FIITJEE JEE MAINS

MOCK TEST - 4

PHYSICS, CHEMISTRY & MATHEMATICS

JEE - MAINS 2014

Time Allotted: 3 Hours **Maximum Marks: 360**

- Do not open this Test Booklet until you are asked to do so.
- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

Important Instructions:

1. Immediately fill in the particulars on this page of the Test Booklet with *Blue / Black Ball Point Pen. Use of pencil is strictly prohibited.*

2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.

3. The test is of **3 hours** duration.

4. The Test Booklet consists of **90** questions. The maximum marks are **360**.

5. There are ***three*** parts in the question paper consisting of **Physics, Chemistry** and **Mathematics** having 35 questions in each part of equal weightage. Each question is allotted **4 (four)** marks for correct response.

6. *Candidates will be awarded marks as stated above in instruction No.5 for correct response of each question. ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*

7. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.

8. Use ***Blue / Black Ball Point Pen only*** for writing particulars / marking responses on ***Side-1*** and ***Side-2*** of the Answer Sheet. ***Use of pencil is strictly prohibited.***

9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall / room.

10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room / Hall. ***However, the candidates are allowed to take away this Test Booklet with them.***

11. **Do not fold or make any stray marks on the Answer Sheet.**

Name of the Candidate (in Capital Letters) :_____

Enrolment Number :_____

Batch :_____ Date of Examination : _____

PHYSICS

1. This question contains Statement-1 and Statement-2. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement-1: For a charged particle moving from point P to point Q, the net work done by an electrostatic field on the particle is independent of the path connecting point P to point Q.

Statement-2: The net work done by a conservative force on an object moving along a closed loop is zero.

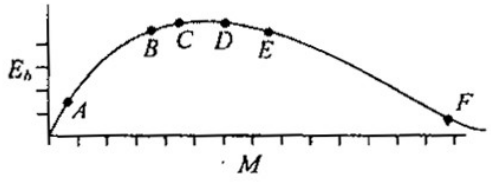
(a) Statement-1 is true, Statement-2 is false

(b) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statement-1.

(c) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement-1.

(d) Statement-1 is false, Statement-2 is true.

2. The above is a plot of binding energy per nucleon E_b, against the nuclear mass M; A, B, C, D, E, F correspond to different nuclei. Consider four reactions:



(i) $A + B \rightarrow C + \varepsilon$ (ii) $C \rightarrow A + B + \varepsilon$

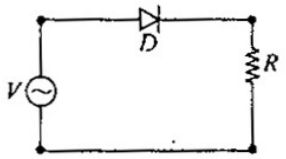
(iii) $D + E \rightarrow F + \varepsilon$ (iv) $F \rightarrow D + E + \varepsilon$

where ε is the energy released? In which reactions is ε positive?

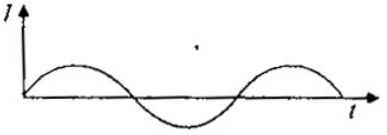
(a) (i) and (iv) (b) (i) and (iii)

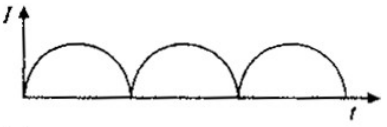
(c) (ii) and (iv) (d) (ii) and (iii)

3. A p-n junction (D) shown in the figure can act as a rectifier.



An alternating current source (V) is connected in the circuit. The current(I) in the resistor(R) can be shown by

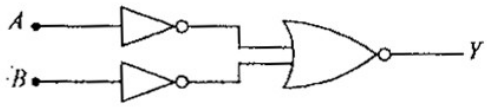
(a)


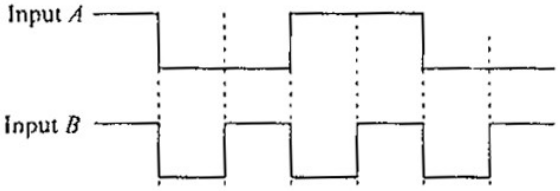
(b)


(c)


(d)


4. The logic circuit shown below has the input waveforms 'A' and 'B' as shown. Pick out the correct output waveform.

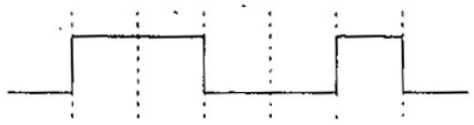




Output is

(a)


(b)


(c)


(d)


5. If x, v and a denote the displacement, the velocity and the acceleration of a particle executing simple harmonic motion of time period T, then, which of the following does not change with time?
(a) $a^2T^2 + 4\pi^2v^2$ (b) aT/x
(c) $aT + 2\pi v$ (d) aT/v

