PH6

Test Booklet Series **0**

← Question Booklet Number

Number of Pages in Booklet
24

No. of Questions in Booklet
100

Maximum Marks
100

Time **2** Hours

Please read the instructions given below carefully and follow them.

Do not open this test booklet until you are asked to do so.

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS 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. Please note that it is the candidate's responsibility to encode and darken the **ROLL NUMBER, TEST BOOKLET SERIES** Code A, B, C or D and Question Booklet Number carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. **Any omission/ discrepancy will render the OMR Answer Sheet liable for rejection.**
3. You have to enter your Roll Number on the Test Booklet in the Box provided below. ***DO NOT*** write ***anything else*** on the Test Booklet.

4. This Test Booklet contains 100 items (questions). Each item shall have five options (A, B, C, D, and E). If a candidate is attempting a question, he has to darken most appropriate circle from A, B, C or D. However if you are not attempting a question then you have to darken the circle 'E'. If none of the five circle is darkened, one-fourth (0.25) marks shall be deducted.
5. **Any candidate not darkening any of the five circles in more than 10% question shall be disqualified.**
6. **All questions are compulsory. Each question carry one mark. For each wrong Answer, one fourth (0.25) mark shall be deducted.**
7. You have to mark all your responses ***ONLY*** on the separate OMR Answer Sheet provided. See directions in the OMR Answer Sheet. Use only **BLUE/BLACK Ball Point Pen** to answer in OMR Answer Sheet.
8. Before you proceed to mark in the OMR Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the OMR Answer Sheet as per instructions mentioned on the OMR Answer Sheet.
9. At the end of the examination you should handover to the invigilator the original copy and office copy of the OMR Sheet. You are permitted to take away with you the Question Booklet along with candidate's copy of the OMR Sheet.
10. Sheets for rough work are appended in the Test Booklet at the end.

1 When 'v' is the velocity of rotative frame, 'm' is the mass of the part, 'ω' is angular velocity of rotative frame. Corolis force =

(A) $2m(\omega \times v)$ (B) $-2m(\omega \times v)$

(C) $m(\omega \times v)$ (D) $-m(\omega \times v)$

(E) Question not attempted

2 An astronaut before setting into outer space synchronises his clock to earth time and earth year as 2023. He travels deep space at a speed of 0.95c for 10 years as shown in his clock and re-enters earth. What would be the earth year upon re-entry?

(A) 2033 (B) 2044

(C) 2055 (D) 2066

(E) Question not attempted

3 A particle is projected up an inclined plane of inclination β at an elevation α to the horizontal. Find the ratio between $\tan\alpha$ and $\tan\beta$, if the particle strikes the plane horizontally.

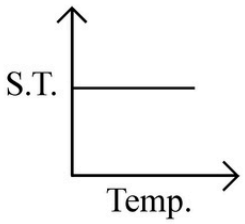
(A) 1 (B) 2

(C) 3 (D) 4

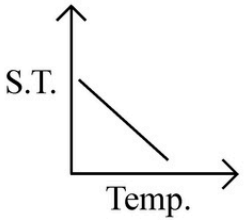
(E) Question not attempted

4 Which graph represents the variation of surface tension with temperature over small temperature ranges for water?

(A)



(B)



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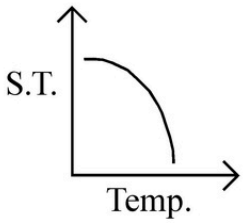
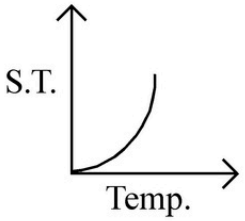


(D)



(E) Question not attempted

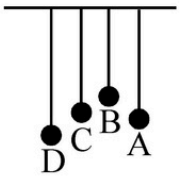
5 An immersion heater in a plastic bucket of negligible heat capacity brings 100g of water to the boiling point from 16° C in 5 mins. The power of heater is,

(A) 1.17×10^3 W (B) 1.17×10^3 cal/s

(C) 1.17 W (D) 117 W

(E) Question not attempted

6 4 identical metallic bobs are suspended from the same height using inelastic thread from an elastic support. The pendulums A and C are of equal length while B is shorter and D is longer as shown in the figure. If the pendulum A is provided with transverse displacement then,



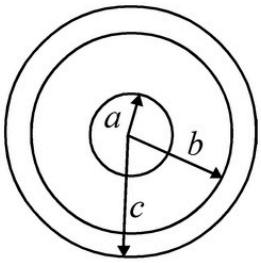
(A) B will vibrate with maximum amplitude
(B) D will vibrate with maximum amplitude
(C) C will vibrate with maximum amplitude
(D) B, C, D vibrate with same amplitude
(E) Question not attempted

7 A simple harmonic oscillator oscillates with an amplitude A. At what point of its motion is the power delivered to it by the restoring force maximum?
(A) When it passes through the equilibrium point both away and towards it.
(B) When it is at the maximum displacement.
(C) When it is at a displacement $\pm\frac{A}{\sqrt{2}}$ from the equilibrium point and moving towards and also away from it.
(D) When it is at a displacement $\pm\frac{2A}{\sqrt{2}}$ from the equilibrium point and moving towards and also away from it.
(E) Question not attempted

