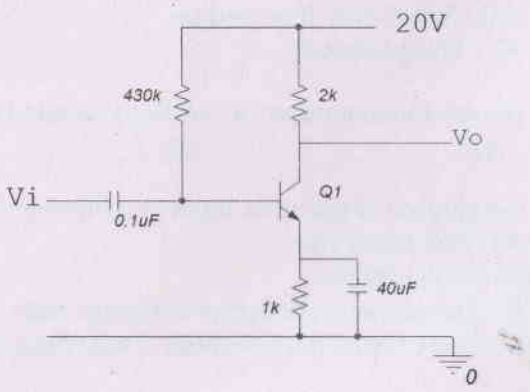
7. A lightly doped harmonic oscillator loses energy at the rate of 1% per minute. The decrease in amplitude of the oscillator per minute will be closest to
   (A) 1% (B) 0.5% (C) 2% (D) 1.5%

8. The darlington pair consists of the following two stages
   (A) CE,CC (B) CE,CB (C) Both CE (D) Both CC

9. First Brillouin Zone of fcc lattice is
   (A) Octahedron (B) Rhomodecahedron (C) Hexagon (D) None of the above

10. The ratio of diffusion constant for hole (D_p) to the mobility (μ_P) of hole is proportional to
    (A) Temperature T
    (B) T^2
    (C) 1/T
    (D) Independent of Temperature

11. The following amplifier circuit uses a BJT with $\beta = 50$ and $V_{BE} = 0.7$ Volt. The base current I_B and the collector voltage V_C are respectively
(A) 43 μA and 11.4 Volts
(B) 45 μA and 11 Volts
(C) 40 μA and 16 Volts
(D) 50 μA and 10 Volts



12. The value of $\sqrt{i} + \sqrt{-i}$, where $i = \sqrt{-1}$, is
(A) 0 (B) $\frac{1}{\sqrt{2}}$ (C) $\sqrt{2}$ (D) $-\sqrt{2}$

13. Find the direct band gap semiconductor out of the following semiconductors :
(A) Si (B) Ge (C) CdTe (D) PbS

14. Electronic Specific Heat C_{el} for electron gas is proportional to temperature as
(A) $C_{el} \alpha T$ (B) $C_{el} \alpha T^{1/2}$ (C) $C_{el} \alpha T^{3/2}$ (D) $C_{el} \alpha T^3$

15. At room temperature, the speed of sound in air is 340 m/s. An organ pipe with both ends open has a length L = 29 cm. An extra hole is created at the position L/2. The lowest frequency of sound produced is
(A) 293 Hz (B) 586 Hz (C) 1172 Hz (D) 2344 Hz

16. The trace of a 2×2 matrix is 4 and its determinant is 8. If one of the eigenvalue is $2(1 + i)$, the other eigenvalue is
(A) $2(1 - i)$ (B) $2(1 + i)$ (C) $(1 + 2i)$ (D) $(1 - 2i)$

17. Calculate the kinetic energy of the muon emitted in the decay of a pion at rest assuming $m_\pi = 139.58\ MeV$ and $m_\mu = 105.66\ MeV$, the kinetic energy of the emitted muon is
(A) 1.2 MeV (B) 3.0 MeV (C) 4.2 MeV (D) 5.3 MeV

18. Estimate the percent of electron excited about the Fermi level at room temperature for Na [E_F = 3.1 ev for Na]
(A) 0.31% (B) 0.54% (C) 0.81% (D) 0.95%

19. Isothermal compressibility of n moles of ideal gas is
(A) $\frac{1}{P}$ (B) $\frac{n}{P}$ (C) $-\frac{1}{P}$ (D) $-\frac{n}{P}$

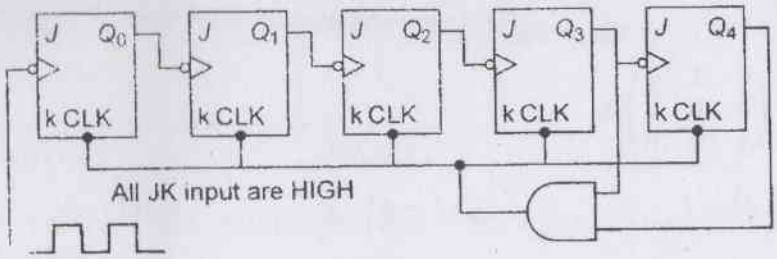
20. To penetrate the Coulomb barrier of a light nucleus, a proton must have a minimum energy of the order of
(A) 1 GeV (B) 1 MeV (C) 1 keV (D) 1 eV