6. In an optics experiment, with the position of the object fixed, a student varies the position of a convex lens and for each position, the screen is adjusted to get a clear image of the object. A graph between the object distance u and the image distance v, from the lens, is plotted using the same scale for the two axes. A straight line passing through the origin and making an angle of 45° with the x-axis meets the experimental curve at P. The coordinates of P will be
(a) $(2f, 2f)$ (b) $(f/2, f/2)$
(c) (f, f) (d) $(4f, 4f)$

7. A thin uniform rod of length l and mass m is swinging freely about a horizontal axis passing through its end. Its maximum angular speed is ω. Its centre of mass rises to a maximum height of
(a) $\frac{1}{3}\frac{l^2\omega^2}{g}$ (b) $\frac{1}{6}\frac{l\omega}{g}$
(c) $\frac{1}{2}\frac{l^2\omega^2}{g}$ (d) $\frac{1}{6}\frac{l^2\omega^2}{g}$

8. Let $P(r) = \frac{Q}{\pi R^4} r$ be the charge density distribution for a solid sphere of radius R and total charge Q. For a point 'p' inside the sphere at distance r_1 from the centre of the sphere, the magnitude of electric field is
(a) 0 (b) $\frac{Q}{4\pi\varepsilon_0 r_1^2}$
(c) $\frac{Qr_1^2}{4\pi\varepsilon_0 R^4}$ (d) $\frac{Qr_1^2}{3\pi\varepsilon_0 R^4}$

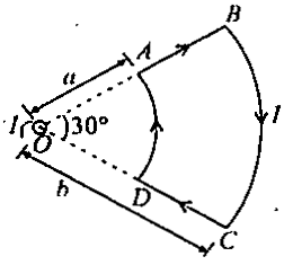
9. The transition from the state $n = 4$ to $n = 3$ in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from
(a) $2 \rightarrow 1$ (b) $3 \rightarrow 2$
(c) $4 \rightarrow 2$ (d) $5 \rightarrow 4$

10. One kg of a diatomic gas is at a pressure of 8×10^4 N/m^2. The density of the gas is 4 kg/m^3. What is the energy of the gas due to its thermal motion?
(a) 3×10^4 J (b) 5×10^4 J
(c) 6×10^4 J (d) 7×10^4 J

11. This question contains Statement-1 and Statement-2. Of the four choices given after the statements, choose the one that best describes the two statements.
Statement-1: The temperature dependence of resistance is usually given as $R = R_0(1 + \alpha\Delta t)$. The resistance of a wire changes from 100 Ω to 150 Ω when its temperature is increased from 27°C to 227°C. This implies that $\alpha = 2.5 \times 10^{-3}$/°C
Statement-2: $R = R_0(1 + \alpha\Delta t)$ is valid only when the change in the temperature ΔT is small and $\Delta R = (R - R_0) << R_0$.
(a) Statement-1 is true, Statement-2 is false
(b) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statement-1.
(c) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement-1.
(d) Statement-1 is false, Statement-2 is true

Directions : Question numbers 12 and 13 are based on the following paragraph.

A current loop $ABCD$ is held fixed on the plane of the paper as shown in the figure. The arcs BC (radius = b) and DA (radius = a) of the loop are joined by two straight wires AB and CD. A steady current I is flowing in the loop. Angle made by AB and CD at the origin O is 30°. Another straight thin wire with steady current I_1 flowing out of the plane of the paper is kept at the origin.



12. The magnitude of the magnetic field (B) due to loop $ABCD$ at the origin (O) is
(a) zero (b) $\frac{\mu_0 I(b-a)}{24ab}$
(c) $\frac{\mu_0 I}{4\pi}\left[\frac{b-a}{ab}\right]$
(d) $\frac{\mu_0 I}{4\pi}\left[2(b-a)+\frac{\pi}{3}(a+b)\right]$

13. Due to the presence of the current I_1 at the origin
(a) the forces on AB and DC are zero.
(b) the forces on AD and BC are zero
(c) the magnitude of the net force on the loop is

given by $\frac{I_1 I}{4\pi}\mu_0\left[2(b-a)+\frac{\pi}{3}(a+b)\right]$

(d) the magnitude of the net force on the loop is given by $\frac{\mu_0 I I_1}{24ab}(b-a)$.

14. A mixture of light, consisting of wavelength 590 nm and an unknown wavelength, illuminates Young's double slit and gives rise to two overlapping interference patterns on the screen. The central maximum of both lights coincide. Further, it is observed that the third bright fringe of known light coincides with the 4th bright fringe of the unknown light. From this data, the wavelength of the unknown light is

(a) 393.4 nm (b) 885.0 nm
(c) 442.5 nm (d) 776.8 nm

15. Two points P and Q are maintained at the potentials of 10 V and –4 V respectively. The work done in moving 100 electrons from P to Q is

(a) -9.60×10^{-17} J (b) 9.60×10^{-17} J
(c) -2.24×10^{-16} J (d) 2.24×10^{-16} J