8 If black wire of platinum is heated, then its colour first appears red, then yellow and finally white. It can be understood on the basis of :
(A) Stefan's law of black body
(B) Kirchhoff's law of radiation
(C) Wien's displacement law
(D) Snell's law
(E) Question not attempted

9 1000 kHz carrier wave is amplitude modulated by the signal frequency 200 – 4000 Hz. The channel width in this case is :
(A) 2 kHz (B) 4 kHz
(C) 6 kHz (D) 8 kHz
(E) Question not attempted

10 A solid conducting sphere of radius 'a' has a net positive charge '$2Q$'. A conducting spherical shell of inner radius 'b' and outer radius 'c' is concentric with the solid sphere and has a net charge '$-Q$'. The surface charge density on the inner and outer surfaces of the spherical shell will be,



(A) $-\frac{2Q}{4\pi b^2};\frac{Q}{4\pi c^2}$

(B) $-\frac{Q}{4\pi b^2};\frac{Q}{4\pi c^2}$

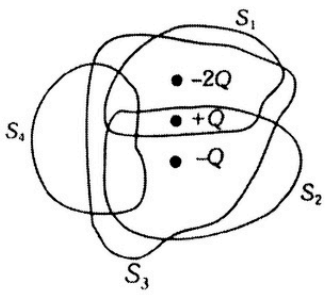
(C) $0;\frac{Q}{4\pi c^2}$

(D) 0, 0

(E) Question not attempted

11 Match the net electric flux from the columns below for 3 point charges $-2Q$, $+Q$ and $-Q$ and 4 closed surfaces S_1, S_2, S_3 and S_4 as shown in figure.

	Column I		**Column II**
A.	Net flux through S_1	p.	$-2Q$
B.	Net flux through S_2	q.	$-\frac{2Q}{\varepsilon_0}$
C.	Net flux through S_3	r.	Zero
D.	Net flux through S_4	s.	$-Q$



(A) $A \to p; B \to r; C \to q; D \to s$

(B) $A \to s; B \to r; C \to p; D \to r$

(C) $A \to r; B \to p; C \to q; D \to p$

(D) $A \to p; B \to r; C \to q; D \to q$

(E) Question not attempted

12 Read the assertion and reason carefully and select the correct option given below:

Assertion : The electric bulbs glows immediately when switch is set to ON.

Reason : The drift velocity of the electrons in metals is low.

(A) Both assertion and reason are true and the reason is not the correct explanation of the assertion.

(B) Assertion is true but the reason is false.

(C) Assertion is false but the reason is true.

(D) Both assertion and reason are true and the reason is the correct explanation of the assertion.

(E) Question not attempted

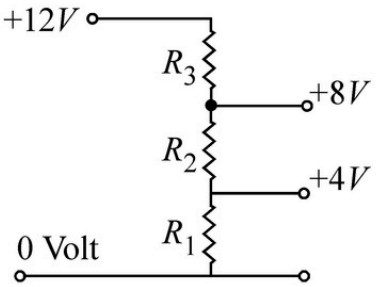
13 A galvanometer of resistance $100\ \Omega$ is converted to a voltmeter of range $10V$ by connecting a resistance of $10\ k\Omega$. The resistance required to convert the same galvanometer to an ammeter of range 1A is :

(A) $0.4\ \Omega$ (B) $0.3\ \Omega$

(C) $0.2\ \Omega$ (D) $0.1\ \Omega$

(E) Question not attempted

14 A potential divider is used to give outputs of $4V$ and $8V$ from a $12V$ source. Which combination of resistances ($R_1 : R_2 : R_3$) gives the correct voltages.



(A) 1 : 1 : 1 (B) 1 : 2 : 1

(C) 2 : 2 : 1 (D) 2 : 3 : 2

(E) Question not attempted

15 A square conducting loop of side length L carries a current I. The magnetic field at the centre of the loop is :

(A) Independent of 'L' (B) Proportional to 'L^2'

(C) Inversely proportional to 'L' (D) Exponential to 'L'

(E) Question not attempted

16 A charged particle with charge 'q' enters a region of constant uniform and mutually orthogonal fields $\vec{E}$ and $\vec{B}$ with a velocity $\vec{v}$ perpendicular to both $\vec{E}$ and $\vec{B}$. It comes out without any change in magnitude or direction of $\vec{v}$. Then :

(A) $\vec{v} = \left(\vec{E} \times \vec{B}\right) / B^2$ (B) $\vec{v} = \left(\vec{B} \times \vec{E}\right) / B^2$

(C) $\vec{v} = \left(\vec{E} \times \vec{B}\right) / E^2$ (D) $\vec{v} = \left(\vec{B} \times \vec{E}\right) / E^2$

(E) Question not attempted

17 Which of the following is NOT an application of eddy currents?

(A) Induction Furnace (B) Galvanometer damping

(C) Speedometer of Automobiles (D) Magnetic resonance imaging

(E) Question not attempted

18 For principal quantum number $n = 3$, the possible values of orbital quantum number 'l' are :

(A) 0, 1, 2 (B) –1, 0, +1

(C) 1, 2, 3 (D) 0, 1, 2, 3

(E) Question not attempted

19 Read the assertion and reason carefully and select the correct option given below.

Assertion : Isomers are the elements having same number of protons and neutrons but different energy and radioactive decay modes.

Reason : The nucleons are present inside the nucleus.

(A) Both assertion and reason are true and the reason is not the correct explanation of the assertion.

(B) Assertion is true but the reason is false.