21. If for a silicon npn transistor, the base-to-emitter voltage (V_{BE}) is 0.7 V and collector-to-base voltage (V_{CB}) is 0.2 V, then the transistor is operating in the
(A) Normal active mode (B) Saturation mode
(C) Cut-off mode (D) Reverse active mode

22. A chain of mass M and length L is suspended vertically with its lower end touching a weighing scale. The chain is released and falls freely onto the scale. Neglecting the size of the individual links, what is the reading of the scale when a length x of the chain has fallen?
(A) Mgx/L (B) 2Mgx/L (C) 3Mgx/L (D) 4Mgx/L

23. Since $^{27}_{14}Si$ and $^{27}_{13}Al$ are "mirror nuclei", their ground states are identical except for charge. If their mass difference is 6 MeV, their radius (neglecting the proton-neutron mass difference) is
(A) 1.2 fm (B) 2.5 fm (C) 3.8 fm (D) 4.6 fm

24. The Mod number of the asynchronous counter shown in the figure:



(A) 24 (B) 48 (C) 25 (D) 36

25. The chemical potential of an ideal Bose gas at any temperature is
(A) Necessarily negative
(B) Either zero or negative
(C) Necessarily positive
(D) Either zero or positive

26. A full adder can be implemented with half adders and OR gates. A 4-bit parallel full adder without any initial carry requires-
(A) 8 Half adders, 4 OR gates
(B) 8 Half adders, 3 OR gates
(C) 7 Half adders, 4 OR gates
(D) 7 Half adders, 3 OR gates

27. The digital multiplexer is basically a combinational logic circuit to perform the operation
(A) AND-AND (B) OR-OR (C) AND-OR (D) OR-AND

28. The ratio between the Young's modulus and Bulk modulus of a body is 5/2. The value of Poission's ratio is
(A) 0.25 (B) 0.50 (C) 0.75 (D) None of these

29. A satellite moves around the earth in a circular orbit of radius R centered at the earth. A second satellite moves in an elliptical orbit of major axis 8R, with the earth at one foci. If the former takes 1 day to complete a revolution, the later would take
(A) 22.6 days (B) 8 days (C) 3 hours (D) 1.1 hours

30. The following Boolean expression
$$Y = A \cdot \bar{B} \cdot \bar{C} \cdot \bar{D} + \bar{A} \cdot B \cdot \bar{C} \cdot \bar{D} + \bar{A} \cdot \bar{B} \cdot \bar{C} \cdot D + \bar{A} \cdot \bar{B} \cdot C \cdot D + \bar{A} \cdot B \cdot C \cdot D + A \cdot \bar{B} \cdot \bar{C} \cdot D$$
can be simplified as
(A) $\bar{A} \cdot \bar{B} \cdot C + A \cdot \bar{D}$ (B) $\bar{A} \cdot B \cdot \bar{C} + A \cdot \bar{D}$ (C) $A \cdot \bar{B} \cdot \bar{C} + \bar{A} \cdot D$ (D) $A \cdot \bar{B} \cdot C + \bar{A} \cdot D$

31. The slope of ac load line is _____ that of dc load line
(A) Same as (B) More than (C) Less than (D) None of the above

32. The electric field of a light wave is given by
$$\vec{E} = E_0 \left[\hat{\imath} \sin(\omega t - kz) + \hat{\jmath} \sin\left(\omega t - kz - \frac{\pi}{4}\right)\right]$$
The polarisation state of the wave is
(A) Left handed circular
(B) Right handed circular
(C) Left handed elliptical
(D) Right handed elliptical

33. Let N_{MB}, N_{BE} and N_{FD} denote the number of ways in which two particles can be distributed in two energy states according to M-B, B-E, and F-D statistics respectively. Then $N_{MB} : N_{BE} : N_{FD}$ is
(A) 4 : 3 : 1 (B) 4 : 2 : 3 (C) 4 : 3 : 3 (D) 4 : 3 : 2

34. The width of the energy gap of a superconductor is maximum at
(A) 0K (B) Transition temperature (C) Room temperature (D) None of the above

35. At Neel temperature
(A) Permeability is maximum
(B) Permeability is minimum
(C) Suceptibility is minimum
(D) Suceptibility is maximum

36. With a 1MHz clock frequency, eight bits can be parallel entered into a shift register-
(A) In 8 μs
(B) In the propagation delay time of 8 flip-flops
(C) In 1 μs
(D) In the propagation delay time of 1 flip-flop

37. The inverse of the matrix $A = \begin{pmatrix} 0 & 1 & 1 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{pmatrix}$ is

(A) $A - I$ (B) $A^2 - I$ (C) $I - A^2$ (D) $I - A$

Where I is the identity matrix.