16. The surface of a metal is illuminated with the light of 400 nm. The kinetic energy of the ejected photoelectrons was found to be 1.68 eV. The work function of the metal is (hc = 1240 eV nm)

(a) 3.09 eV (b) 1.41 eV
(c) 1.51 eV (d) 1.68 eV

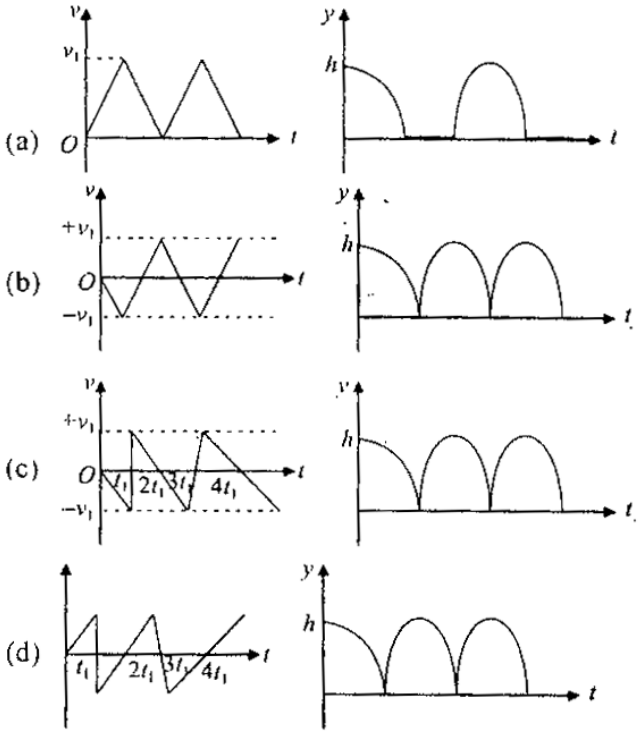
17. A particle has an initial velocity $3\hat{i} + 4\hat{j}$ and an acceleration of $0.4\hat{i} + 0.3\hat{j}$. Its speed after 10 s is

(a) 10 units (b) $7\sqrt{2}$ units
(c) 7 units (d) 8.5 units

18. A motor cycle starts from rest and accelerates along a straight path at 2 m/s^2. At the starting point of the motor cycle there is a stationary electric siren. How far has the motor cycle gone when the driver hears the frequency of the siren at 94% of its value when the motor cycle was at rest?
(Speed of sound = 330 ms^{-1}).

(a) 49 m (b) 98 m
(c) 147 m (d) 196 m

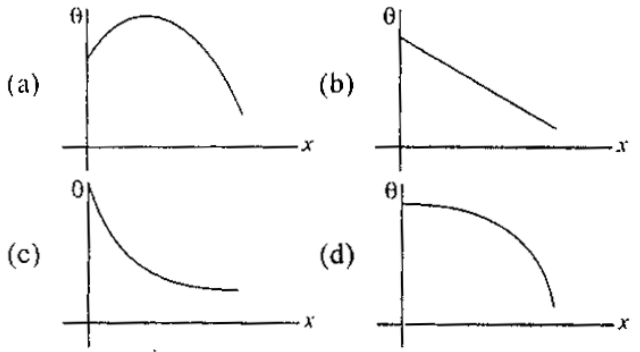
19. Consider a rubber ball freely falling from a height h = 4.9 m onto a horizontal elastic plate. Assume that the duration of collision is negligible and the collision with the plate is totally elastic. Then the velocity as a function of time and the height as function of time will be



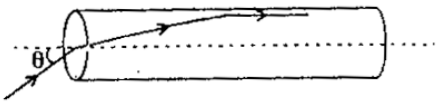
20. A charge Q is placed at each of the opposite corners of a square. A charge q is placed at each of the other two corners. If the net electrical force on Q is zero, then the Q/q equals

(a) $-2\sqrt{2}$ (b) -1
(c) 1 (d) $-\frac{1}{\sqrt{2}}$

21. A long metallic bar is carrying heat from one of its ends to the other end under steady-state. The variation of temperature θ along the length x of the bar from its hot end is best described by which of the following figures?



22. A transparent solid cylindrical rod has a refractive index of $\frac{2}{\sqrt{3}}$. It is surrounded by air. A light ray is incident at the mid-point of one end of the rod as shown in the figure.



The incident angle θ for which the light ray grazes along the wall of the rod is

(a) $\sin^{-1}\left(\frac{1}{2}\right)$ (b) $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$

(c) $\sin^{-1}\left(\frac{2}{\sqrt{3}}\right)$ (d) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

23. Three sound waves of equal amplitudes have frequencies $(\upsilon - 1)$, υ, $(\upsilon + 1)$. They superpose to give beats. The number of beats produced per second will be

(a) 4 (b) 3

(c) 2 (d) 1

24. The height at which the acceleration due to gravity becomes $g/9$ (where g = the acceleration due to gravity on the surface of the earth) in terms of R, the radius of the earth is

(a) $2R$ (b) $\frac{R}{\sqrt{2}}$

(c) $R/2$ (d) $\sqrt{2}R$

25. Two wires are made of the same material and have the same volume. However wire 1 has cross-sectional area A and wire 2 has cross-sectional area $3A$. If the length of wire 1 increases by Δx on applying force F, how much force is needed to stretch wire 2 by the same amount?