(C) Assertion is false but the reason is true.

(D) Both assertion and reason are true and the reason is the correct explanation of the assertion.

(E) Question not attempted

20 Calculate the lattice constant of a Face Centered Cubic structure = 1.7458 $\mathring{A}$ and with an interplanar spacing of (220) planes.

(A) 0.4983 $\mathring{A}$ (B) 4.983 $\mathring{A}$

(C) 40.983 $\mathring{A}$ (D) 400.983 $\mathring{A}$

(E) Question not attempted

21 In a Phase shift RC coupled oscillator, the number of resistors and capacitors required to have a phase shift of 180° is :

(A) R and 2C
(B) 2R and C
(C) 3R and 3C
(D) 4R and 4C
(E) Question not attempted

22 The minimum error with which the energy of the excited state of hydrogen atom measured is 0.026 eV. What is its life time in this excited state?

(A) $2.5 \times 10^{+14}\ s$
(B) $2.5 \times 10^{-14}\ s$
(C) $2.5 \times 10^{-4}\ s$
(D) $2.5 \times 10^{+4}\ s$
(E) Question not attempted

23 The wave function for a particle of mass 'm' is, $\psi(x,t) = e^{i\omega t}\left(A\cos kx + B\sin kx\right)$. The probability current density is :

(A) 0
(B) $\frac{\hbar}{km}$
(C) $\frac{2\hbar i}{km}\left(A * B - B * A\right)$
(D) $\frac{\hbar k}{2mi}\left(A * B - B * A\right)$
(E) Question not attempted

24 An electron of mass 9.1×10^{-31} kg is moving with a velocity of 9.93×10^{4} ms^{-1}. Calculate its de-Broglie wavelength. Given: $h = 6.6 \times 10^{-34}$ Js.

(A) 7.3 $\mathring{A}$
(B) 73 $\mathring{A}$
(C) 0.73 $\mathring{A}$
(D) 1.73 $\mathring{A}$
(E) Question not attempted

25 'Gluons' are particles that carry :

(A) Strong force
(B) Weak force
(C) Electromagnetic Force
(D) Gravitational Force
(E) Question not attempted

26 Read the assertion and reason carefully and select the correct option given below.

Assertion : The interaction $\mu^- \rightarrow e^- + \nu_\mu + \overline{\nu}_e$ is allowed via weak interaction.

Reason : As neutrino is involved and it is a Lepton.

(A) Both assertion and reason are true and the reason is not the correct explanation of the assertion.
(B) Assertion is true but the reason is false.
(C) Assertion is false but the reason is true.
(D) Both assertion and reason are true and the reason is the correct explanation of the assertion
(E) Question not attempted

27 If temperature of the sink of Carnot engine is absolute zero, then efficiency is :

(A) 0% (B) 50%

(C) 100% (D) undefined

(E) Question not attempted

28 The condition for achromatism of two lenses in contact is :

(A) $\frac{w_1}{f_1} + \frac{w_2}{f_2} = 0$ (B) $\frac{w_1}{f_1} - \frac{w_2}{f_2} = 0$

(C) $\frac{w_1}{f_1} * \frac{w_2}{f_2} = 0$ (D) $w_1 f_1 + w_2 f_2 = 0$

(E) Question not attempted

29 The potential barrier in a p-n junction diode is :

(A) 0.3 V for Ge and 0.8 V for Si

(B) 0.2 V for Ge and 0.7 V for Si

(C) 0.3 V for Ge and 0.7 V for Si

(D) 0.5 V for Ge and 0.7 V for Si

(E) Question not attempted

30 Which is NOT Kepler's Law of planetary motion?

(A) Law of orbit (B) Law of conservation of energy

(C) Law of time period (D) Law of constant areal velocity

(E) Question not attempted

31 If a spring of force constant k is divided into two equal parts, the force constant will be :

(A) $k / 2$ (B) $2k$

(C) k (D) $4k$

(E) Question not attempted

32 The forbidden band of a solid lies :

(A) below the conduction band

(B) above the valence band

(C) between the conduction and valence band

(D) can not be located

(E) Question not attempted

33 Which of the diode is used for detecting light signal?

(A) Photo diode (B) LED

(C) Zener diode (D) Tunnel diode

(E) Question not attempted

34 Match the following :

1.	Energy of thermal neutron	i.	3 eV
2.	Energy of X-rays	ii.	0.025 eV
3.	Photoelectric threshold of a metal	iii.	10 keV
4.	Binding energy per nucleon	iv.	8 MeV

(A) 1-i, 2-ii, 3-iv, 4-iii
(B) 1-ii, 2-iii, 3-i, 4-iv
(C) 1-iii, 2-iv, 3-ii, 4-i
(D) 1-iv, 2-i, 3-iii, 4-ii
(E) Question not attempted

35 For the hydrogen atom, which series describes electron transitions to the $N = 1$ orbit, the lowest energy electron orbit? Is it :
(A) Lyman series
(B) Balmer series
(C) Paschen series
(D) Pfund series
(E) Question not attempted

36 For an infinite sheet of positive charge, the electric field lines :
(A) run parallel to the sheet of charge
(B) are perpendicular to the sheet of charge and point in toward the sheet
(C) are perpendicular to the sheet of charge and point away from the sheet
(D) fall off as one over r squared
(E) Question not attempted

37 A beam of white light is passed through a diffraction grating and the resulting spectrum is allowed to fall on a screen. Which colour of light that undergoes the greatest deviation from its original direction?
(A) red
(B) yellow
(C) blue
(D) violet
(E) Question not attempted

38 In a charged hollow metal conductor, the charge is :
(A) on the inside surface only
(B) on both the inside and outside surfaces
(C) only between the inside and outside surfaces
(D) on the outside surface only
(E) Question not attempted

39 A light ray traveling in benzene strikes the benzene-air surface at the critical angle. The angle of refraction of the light ray is :
(A) 30 degrees
(B) 60 degrees
(C) 180 degrees
(D) 90 degrees
(E) Question not attempted

40 **Assertion :** Units of Rydberg constant R are m^{-1}.

