VMC Vidyamandir Classes SINCE 1986

IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE ADVANCED BOOSTER TEST-2

JEE 2024

Date	Timing	Maximam Marks	Duration
24th July, 2023	4:00 PM - 7:00 PM	177	3 Hours

General Instructions

1. The question paper consists of 3 Subjects (Subject I: **Physics**, Subject II: **Chemistry**, Subject III: **Mathematics**). Each Subject has **two** sections (Section 1 & Section 2).

2. **Section 1** contains **3 types** of questions **[Type A, Type B and Type C].**

Type A contains **Five (05) Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

Type B contains **Five (05) Multiple Correct Answers Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

Type C contains **ONE (01) paragraph**. Based on the paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

3. **Section 2** contains **6 Numerical Value Type Questions**. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

4. For answering a question, an ANSWER SHEET (OMR SHEET) is provided separately. Please fill your **Test Code, Roll No.** and **Group** properly in the space given in the ANSWER SHEET.

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

Candidate's Signature : _____ **Invigilator's Signature** _____

Syllabus:

Physics : Electrostatics, DC Circuits, Capacitors, Kinematics of a Particle, Motion in Two Dimensions, Dynamics of a Particle

Chemistry : Chemical Kinetics, Electrochemistry, Surface Chemistry, Stoichiometry - I & II, Atomic Structure, Periodic Classification

Mathematics : Functions, Inverse Trigonometric Functions, DC - I, Straight Line, Circles

MARKING SCHEME

SECTION-1 | Type A

- This section contains **Five (05)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the answer. For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme:

  Full Marks : +3 If ONLY the correct option is chosen;
  Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);
  Negative Marks : –1 In all other cases.

SECTION-1 | Type B

- This section contains **Five (05)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme:

  Full Marks : +4 If only (all) the correct option(s) is(are) chosen;
  Partial Marks : +3 If all the four options are correct but ONLY three options are chosen;
  Partial Marks : +2 If three or more options are correct but ONLY two options are chosen, both of which are correct;
  Partial Marks : +1 If two or more options are correct but ONLY one option is chosen and it is a correct option;
  Zero Marks : 0 If unanswered;
  Negative Marks : –2 In all other cases.
- For example, in a question, if (A), (B) and (D) are the ONLY three options corresponding to correct answers, then
  choosing ONLY (A), (B) and (D) will get +4 marks; choosing ONLY (A) and (D) will get +2 marks;
  choosing ONLY (A) will get +1 mark;
  choosing no option(s) (i.e. the question is unanswered) will get 0 marks and
  choosing any other option(s) will get –2 marks.

SECTION-1 | Type C

- This section contains **ONE paragraphs**. Based on each paragraph, there are **TWO** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme;

  Full Marks : +3 If ONLY the correct option is chosen;
  Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);
  Negative Marks : −1 In all other cases.

SECTION - 2

- This section contains **6 Integer Type Questions**. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)
- Answer to each question will be evaluated according to the following marking scheme:

  Full Marks: +3 If ONLY the correct Integer value is entered. There is **NO negative marking.**
  Zero Marks: 0 In all other cases.

SUBJECT I : PHYSICS 59 MARKS

SECTION-1 | Type A

This section consists of 5 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. A $t = 0$, two particles B and C are located at the origin of the coordinate system. Then they start moving simultaneously. B moves under a constant acceleration of $2\hat{k}\, m/s^2$ with an initial velocity of $8\,\hat{j}\, m/s$. Particle C moves with constant velocity $\vec{V}_0$ in such a way that B and C collides at $t = 4$ sec. Then:

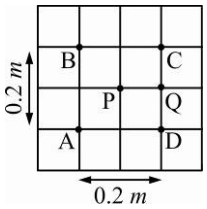
(A) $\vec{v}_0 = \left(8\hat{j} + 4\hat{k}\right) m/s$

(B) $\vec{v}_0 = (4\hat{j} + 8\hat{k}) m/s$

(C) $\vec{v}_0 = \left(8\hat{j} + 8\hat{k}\right) m/s$

(D) It is not possible that B and C collide with each other for any value of $\vec{v}_0$

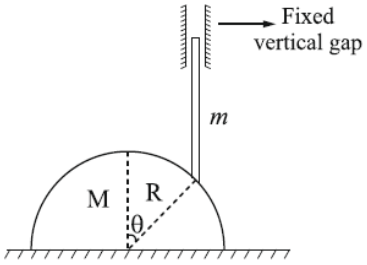
2. A, B, C, D, P and Q are points in a uniform electric field. The potentials at these points are $V(A) = 2$ volt. $V(P) = V(B) = V(D) = 5$ volt. $V(C) = 8$ volt. The electric field at P is :