(a) F (b) $4F$

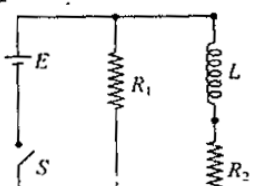
(c) $6F$ (d) $9F$

26. In an experiment the angles are required to be measured using an instrument. 29 divisions of the main scale exactly coincide with the 30 divisions of the vernier scale. If the smallest division of the main scale is half-a-degree (= 0.5°), then the least count of the instrument is

(a) one minute (b) half minute

(c) one degree (d) half degree

27. An inductor of inductance $L = 400$ mH and resistors of resistances $R_1 = 2\ \Omega$ and $R_2 = 2\ \Omega$ are connected to a battery of emf 12 V as shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at

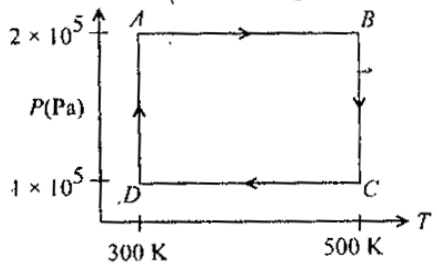


(a) $6e^{-5t}$ V (b) $\frac{12}{t}e^{-3t}$ V

(c) $6\left(1-e^{-t/0.2}\right)$ V (d) $12e^{-5t}$ V

Directions: Question numbers 28, 29 and 30 are based on the following paragraph.

Two moles of helium gas are taken over the cycle $ABCDA$, as shown in the P - T diagram.



28. Assuming the gas to be ideal the work done on the gas in taking it from A to B is

(a) $200R$ (b) $300R$

(c) $400R$ (d) $500R$

29. The work done on the gas in taking it from D to A is

(a) $-414R$ (b) $+414R$

(c) $-690R$ (d) $+690R$

30. The net work done on the gas in the cycle $ABCDA$ is

(a) zero (b) $276R$

(c) $1076R$ (d) $1904R$

CHEMISTRY

31. Knowing that the chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state, which of the following statements is incorrect ?

(a) Because of the large size of the Ln(III) ions the bonding in its compounds is predominantly ionic in character.

(b) The ionic sizes of Ln(III) decrease in general with increasing atomic number.

(c) Ln(III) compounds are generally colourless.

(d) Ln(III) hydroxides are mainly basic in character.

32. A liquid was mixed with ethanol and a drop of concentrated H_2SO_4 was added. A compound with a fruity smell was formed. The liquid was

(a) CH_3OH (b) CHO

(c) CH_3COCH_3 (d) CH_3COOH

33. Arrange the carbanions,

in order of their decreasing stability

(a) $C_6H_5\bar{C}H_2 > \bar{C}Cl_3 > (CH_3)_3\bar{C} > (CH_3)_2\bar{C}H$

(b) $(CH_3)_2\bar{C}H > \bar{C}Cl_3 > C_6H_5\bar{C}H_2 > (CH_3)_3\bar{C}$

(c) $\bar{C}Cl_3 > C_6H_5\bar{C}H_2 > (CH_3)_2\bar{C}H > (CH_3)_3\bar{C}$

(d) $(CH_3)_3\bar{C} > (CH_3)_2\bar{C}H > C_6H_5\bar{C}H_2 > \bar{C}Cl_3$

34. The alkene that exhibits geometrical isomerism is

(a) propene (b) 2-methylpropene

(c) 2-butene (d) 2-methyl-2-butene

35. In which of the following arrangements, the sequence is not strictly according to the property written against it ?

(a) $CO_2 < SiO_2 < SnO_2 < PbO_2$: increasing oxidising power

(b) $HF < HCl < HBr < HI$: increasing acid strength

(c) $NH_3 < PH_3 < AsH_3 < SbH_3$: increasing basic strength

(d) $B < C < O < N$: increasing first ionization enthalpy

36. The major product obtained on interaction of phenol with sodium hydroxide and carbon dioxide is

(a) benzoic acid (b) salicylaldehyde

(c) salicylic acid (d) phthalic acid

37. Which of the following statements is incorrect regarding physisorption ?

(a) It occurs because of van der Waals forces.

(b) More easily liquefiable gases are adsorbed readily.

(c) Under high pressure it results into multi molecular layer on adsorbent surface.

(d) Enthalpy of adsorption ($\Delta H_{adsorption}$) is low and positive.