Reason : It follows from Bohr's formula $v = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$, where the symbols have their usual meaning.

(A) If both assertion and reason are true and the reason is the correct explanation of the assertion.
(B) If both assertion and reason are true but reason is not the correct explanation of the assertion.
(C) If assertion is true but reason is false.
(D) If the assertion and reason both are false.
(E) Question not attempted

41 **Assertion :** Parallax method cannot be used for measuring distances of stars more than 100 light years away.
Reason : Because parallax angle reduces so much that it cannot be measured accurately.
(A) If both assertion and reason are true and the reason is the correct explanation of the assertion.
(B) If both assertion and reason are true but reason is not the correct explanation of the assertion.
(C) If assertion is true but reason is false.
(D) If the assertion and reason both are false.
(E) Question not attempted

42 **Assertion :** Radar is used to detect an aeroplane in the sky
Reason : Radar works on the principle of reflection of waves.
(A) If both assertion and reason are true and the reason is the correct explanation of the assertion.
(B) If both assertion and reason are true but reason is not the correct explanation of the assertion.
(C) If assertion is true but reason is false.
(D) If the assertion and reason both are false.
(E) Question not attempted

43 **Assertion :** L/R and CR both have same dimensions.
Reason : L/R and CR both have dimension of time.
(A) If both assertion and reason are true and the reason is the correct explanation of the assertion.
(B) If both assertion and reason are true but reason is not the correct explanation of the assertion.
(C) If assertion is true but reason is false.
(D) If the assertion and reason both are false.
(E) Question not attempted

44 Match the following :

1.	Fleming's left hand rule	i.	Direction of induced current
2.	Right hand thumb rule	ii.	Magnitude and direction of magnetic induction
3.	Biot-Savart law	iii.	Direction of force due to magnetic induction
4.	Fleming's right hand rule	iv.	Direction of magnetic lines due to current

(A) 1-i, 2-ii, 3-iv, 4-iii
(B) 1-ii, 2-iii, 3-i, 4-iv
(C) 1-iii, 2-iv, 3-ii, 4-i
(D) 1-iv, 2-i, 3-iii, 4-ii
(E) Question not attempted

45 A car travels on a horizontal circular track of radius 9 m, starting from rest at a constant tangential acceleration of 3 m/sec^2. Its resultant acceleration after 2 sec of its starting is :
(A) 3 m/sec^2
(B) 7 m/sec^2
(C) 4 m/sec^2
(D) 5 m/sec^2
(E) Question not attempted

46 A 220 Volt, 100 W bulb is connected to a 110 Volt source. Power consumed by the bulb is :
(A) 10 W
(B) 15 W
(C) 20 W
(D) 25 W
(E) Question not attempted

47 A particle of charge e and mass m moves with a velocity v in a magnetic field B applied perpendicular to the motion of the particle. The radius r of its path in the field is :
(A) mv / Be
(B) Be / mv
(C) ev / Bm
(D) Bv / em
(E) Question not attempted

48 A cantilever of weight w is uniformly loaded with weight $W\left(W \gg w\right)$ along its length. The depression produced within elastic limit, at its free end is δ_1. Another cantilever of same dimension and same material is loaded at its free end with same weight W. The depression produced in this case is δ_2.Then :
(A) $\delta_2 = 4\delta_1$
(B) $2\delta_2 = 5\delta_1$
(C) $3\delta_2 = 4\delta_1$
(D) $3\delta_2 = 8\delta_1$
(E) Question not attempted

49 A vessel contains oil (density = 0.8 gm/cm^3) over mercury (density = 13.6 g/cm^3). A homogeneous sphere floats with half its volume immersed in mercury and the other half in oil. The density of the material of the sphere in gm/cm^3 is :

(A) 3.3 (B) 6.4
(C) 7.2 (D) 12.8
(E) Question not attempted

50 **Assertion :** Force of friction depends on the actual area of contact.
Reason : Smoother the surfaces of contact smaller is the opposition of the motion.