(A) $10 Vm^{-1}$ along PQ **(B)** $15\sqrt{2} Vm^{-1}$ along PA

(C) $5 Vm^{-1}$ along PC **(D)** $5 Vm^{-1}$ along PA

3. In the system shown all surfaces are smooth. System is released from rest, acceleration of hemisphere just after the release is:

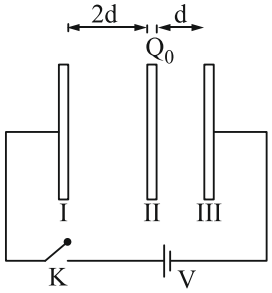


(A) $\dfrac{mg}{m + M\cot\theta}$ **(B)** $\dfrac{Mg}{m\tan\theta + M\cot\theta}$

(C) $\dfrac{mg}{M\tan\theta + m}$ **(D)** $\dfrac{mg}{M\tan\theta + m\cot\theta}$

SPACE FOR ROUGH WORK

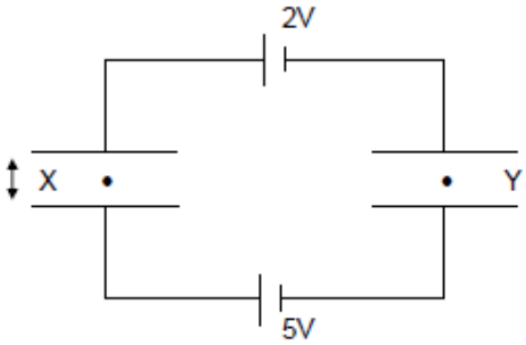
4. Three conducting plates with plate area 'A' each are kept parallel to each other as shown. Initially key is open and middle plate has charge Q_0 on it. Now key is closed at t = 0. Find amount of charge on plate I in steady state.



(A) $\frac{2}{3}\frac{A\in_0 V}{d}$ **(B)** $\frac{Q_0}{6}+\frac{A\in_0 V}{3d}$

(C) $\frac{Q_0}{2}+\frac{A\in_0 V}{3d}$ **(D)** $\frac{Q_0}{3}+\frac{2A\in_0 V}{3d}$

5. Four metallic plates are used to form two identical parallel plate capacitors as shown is the figure. Initially all plates were uncharged. Two batteries are connected to the capacitors. Points *x* and *y* are equidistant from two plates. Find potential difference between points *x* and *y* in steady state.



(A) 7V **(B)** 3.5 V **(C)** 2 V **(D)** 5V

SPACE FOR ROUGH WORK

SECTION-1 | Type B

This section consists of 5 Multiple Correct Answers Type Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

6. A rocket is fired vertically up from the ground. Burning of fuel releases exhaust gases which give it a resultant upward acceleration of 10 m/s^2. Assume that this acceleration remains constant till the time fuel gets finished. If the fuel gets finished in 1 minute, choose the correct options. (Take g = 10 m/s^2 for the entire journey)

(A) The maximum height reached by rocket from ground is 18 km

(B) The maximum height reached by rocket from ground is 36 km

(C) The time after which rocket falls back on ground is 240 s

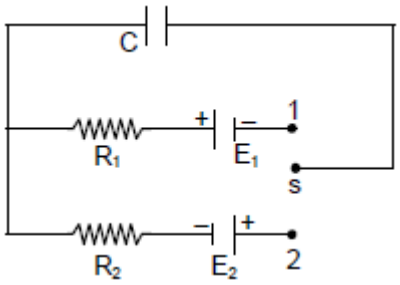
(D) The time after which rocket falls back on ground is $(120+60\sqrt{2})$ s

7. The range of voltage of a meter used as a voltmeter can be changed to n time its original value with the help of a 27Ω multiplier. Using the same meter as an ammeter, its range of current can be changed to n times its original value using a 3Ω shunt. The power dissipated by the moving – coil of the meter when giving a full-scale reading is $9\times10^{-4}W$. Select the correct statement(s)

(A) The resistance of the coil is 9Ω **(B)** The resistance of the coil is 81Ω

(C) The full deflection current is 9 mA **(D)** The full deflection current is 10mA

8. An uncharged capacitor C, resistance $R_1=R$ and $R_2=2R$, cells of emf $E_1=E$ and $E_2=E$ are connected as shown in the figure. First switch S is connected to terminal 1 for a long time. H_1 is heat energy lost through the resistor R_1 up to the steady state and U_1 is energy stored in the capacitor at steady state. Now the switch is connected to terminal 2 for another long duration. H_2 is heat energy lost through the resistor R_2 up to the steady state and U_2 is energy stored in the capacitor at steady state. Choose the correct statement(s)