38. Which of the following on heating with aqueous KOH produces acetaldehyde ?

(a) CH_3COCl (b) CH_3CH_2Cl

(c) CH_2ClCH_2Cl (d) CH_3CHCl_2

39. In an atom, an electron is moving with a speed of 600 m/s with an accuracy of 0.005%. Certainty with which the position of the electron can be located is ($h = 6.6 \times 10^{-34}$ kg m^2 s^{-1}, mass of electron, $e_m = 9.1 \times 10^{-31}$ kg)

(a) 1.52×10^{-4} m (b) 5.10×10^{-3} m

(c) 1.92×10^{-3} m (d) 3.84×10^{-3} m

40. In a fuel cell methanol is used as fuel and oxygen gas is used as an oxidizer. The reaction is

$$CH_3OH_{(l)} + \frac{3}{2}O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(l)}.$$

At 298 K standard Gibb's energies of formation for $CH_3OH_{(l)}$, $H_2O_{(l)}$ and $CO_{2(g)}$ are –166.2, –237.2 and –394.4 kJ mol^{-1} respectively. If standard enthalpy of combustion of methanol is –726 kJ mol^{-1}, efficiency of the fuel cell will be

(a) 80 % (b) 87%

(c) 90% (d) 97%

41. Two liquids *X* and *Y* form an ideal solution. At 300 K, vapour pressure of the solution containing 1 mol of *X* and 3 mol of *Y* is 550 mm Hg. At the same temperature, if 1 mol of *Y* is further added to this solution, vapour pressure of the solution increases by 10 mm Hg. Vapour pressure (in mm Hg) of *X* and *Y* in their pure states will be, respectively

(a) 200 and 300 (b) 300 and 400

(c) 400 and 600 (d) 500 and 600

42. The half-life period of a first order chemical reaction is 6.93 minutes. The time required for the completion of 99% of the chemical reaction will be (log 2 = 0.301)

(a) 230.3 minutes (b) 23.03 minutes

(c) 46.06 minutes (d) 460.6 minutes

43. Given : $E^\circ_{Fe^{3+}/Fe} = -0.036$ V, $E^\circ_{Fe^{2+}/Fe} = -0.439$ V. The value of standard electrode potential for the change, $Fe^{3+}_{(aq)} + e \rightarrow Fe^{2+}_{(aq)}$ will be

(a) – 0.072 V (b) 0.385 V

(c) 0.770 V (d) – 0.270 V

44. On the basis of the following thermochemical data ($\Delta_f G^\circ\ H^+_{(aq)} = 0$).

$$H_2O_{(l)} \rightarrow H^+_{(aq)} + OH^-_{(aq)};\ \Delta H = 57.32 \text{ kJ}$$

$$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)};\ \Delta H = -286.2 \text{ kJ}$$

The value of enthalpy of formation of OH^- ion at 25°C is

(a) – 22.88 kJ (b) – 228.88 kJ

(c) + 228.88 kJ (d) – 343.52 kJ

45. Copper crystallizes in *fcc* with a unit cell length of 361 pm. What is the radius of copper atom ?

(a) 108 pm (b) 127 pm (c) 157 pm (d) 181 pm

46. Which of the following has an optical isomer ?

(a) $[Co(NH_3)_3Cl]^+$ (b) $[Co(en)(NH_3)_2]^{2+}$

(c) $[Co(H_2O)_4(en)]^{3+}$ (d) $[Co(en)_2(NH_3)_2]^{3+}$

47. Solid $Ba(NO_3)_2$ is gradually dissolved in a 1.0×10^{-4} M Na_2CO_3 solution. At what concentration of Ba^{2+} will a precipitate begin to form ?(K_{sp} for $BaCO_3 = 5.1 \times 10^{-9}$)

(a) 4.1×10^{-5} M (b) 5.1×10^{-5} M
(c) 8.1×10^{-8} M (d) 8.1×10^{-7} M

48. Which one of the following reactions of xenon compounds is not feasible ?

(a) $XeO_3 + 6HF \rightarrow XeF_6 + 3H_2O$
(b) $3XeF_4 + 6H_2O \rightarrow 2Xe + XeO_3 + 12HF + 1.5\ O_2$
(c) $2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + O_2$
(d) $XeF_6 + RbF \rightarrow Rb[XeF_7]$

49. Using MO theory predict which of the following species has the shortest bond length ?

(a) O_2^{2+} (b) O_2^{+}
(c) O_2^{-} (d) O_2^{2-}

50. In context with the transition elements, which of the following statements is incorrect ?

(a) In addition to the normal oxidation states, the zero oxidation state is also shown by these elements in complexes.
(b) In the highest oxidation states, the transition metals show basic character and form cationic complexes.
(c) In the highest oxidation states of the first five transition elements (Sc to Mn), all the 4*s* and 3*d* electrons are used for bonding.
(d) Once the d^5 configuration is exceeded, the tendency to involve all the 3*d* electrons in bonding decreases.