(A) Both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion
(B) Both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion
(C) Assertion is true but the Reason is false
(D) Both, Assertion and Reason are false
(E) Question not attempted

51 A relativistic charged particle, whose kinetic energy equals its rest mass energy, enters normal to a magnetic field and traverses a circular trajectory of radius R. If the kinetic energy were twice its rest mass energy and it would have entered normally the same magnetic field traversing a circular path of radius R_0. Then this R_0 :

(A) is $< R$.
(B) is $> R$.
(C) is $> 2R$.
(D) independent of the charge and mass of particle
(E) Question not attempted

52 Two events, separated by a spatial distance 9×10^9 m along $\hat{x}$, are simultaneous in one inertial frame. The time interval between these two events in another inertial frame moving with a constant velocity $v = 0.8c\ \hat{x}$ with respect to the first one is :

(A) 60 s (B) 40 s
(C) 20 s (D) zero (Simultaneous)
(E) Question not attempted

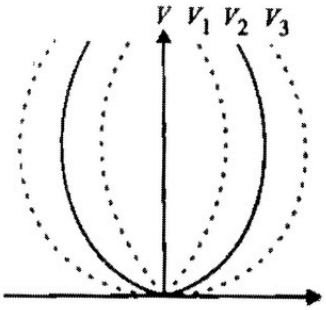
53 The potential function $x^2 - y^2 + z$ satisfies :

(A) Poisson's equation (B) Laplace equation
(C) Green's function (D) Bessel's function
(E) Question not attempted

54 Relativistic motion of a particle in an attractive inverse square law of force is :

(A) Ellipse (B) Processing ellipse
(C) Parabola (D) Circle
(E) Question not attempted

55 Figure shows three one dimensional potentials V_1 , V_2 and V_3 of small oscillations of the particle about the origin is the 3 cases satisfy :



(A) $V_1 = V_2 = V_3$
(B) $V_1 > V_2 > V_3$
(C) $V_1 < V_2 < V_3$
(D) $V_1 < V_2 > V_3$
(E) Question not attempted

56 Planck's law of energy distribution of black body radiation agrees with the Rayleigh jeans law :
(A) At all wavelengths
(B) At short wavelengths
(C) At long wavelengths
(D) Only at the maximum of the energy distribution curve
(E) Question not attempted

57 Bose Einstein condensation temperature refers to the temperature below which :
(A) An assembly of Bose gas condense to the liquid state
(B) There is an appreciable occupation of the ground state in an electron system
(C) There is a significantly large occupancy of the ground state in a system of Bosons.
(D) The bosons essentially behave like fermions.
(E) Question not attempted

58 Which one of the following statements is correct for the relationship between the magnetic vector potential (A) and the magnetic field induction (B)?
(A) If all components of A are non-zero then B cannot be zero.
(B) If B is a uniform field in Z direction then A should not possess any Z components.
(C) If B is zero anywhere that does not mean that A has to be zero there.
(D) If B is non uniform field in Z direction then A may possess all its components.
(E) Question not attempted

59 An oscillator consists of :
(A) tank circuit
(B) transistor amplifier
(C) feedback circuit
(D) all of these
(E) Question not attempted

60 The overall efficiency of a transformer is 90%. The transformer is rated for an output of 9 kW. The primary voltage is 1000 volt and the resistance of the primary coil is $R_p = 1k\Omega$. The ratio of turns in the primary to the secondary coil is 5:1. The iron losses at full load are 700 watt.

(A) The current in the secondary is I_s = 4.5A

(B) The resistance of the secondary coil is approximately 4.5Ω

(C) The copper loss in the primary is 1000 watt.

(D) The copper loss in the secondary is 700 watt.

(E) Question not attempted

61 The high input impedance of the field effect transistor (FET) amplifier is due to :

(A) Pinch-off voltage

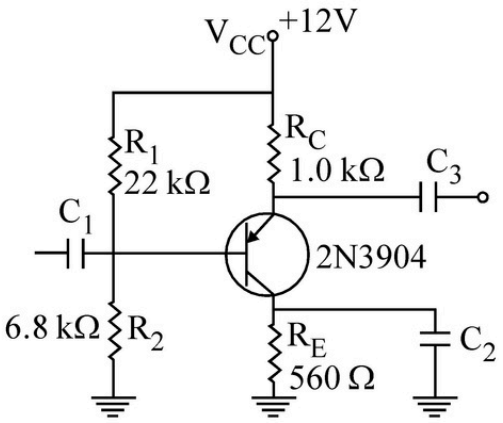
(B) High gate current

(C) Source and drain being far apart

(D) Reverse biasing between gate and source

(E) Question not attempted

62 A minimum value for the emitter bypass capacitor, C_2, in given figure if the amplifier must operate over a frequency range from 2 kHz to 10 kHz, is :



(A) 1.42 *F*

(B) 1.42 *mF*

(C) 1.42 μF

(D) 1.42 *pF*

(E) Question not attempted

63 Two beams of light in the visible range (400 nm - 700 nm) interfere with each other at a point. The optical path difference between them is 5000 nm. Which of the following wavelengths will interfere constructively at the given point?

(A) 416.67 nm

(B) 550.67 nm

(C) 600.67 nm

(D) 660.67 nm

(E) Question not attempted

64 A combination of two thin convex lenses of equal focal lengths, is kept separated along the optic axes between a distances of 20 cm between them. The combination behaves as a lens system of infinite focal length. If an object is kept at 10 cm from the first lens, its image will be formed on the other side at a distance x from the second lens. The value of x is :

(A) 10 cm
(B) 20 cm
(C) 6.67 cm
(D) infinite
(E) Question not attempted

65 White light is incident on a grating G_1 with groove density 600 lines/mm and width 50 mm. A small portion of the diffracted light is incident on another grating G_2 with groove density 1800 lines/mm and width 15 mm. The resolving power of the combined system is :

(A) 3×10^3
(B) 57×10^3
(C) 81×10^7
(D) $10^8 \times 10^5$
(E) Question not attempted