(A) $\frac{U_1}{U_2}=1$ **(B)** $\frac{H_1}{H_2}=\frac{1}{4}$ **(C)** $H_2=2H_1$ **(D)** $H_2=CE^2$

SPACE FOR ROUGH WORK

9. Heater – 1 takes 10 minutes to increase temperature of liquid (A) of mass 2 kg by 20°C when connected with 200 V supply. Heater – 2 takes 20 minutes to increase temperature of liquid B of mass 4 kg by 20°C when connected with 400 V supply.

Given : Specific heat of liquid A = 6000 J/kg°C

Specific heat of liquid B = 12000 J/kg°C

Select correct option (s)

(A) The power of heater – 1 is 400 watt

(B) The resistance of heater –2 is 200Ω

(C) If both heaters are connected in series to a 300 V supply then time taken to increase temperature of liquid A by 30°C is 20 min.

(D) If both heaters are connected is parallel to a 300 V supply then time taken to increases temperature of liquid – B by 27° C is 16 min.

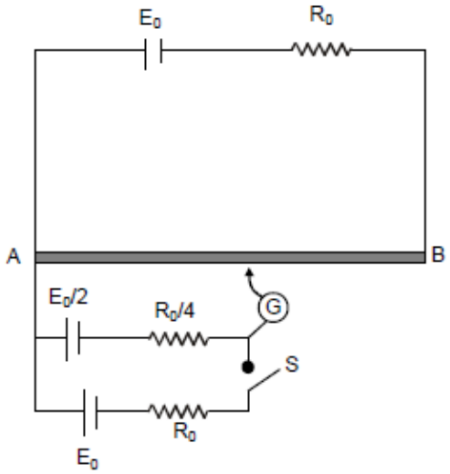
10. The resistance per unit length of potentiometer wire of uniform cross section is $\left(\frac{3R_0x}{\ell^2}\right)$, where x is measured from end A. Balanced length is also measured from end A. Select correct option(s)

(A) When S is open balance length is at $\frac{\ell}{2}$

(B) When S is open balance length is at $\ell\sqrt{\frac{5}{6}}$

(C) When S is closed balance length is at $\ell\sqrt{\frac{3}{4}}$

(D) When S is closed balance length is at $\ell\sqrt{\frac{7}{8}}$



SPACE FOR ROUGH WORK

SECTION-1 | Type C

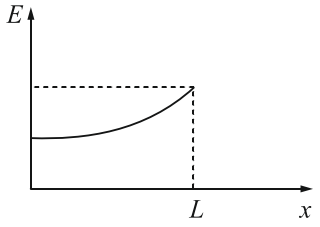
This section consists of ONE (01) paragraph. Based on each paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

PARAGRAPH FOR Q-11 & 12

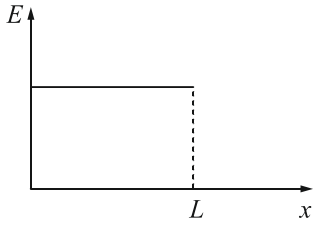
A parallel plate capacitor has square plates of side length (L). Plates are kept vertical at separation d between them. The space between the plates is filled with a dielectric whose dielectric constant changes with height (x) from lower edge of the plates as $k = e^{\beta x}$ where β is a positive constant. A constant potential difference of V is applied across the capacitor plates. If C, E, σ represent capacitance of the capacitor, Electric field between the plates and surface charge density on the plates respectively.

11. Variation of Electric field (E) with x is represented by :

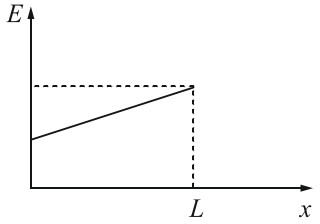
(A)



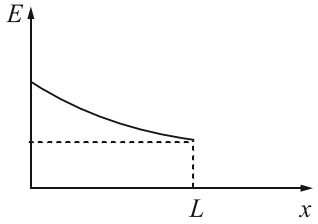
(B)



(C)

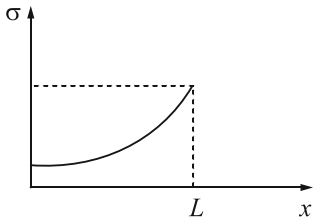


(D)