51. Calculate the wavelength (in nanometre) associated with a proton moving at 1.0×10^3 ms^{-1}. (Mass of proton = 1.67×10^{-27} kg and $h = 6.63 \times 10^{-34}$ Js)

(a) 0.032 nm (b) 0.40 nm
(c) 2.5 nm (d) 14.0 nm

52. A binary liquid solution is prepared by mixing *n*-heptane and ethanol. Which one of the following statements is correct regarding the behaviour of the solution ?

(a) The solution formed is an ideal solution
(b) The solution is non-ideal, showing +ve deviation from Raoult's law.
(c) The solution is non-ideal, showing –ve deviation from Raoult's law.
(d) *n*-heptane shows +ve deviation while ethanol shows –ve deviation from Raoult's law.

53. The number of stereoisomers possible for a compound of the molecular formula $CH_3 - CH = CH - CH(OH) - Me$ is

(a) 3 (b) 2
(c) 4 (d) 6

54. The IUPAC name of *neo*-pentane is

(a) 2-methylbutane (b) 2,2-dimethylpropane
(c) 2-methylpropane (d) 2,2-dimethylbutane

55. The set representing the correct order of ionic radius is

(a) $Li^+ > Be^{2+} > Na^+ > Mg^{2+}$
(b) $Na^+ > Li^+ > Mg^{2+} > Be^{2+}$
(c) $Li^+ > Na^+ > Mg^{2+} > Be^{2+}$
(d) $Mg^{2+} > Be^{2+} > Li^+ > Na^+$

56. The two functional groups present in a typical carbohydrate are

(a) –OH and –COOH (b) –CHO and –COOH
(c) $>C=O$ and –OH (d) –OH and –CHO

57. The bond dissociation energy of B – F in BF_3 is 646 kJ mol^{-1} whereas that of C – F in CF_4 is 515 kJ mol^{-1}. The correct reason for higher B – F bond dissociation energy as compared to that of C – F is

(a) smaller size of B-atom as compared to that of C-atom
(b) stronger σ bond between B and F in BF_3 as compared to that between C and F in CF_4
(c) significant $p\pi$-$p\pi$ interaction between B and F in BF_3 whereas there is no possibility of such interaction between C and F in CF_4.
(d) lower degree of $p\pi$-$p\pi$ interaction between B and F in BF_3 than that between C and F in CF_4.

58. In Cannizzaro reaction given below

$$2\,PhCHO \xrightarrow{:OH^-} PhCH_2OH + PhCOO^-$$

the slowest step is

(a) the attack of $:OH^-$ at the carboxyl group
(b) the transfer of hydride to the carbonyl group
(c) the abstraction of proton from the carboxylic group
(d) the deprotonation of $PhCH_2OH$

59. Which of the following pairs represents linkage isomers ?

(a) $[Cu(NH_3)_4][PtCl_4]$ and $[Pt(NH_3)_4][CuCl_4]$
(b) $[Pd(PPh_3)_2(NCS)_2]$ and $[Pd(PPh_3)_2(SCN)_2]$

(c) $[Co(NH_3)_5(NO_3)]SO_4$ and $[Co(NH_3)_5(SO_4)]NO_3$

(d) $[PtCl_2(NH_3)_4]Br_2$ and $[PtBr_2(NH_3)_4]Cl_2$

60. Buna-N synthetic rubber is a co-polymer of

(a) $H_2C=CH-\underset{\displaystyle Cl}{\underset{|}{C}}=CH_2$ and $H_2C=CH-CH=CH_2$

(b) $H_2C=CH-CH=CH_2$ and $H_5C_6-CH=CH_2$

(c) $H_2C=CH-CN$ and $H_2C=CH-CH=CH_2$

(d) $H_2C=CH-CN$ and $H_2C=CH-\underset{\displaystyle Cl}{\underset{|}{C}}=CH_2$

MATHEMATICS

Directions : Questions number 61 to 65 are Assertion-Reason type questions. Each of these questions contains two statements :
Statement - 1 (Assertion) and Statement - 2 (Reason). Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1

(b) Statement- 1 is true, Statement-2 is false

(c) Statement-1 is false, Statement-2 is true

(d) Statement-1 is true, Statement-2 is true; Statement-2 is correct explanation for Statement-1

61. **Statement-1** : $\sim(p \leftrightarrow \sim q)$ is equivalent to $p \leftrightarrow q$.

Statement-2 : $\sim(p \leftrightarrow \sim q)$ is a tautology.

62. Let A be a 2×2 matrix

Statement-1 : adj (adj A) = A

Statement-2 : $|\text{adj } A| = |A|$

63. Let $f(x) = (x+1)^2 - 1, x \geq -1$.

Statement-1 : The set $\{x : f(x) = f^{-1}(x)\} = \{0, -1\}$.

Statement-2 : f is a bijection.