66 The interaction in the nuclear process, $p \rightarrow n + e^+ + \nu_e$, is/are :

(A) Weak with parity preserving
(B) Weak and long range
(C) Strong and parity violating
(D) Weak and short range
(E) Question not attempted

67 The ground state spin and parity of ^{16}N $(Z = 7)$ nucleus is :

(A) 1^+
(B) 2^-
(C) 2^+
(D) 4^+
(E) Question not attempted

68 Proton and neutron are the two states of the same particle: the nucleon. The two states differ in :

(A) spin
(B) isospin
(C) z-component of spin
(D) z-component of isospin
(E) Question not attempted

69 To explain the observed magnetic moment of a deuteron (0.8574 μ_N), its ground state wave function is taken to be an admixture of S and D states. The expectation values of the Z-component of the magnetic moment in pure S and pure D states are 0.8797 μ_N and 0.310 μ_N respectively. The contribution of the D state to the mixed ground state is approximately :

(A) 40%
(B) 4%
(C) 0.4%
(D) 0.04%
(E) Question not attempted

70 The nuclear reaction, $4_1H^1 \rightarrow {}_2He^4 + 2_{-1}e^0 + 26\ MeV$ represents :

(A) Fusion
(B) Fission
(C) β-decay
(D) γ-decay
(E) Question not attempted

71 An atomic bomb consisting of ^{235}U explodes and releases an energy of $10^{14}\ j$. It is known that each ^{235}U which undergoes fission releases 3 neutrons and about 200 MeV of energy. Further only 20% of the ^{235}U atoms in the bomb undergoes fission.
The total number of neutron released is about :

(A) 4.7×10^{24}
(B) 9.7×10^{24}
(C) 1.9×10^{25}
(D) 3.7×10^{25}
(E) Question not attempted

72 In the muon decay $\bar{\mu} \rightarrow \bar{\beta} + \nu_\mu + \bar{\nu}_\mu$, the $\bar{\beta}$ is ejected with relativistic energy. If mass of μ – meson is 206 me, the maximum available energy in eV for the process is :

(A) 100 MeV
(B) 105 MeV
(C) 210 MeV
(D) 150 MeV
(E) Question not attempted

73 If $\bar{J}_1$ and $\bar{J}_2$ are angular momenta of two non-interacting systems and $\bar{J}$ represents the sum of $\bar{J}_1$ and $\bar{J}_2$ then :

(A) J_1^2 and J_2^2 commute with J^2 only
(B) J_1^2 and J_2^2 commute with J_z only
(C) J_1^2 and J_2^2 commute with both J^2 and J_z
(D) J_{1z} and J_{2z} commute with J^2
(E) Question not attempted

74 In Compton effect experiment, photons of energy $h\nu$ are incident on a target material of atomic number Z. The change in wavelength can be seen more easily if :

(A) ν is in visible region and Z is small
(B) ν is in X-ray region and Z is small
(C) ν is in X-ray region and Z is larger
(D) ν is in visible region and Z is large
(E) Question not attempted

75 Identify the decimal equivalent of the binary number $(11010100)_2$:

(A) 312
(B) 212
(C) 256
(D) 512
(E) Question not attempted

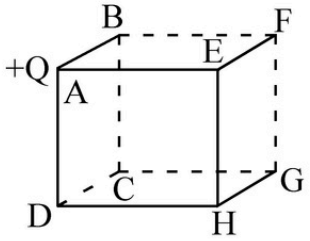
76 Which of the following has the order of increasing energy?

(A) $^1D_2$, $^3D_2$, $^3F_2$ (B) $^3F_2$, $^3D_2$, $^1D_2$

(C) $^3D_2$, $^3F_2$, $^1D_2$ (D) $^1D_2$, $^3F_2$, $^3D_2$

(E) Question not attempted

77 A positive point charge $+Q$ is placed at one of the corners of a cube (say A). The electric flux through the front face EFGH is :



(A) $\frac{Q}{\varepsilon_0}$ (B) $\frac{Q}{6\varepsilon_0}$

(C) $\frac{Q}{16\varepsilon_0}$ (D) $\frac{Q}{24\varepsilon_0}$

(E) Question not attempted

78 The internal energy of n moles of a gas is given by $E = \frac{3}{2} n RT - \frac{a}{V}$, where V is the volume of the gas at temperature T and a is a positive constant. One mole of the gas in state (T_1, V_1) is allowed to expand adiabatically into vacuum to a final state (T_2, V_2). The temperature T_2 is :

(A) $T_1 + Ra\left(\frac{1}{V_2} + \frac{1}{V_1}\right)$ (B) $T_1 - \frac{2}{3}Ra\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

(C) $T_1 + \frac{2}{3}Ra\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$ (D) $T_1 - \frac{1}{3}Ra\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

(E) Question not attempted

79 In the presence of an inhomogeneous weak magnetic field, spectral-lines due to transitions between two sets of states were observed :

(1) $^5I_5 \rightarrow {}^5H_4$ (2) $^2D_{5/2} \rightarrow {}^2P_{3/2}$

The type of Zeeman effect observed in (1) and (2) respectively are :

(A) Normal, Normal (B) Anomalous, Anomalous

(C) Anomalous, Normal (D) Normal, Anomalous

(E) Question not attempted

80 For silver, the specific heat at constant pressure in the range of 50 K to 100 K is given by $C_P = 0.076\ T - 0.00026\ T^2 - 0.15$ cal mol^{-1} deg^{-1} where T is the Kelvin temperature. If 2 mole of silver are heated from 50 K to 100 K, calculate the change in entropy.