38. As the temperature is increased, the voltage across a diode carrying a constant current
(A) Decreases
(B) Increases
(C) Remains same
(D) May increase or decrease depending upon the doping levels in the junction

39. If the dimension of mass, length, time and charge are M, L, T and C respectively, the dimension of the magnetic induction field 'B' is
(A) $M L^2 T^{-1} C^{-1}$ (B) $M T^{-1} C^{-1}$ (C) $L^2 T^{-1} C$ (D) LT^{-1}

40. The muon has mass 105 Mev/c^2 and mean life 2.2μs in its rest frame. The mean distance traversed by a muon of energy 315 Mev before decaying is approximately
(A) 3×10^5 km (B) 22 cm (C) 6.6 μm (D) 1.86 km

41. Number of atoms per unit cell in Base centred cubic crystal is
(A) 1 (B) 2 (C) 4 (D) 8

42. For a given dielectric, the electronic polarizability
(A) Increases with temperature
(B) Decreases with temperature
(C) May increase or decrease with temperature
(D) Is not affected by temperature

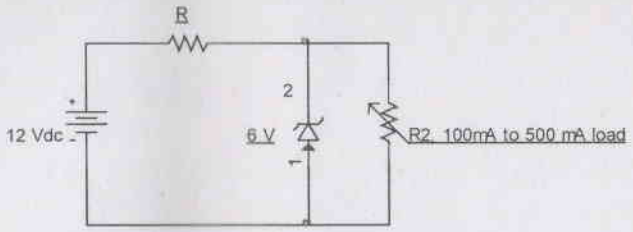
43. Calculate the activity of K^{40} in 100 kg man assuming that 0.35% of the body weight is potassium. The natural abundance of $K^{40}$is 0.012%, its half-life is $1.31 \times 10^9 years$.
(A) 0.28 μCi (B) 0.16 μCi (C) 0.32 μCi (D) $none$

44. In a full wave rectifier using two ideal diodes, V_{dc} and V_m are the d.c. and peak values of the voltage respectively across a resistive load. The approximate relationship of V_{dc} and peak inverse voltage (PIV) for this rectifier is,
(A) $V_{dc} = V_m/\pi$, PIV = V_m
(B) $V_{dc} = 2V_m/\pi$, PIV = V_m
(C) $V_{dc} = 2V_m/\pi$, PIV = $2V_m$
(D) $V_{dc} = V_m/\pi$, PIV = $2V_m$

45. Class AB operation is often used in power amplifiers in order to
(A) Get maximum efficiency
(B) Remove even harmonics
(C) Reduce collector dissipation
(D) Overcome cross over distortion

46. Given two coupled inductance L_1 & L_2, their mutual inductance M satisfies
(A) $M = (L_1^2 + L_2^2)^{1/2}$ (B) $M \geq (L_1 + L_2)/2$ (C) $M \leq (L_1 L_2)^{1/2}$ (D) $M \geq (L_1 L_2)^{1/2}$

47. In the voltage regulator shown in the given figure, the load current can vary from 100mA to 500mA. Assuming that the Zener diode is ideal (i.e. Zener knee current is negligibly small and Zener resistance is zero in the breakdown region), the value of R should be-



(A) 6 Ω (B) 60 Ω (C) 12Ω (D) 24Ω

48. For a 12-bit A/D converter the range of input signal is 0 to +10 volt. The voltage corresponding to 1 LSB will be-

(A) 0 (B) 0.0012 V (C) 0.0024 V (D) 0.833 V

49. For small angular displacement (i.e., sin $\theta \approx \theta$), a simple pendulum oscillates harmonically. For larger displacement, the motion

(A) Becomes a periodic
(B) Remains periodic with the same period
(C) Remains periodic with a higher period
(D) Remains periodic with a lower period

50. Effective mass of the electron means

(A) Mass of the electron in a molecule
(B) Mass of the electron in vacuum
(C) Mass of the electron in solid
(D) Mass of the electron in an atom