64. **Statement-1** : The variance of first n even natural numbers is $\frac{n^2-1}{4}$

Statement-2 : The sum of first n natural numbers is $\frac{n(n+1)}{2}$ and the sum of squares of first n natural numbers is $\frac{n(n+1)(2n+1)}{6}$

65. Let $f(x) = x|x|$ and $g(x) = \sin x$.

Statement-1 : gof is differentiable at $x = 0$ and its derivative is continuous at that point.

Statement-2 : gof is twice differentiable at $x = 0$.

66. The area of the region bounded by the parabola $(y-2)^2 = x - 1$, the tangent to the parabola at the point (2, 3) and the x-axis is

(a) 6 (b) 9

(c) 12 (d) 3

67. Given $P(x) = x^4 + ax^3 + bx^2 + cx + d$ such that $x = 0$ is the only real root of $P'(x) = 0$. If $P(-1) < P(1)$ then in the interval $[-1, 1]$:

(a) $P(-1)$ is not minimum but $P(1)$ is the maximum of P

(b) $P(-1)$ is the minimum but $P(1)$ is not the maximum of P

(c) neither $P(-1)$ is the minimum nor $P(1)$ is the maximum of P

(c) $P(-1)$ is the minimum and $P(1)$ is the maximum of P

68. The shortest distance between the line $y - x = 1$ and the curve $x = y^2$ is

(a) $\frac{2\sqrt{3}}{8}$ (b) $\frac{3\sqrt{2}}{5}$

(c) $\frac{\sqrt{3}}{4}$ (d) $\frac{3\sqrt{2}}{8}$

69. Let the line $\frac{x-2}{3} = \frac{y-1}{-5} = \frac{z+2}{2}$ lie in the plane $x + 3y - \alpha z + \beta = 0$. Then (α, β) equals

(a) $(-6, 7)$ (b) $(5, -15)$

(c) $(-5, 5)$ (d) $(6, -17)$

70. From 6 different novels and 3 different dictionaries 4 novels and 1 dictionary are to be selected and arranged in a row on a shelf so that the dictionary is always in the middle. Then the number of such arrangements is

(a) at least 500 but less than 750

(b) at least 750 but less than 1000

(c) at least 1000 (d) less than 500

71. In a binomial distribution $B\left(n,\ p=\frac{1}{4}\right)$, if the probability of at least one success is greater than or equal to $\frac{9}{10}$, then n is greater than

(a) $\frac{1}{\log_{10}4+\log_{10}3}$ (b) $\frac{9}{\log_{10}4-\log_{10}3}$

(c) $\frac{4}{\log_{10}4-\log_{10}3}$ (d) $\frac{1}{\log_{10}4-\log_{10}3}$

72. The lines $p(p^2+1)x-y+q=0$ and $(p^2+1)^2x+(p^2+1)y+2q=0$ are perpendicular to a common line for

(a) exactly one value of p
(b) exactly two values of p
(c) more than two values of p
(d) no value of p

73. If A, B and C are three sets such that $A\cap B=A\cap C$ and $A\cup B=A\cup C$, then

(a) $A=C$ (b) $B=C$
(c) $A\cap B=\phi$ (d) $A=B$

74. For real x, let $f(x)=x^3+5x+1$, then

(a) f is onto R but not one-one
(b) f is one-one and onto R
(c) f is neither one-one nor onto R
(d) f is one-one but not onto R

75. The differential equation which represents the family of curves $y=c_1e^{c_2x}$, where c_1 and c_2 are arbitrary constants, is

(a) $y''=y'y$ (b) $yy''=y'$
(c) $yy''=(y')^2$ (d) $y'=y^2$

76. Let a, b, c be such that $b(a+c)\neq 0$. If

$$\begin{vmatrix} a & a+1 & a-1 \\ -b & b+1 & b-1 \\ c & c-1 & c+1 \end{vmatrix}+\begin{vmatrix} a+1 & b+1 & c-1 \\ a-1 & b-1 & c+1 \\ (-1)^{n+2}a & (-1)^{n+1}b & (-1)^n c \end{vmatrix}=0,$$

then the value of n is

(a) any even integer (b) any odd integer
(c) any integer (d) zero

77. The remainder left out when $8^{2n}-(62)^{2n+1}$ is divided by 9 is

(a) 2 (b) 7
(c) 8 (d) 0

78. Let y be an implicit function of x defined by $x^{2x}-2x^x\cot y-1=0$. Then $y'(1)$ equals

(a) 1 (b) $\log 2$
(c) $-\log 2$ (d) -1

79. If the roots of the equation $bx^2+cx+a=0$ be imaginary, then for all real values of x. The expression $3b^2x^2+6bcx+2c^2$ is

(a) less than $4ab$ (b) greater than $-4ab$
(c) less than $-4ab$ (d) greater than $4ab$