(A) 3.58 cal / K (B) 0.358 cal / K
(C) 5.38 cal / K (D) 0.538 cal / K
(E) Question not attempted

81 The difference between the second and third year's interest on a certain sum @ 8% Compound Interest is ₹ 32,659.20. Determine the sum.

(A) ₹ 3,25,000 (B) ₹ 3,50,000
(C) ₹ 3,75,000 (D) ₹ 4,00,000
(E) Question not attempted

82 A trader 'A' sold a laptop at 27.5% profit to trader 'B'. Trader B sold it at 20% profit to a customer. The profit made by trader 'B' was ₹ 650 less than the profit made by trader 'A'. Find the cost price of the laptop for trader 'A'.

(A) ₹ 30,750 (B) ₹ 32,500
(C) ₹ 34,350 (D) ₹ 36,250
(E) Question not attempted

83 Neeru and Deepti brought an equal amount of money for shopping. Neeru spends ₹ 2,500 and Deepti spends $3\frac{1}{5}$ times of what Neeru spends. After that Neeru had $2\frac{5}{6}$ times of what Deepti had been left with. How much money was left with Deepti after shopping?

(A) ₹ 2,450 (B) ₹ 2,725
(C) ₹ 3,000 (D) ₹ 3,250
(E) Question not attempted

84 If $a = \left(\sqrt{5} + \sqrt{10}\right) \Big/ \left(\sqrt{10} - \sqrt{5}\right)$ and $b = \left(\sqrt{10} - \sqrt{5}\right) \Big/ \left(\sqrt{10} + \sqrt{5}\right)$, simplify and find the value of $\left(\sqrt{a} - \sqrt{b} - 2\sqrt{ab}\right)$

(A) 0 (B) 1
(C) 5 (D) 10
(E) Question not attempted

85 There are four girls of different ages. The average weight of Mohini and Veena was 17 kgs less than the average weight of Meenal and Sonali. The average weight of all four girls is 58 kgs. However, Mohini weighs 50% as much as Veena. What is the weight of Mohini?

(A) 30 kgs (B) 33 kgs
(C) 36 kgs (D) 39 kgs
(E) Question not attempted

Qs. 86-87 : Each of these questions contains six statements followed by four sets of combinations of three. Choose the set in which the statements are logically related.

86
a. Painting and music are arts.
b. Art is a symptom of culture.
c. Culture and art are complementary.
d. Music is a form of art.
e. Painting is a form of art.
f. Music depicts culture.

(A) bdf
(B) aef
(C) ace
(D) cef
(E) Question not attempted

87
a. All boys are good.
b. Some men are bad.
c. Good people are educated.
d. Boys are educated.
e. Ram is an educated boy.
f. Hari is an educated man.

(A) bcf
(B) acd
(C) def
(D) adc
(E) Question not attempted

Qs. 88-90 : Each of these has a question followed by two statements I and II. Mark the answer as:
(A) if the question can be answered with the help of statement I alone,
(B) if the question can be answered with the help of statement II alone,
(C) if both the statements I and II are needed to answer the question, and
(D) if the question cannot be answered even with the help of both the statements.
(E) Question not attempted

88 X says to Y, "I am 3 times as old as you were 3 years ago". How old is X?
I. Y's age 17 years from now will be same as X's present age.
II. X's age nine years from now will be 3 times Y's present age.

89 What is the radius of a given circle?
I. Ratio of its area to circumference is > 7.
II. Diameter of the circle is ≤ 32.

90 What is the time difference between City A and City B?
I. The departure time of a flight at City A is 9.00 AM local time and its arrival time at City B is 10.00 AM local time.
II. The duration of the above flight is 5 hours.

91 Which of the following is a part of the Yadvindra Garden Pinjore?

I Shish mahal
II Hawa mahal
III Rang mahal
IV Jal mahal

Choose the correct option from the following:

(A) I, II and III only
(B) II, III and IV only
(C) I, III and IV only
(D) I, II, III and IV all
(E) Question not attempted

92 Consider the following statements about Loharu :

I As per legend the town was originally inhabited by blacksmiths.
II It is situated on Bhiwani - Jaipur road.
III It is a railway station on Rewari-Rajgarh section.
IV The Fort of Loharu was built by Maharaja of Sikar.

Which of the above statements is/are not correct?

(A) I and II only
(B) II and III only
(C) III and IV only
(D) IV only
(E) Question not attempted

93 According to legend which of the following town / city draw its name from the term "fear of lions" / "abode of lions"?

(A) Narnaul
(B) Narnaund
(C) Narwana
(D) Nagina
(E) Question not attempted

94 The main Holy tank at Kapal-Mochan was also known as

(A) Rin Mochan tirath
(B) Plaksh tirath
(C) Somsar tirath
(D) Sidheshwar tirath
(E) Question not attempted

95 Which of the following place is associated with Pir Budhu Singh, a muslim saint, who helped Guru Gobind Singh in the battle of Bhagani?

(A) Sadhaura
(B) Sugh
(C) Buria
(D) Bilaspur
(E) Question not attempted

Qs. 96-100 : Answer the questions on the basis of the contents of the passage given below:

India's announcements at the 26th and 27th Conference of Parties (COP) are now the pillars of its climate leadership. If COP26 in 2021 was a watershed moment because of its announcement of the country's plan to go net-zero by 2070, last year's COP27 in Egypt will be remembered for the country's path-breaking announcement of a long-term strategy (LTS) for low carbon development. With this, India joined the coveted list of 56 countries that have submitted their LTS documents to the United Nations Framework Convention on Climate Change (UNFCCC). The 121-page LTS is consistent with India's net-zero targets and gives key industries such as electricity, industry, transport and finance a guide for the future. The strategies are bold, but they are also evolutionary and flexible. The Indian delegation was clear – the country has contributed little to global warming and the heat must be turned up on the rich countries to deliver on their net-zero promises first and to fulfil their financial commitments. We outline the key takeaways from this flagship document that will guide India's actions in the coming five decades. First, sectoral transformations are key. India's LTS has prioritized six strategic sectors - electricity, transport, urban, industry, carbon dioxide removal and forests. Of these, electricity, and industry sectors together account for over three-fourths of India's CO_2 emissions, while rapid changes are happening in the transport and urban sectors. More renewable power, demand side reductions and a just transition for phase down of coal will be priorities in the electricity sector. In transport, India will look to transition to cleaner fuels, increased energy efficiency, and aggressive electrification. Urban transition will focus on material efficiency of buildings. The industrial sector will aim to improve energy efficiency, electrification, material efficiency, green hydrogen, and decarbonisation of hard-to-abate sectors. Second, finance and investments. India has identified finance as the key enabler for its LTS vision. India must continue to push developed countries to pay the billions of dollars they promised. Third, changes to LiFE - LiFE is India's call for citizens, communities, industry leaders and policy makers of the world to adopt a life-style for the environment. The LTS nudges people to make simple yet effective sustainable choices, industries and markets to scale these, and government policies to support them. LiFE elevates the importance of individual contribution to the larger climate goal, giving it as much importance as industry and policy level actions, an aspect largely missing from the climate discourse till now. Fourth, invest in research and innovation, India's LTS notes the relevance of research and innovation and identifies multiple technologies in the energy and industry sectors that need to be explored and scaled up. While the emphasis on innovation is great, it only focuses on technology related innovations. Innovations on business models are equally important to push low-carbon technologies. Fifth, adaptation, resilience, and international cooperation. How is India, where 75% of districts are hotspots of extreme weather events, preparing itself? The LTS emphasises the need for strengthening basic infrastructure like irrigation systems and disaster-resilient buildings, institutional infrastructure for better disaster response, and raising incomes to bolster capabilities of individuals and communities to adapt to the long-term impacts of climate change. This needs international

cooperation, and multi-lateral initiatives and platforms. But there's a crucial element missing in India's long-term strategy. It could have included carbon pricing through the emission-trading scheme as a key instrument. The Centre has already announced the creation of a domestic carbon market and the Lok Sabha has passed it. This is clearly going to be an important element of India's strategy, but the LTS is quiet about it.

96 It could be inferred from the passage that only 56 countries

i. are having in place proper, well-planned strategies for tackling climate changes in their respective regions.

ii. have the capability of leading the crusade for global climate change and low carbon development.

iii. have already submitted their LTS documents to UNFCCC.

(A) i and iii
(B) iii only
(C) i only
(D) ii and iii
(E) Question not attempted

97 It is implied in the passage that

i. The power sector must be a key contributor to any efforts towards reducing the carbon footprint in India.

ii. Although India itself has not yet contributed significantly towards mitigating global warming, it is of the firm belief that the onus for doing the same is more on the rich countries as they are better off and could make the needed financial commitments in this direction.

iii. India's LTS document is comprehensive and designed flexibly enough to adapt to any changes in strategy that would be needed as the situations develop over time during its implementation.

iv. India's LTS document is developed in line with the global plan to go net-zero by 2070 as agreed upon by all the 56 countries leading the world in this direction.

v. By 2070 the climate scenario in at least 56 countries of the world will be almost completely under control as these have already put in place robust strategies to ensure the same.

(A) i, ii, iii and iv
(B) ii, iii, iv and v
(C) i and iii
(D) ii, iii and v
(E) Question not attempted

98 The option closest in meaning to the word 'coveted' as used in the passage is:

(A) Aspired
(B) Desired
(C) Hoped
(D) Needed
(E) Question not attempted

99 It is evident from the passage that

(A) through innovation it is possible to reduce the overall energy consumption in India despite the growth in various sectors of the economy.
(B) every citizen of a country could individually play an active role in the efforts towards environmental protection.
(C) 75% of the geographic area of India is prone to extreme climate events.
(D) All these
(E) Question not attempted

100 With which of the following statements about India's LTS document would the author likely disagree, going by the contents of the passage?

i. It is not comprehensive enough and was probably rushed to be completed in time for COP27.
ii. Though quite comprehensive, it could have been made more robust by including the element of carbon pricing through the emission trading scheme.
iii. The document cannot be viewed as watertight and would need constant reviewing as it is the blueprint for a long journey of five decades during which situations requiring course corrections are certainly going to arise.
iv. Contribution of individual citizens to the larger national interest of environmental protection is one of the aspects neglected by this document thereby rendering it incomplete if not irrelevant.

(A) i and iv
(B) iii only
(C) i and iii
(D) ii and iii
(E) Question not attempted