80. The sum to infinity of the series

$1+\frac{2}{3}+\frac{6}{3^2}+\frac{10}{3^3}+\frac{14}{3^4}+\ldots\ldots$ is

(a) 3 (b) 4
(c) 6 (d) 2

81. The projections of a vector on the three coordinate axis are 6, –3, 2 respectively. The direction cosines of the vector are

(a) $\frac{6}{5},\frac{-3}{5},\frac{2}{5}$ (b) $\frac{6}{7},\frac{-3}{7},\frac{2}{7}$

(c) $\frac{-6}{7},\frac{-3}{7},\frac{2}{7}$ (d) 6, –3, 2

82. Let A and B denote the statements

$A:\cos\alpha+\cos\beta+\cos\gamma=0$

$B:\sin\alpha+\sin\beta+\sin\gamma=0$

If $\cos(\beta-\gamma)+\cos(\gamma-\alpha)+\cos(\alpha-\beta)=-\frac{3}{2}$, then

(a) A is false and B is true
(b) both A and B are true
(c) both A and B are false
(d) A is true and B is false

83. One ticket is selected at random from 50 tickets numbered 00, 01, 02, ..., 49. Then the probability that the sum of the digits on the selected ticket is 8, given that the product of these digits is zero, equals

(a) $\frac{1}{7}$ (b) $\frac{5}{14}$

(c) $\frac{1}{50}$ (d) $\frac{1}{14}$

84. Three distinct points A, B and C are given in the 2-dimensional coordinate plane such that the ratio of the distance of any one of them from the point (1, 0) to the distance from the point (–1, 0) is equal to 1/3. Then the circumcentre of the triangle ABC is at the point

(a) $\left(\frac{5}{4},0\right)$ (b) $\left(\frac{5}{2},0\right)$

(c) $\left(\frac{5}{3},0\right)$ (d) (0, 0)

85. If the mean deviation of number $1, 1+d, 1+2d, \ldots, 1+100d$ from their mean is 255, then the d is equal to

(a) 20.0 (b) 10.1

(c) 20.2 (d) 10.0

86. The ellipse $x^2 + 4y^2 = 4$ is inscribed in a rectangle aligned with the coordinate axes, which in turn is inscribed in another ellipse that passes through the point (4, 0). Then the equation of the ellipse is

(a) $x^2 + 12y^2 = 16$ (b) $4x^2 + 48y^2 = 48$

(c) $4x^2 + 64y^2 = 48$ (d) $x^2 + 16y^2 = 16$

87. If $\left|Z - \frac{4}{Z}\right| = 2$, then the maximum value of $|Z|$ is equal to

(a) $\sqrt{5}+1$ (b) 2

(c) $2+\sqrt{2}$ (d) $\sqrt{3}+1$

88. If P and Q are the points of intersection of the circles $x^2 + y^2 + 3x + 7y + 2p - 5 = 0$ and $x^2 + y^2 + 2x + 2y - p^2 = 0$, then there is a circle passing through P, Q and (1, 1) for

(a) all except one value of p

(b) all except two values of p

(c) exactly one value of p

(d) all values of p

89. If $\vec{u}, \vec{v}, \vec{w}$ are non-coplanar vectors and p, q are real numbers, then the equality

$$[3\vec{u}\ \ p\vec{v}\ \ p\vec{w}] - [p\vec{v}\ \ \vec{w}\ \ q\vec{u}] - [2\vec{w}\ \ q\vec{v}\ \ q\vec{u}] = 0$$

holds for

(a) exactly two values of (p, q)

(b) more than two but not all values of (p, q)

(c) all values of (p, q)

(d) exactly one value of (p, q)

90. $\int_0^{\pi} [\cot x]dx$, where [.] denotes the greatest integer function, is equal to

(a) 1 (b) -1

(c) $-\pi/2$ (d) $\pi/2$

Answer key
JEE MAINS MOCK TEST – 4

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

Answer key
JEE MAINS MOCK TEST – 4

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

Answer key
JEE MAINS MOCK TEST – 4

1.C	2.A	3.C	4.A	5.B	6.A	7.D	8.C	9.D	10.B	11.A	12.B	13.B	14.C	15.D
16.B	17.B	18.B	19.C	20.A	21.B	22.D	23.A	24.A	25.D	26.A	27.D	28.C	29.B	30.B
31.C	32.D	33.C	34.C	35.C	36.C	37.D	38.D	39.C	40.D	41.C	42.C	43.C	44.B	45.B
46.D	47.B	48.A	49.A	50.B	51.B	52.B	53.C	54.B	55.B	56.C	57.C	58.B	59.B	60.C
61.B	62.A	63.B	67.C	65.B	66.B	67.A	68.D	69.A	70.C	71.D	72.A	73.B	74.B	75.C

76.B 77.A 78.D 79.B 80.A 81.B 82.B 83.D 84.A 85.B 86.A 87.A 88.A 89.D 90.C