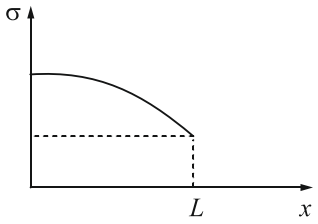


12. Variation of surface sharge dentiy (σ) with x is represented by:

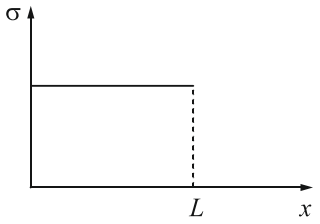
(A)



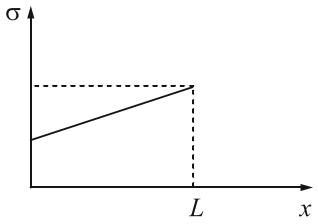
(B)



(C)



(D)

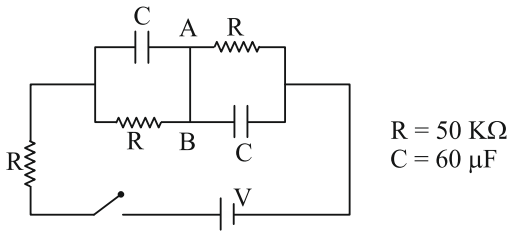


SPACE FOR ROUGH WORK

SECTION-2

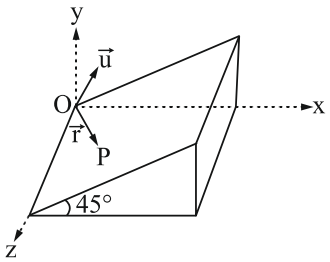
This section consists of 6 Numerical Value Type Questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

1. In the circuit shown, switch S is closed at time $t=0$. At a later time t_0 it is found that current through AB is zero. Find the value of t_0 (in seconds) [Take $\ell n(2)=0.693$]



2. Two particles A and B are separated from each other by a distance *l*. At time *t* = 0, particle A starts moving with uniform acceleration *a* along a line perpendicular to initial line joining A and B. At the same moment, particle B starts moving with tangential acceleration of constant magnitude *b* such that particle B always points towards the instantaneous position of A, (*b* > *a*). Find the distance (in *m*) travelled by B till the moment B converges with A. (take $b=3\,m/s^2, a=1\,m/s^2$ and $l=8m$)

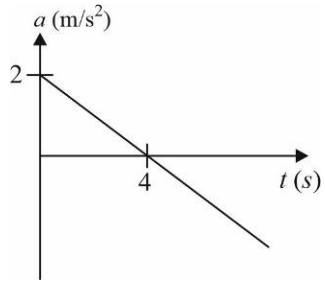
3. A ball is thrown from origin with a velocity $\vec{u}=(5\hat{i}+15\hat{j}+10\hat{k})m/s$. The ball hits an inclined plane at point P as shown. Find the time taken (in s) by the-ball to reach point P.



SPACE FOR ROUGH WORK

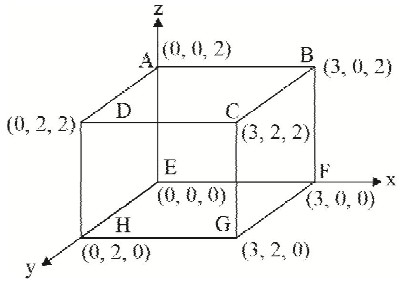
4. A block of mass 1 kg is kept at rest on a rough horizontal surface. The coefficient of friction between the block and surface is 0.5. A horizontal force of 10 N is applied on the block for 6 seconds after which the direction of force is reversed keeping the magnitude same. Find the kinetic energy (in Joules) with which the block returns to its starting point. (Take $g = 10\ \text{m/s}^2$)

5. A particle starts from rest and moves on a straight line with acceleration which varies with time as shown in the graph.



For the duration from start to the moment when its velocity becomes zero again, find the distance (in m) travelled by the particle.

6. An electric field $\vec{E} = 4x\hat{i} - (y^2 + 1)\hat{j}N/C$ passes through the box shown in figure. The flux of the electric field through surfaces ABCD and BCGF are marked as ϕ_I and ϕ_{II} respectively. The difference between $(\phi_I - \phi_{II})$ is (in Nm^2/C) _____ .



SPACE FOR ROUGH WORK

SUBJECT II : CHEMISTRY 59 MARKS

SECTION-1 | Type A

This section consists of 5 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. Select the incorrect statement:

(A) Lyophillic sols shows significant Tyndall effect

(B) Lyophobic sols shows the Brownian movement of colloidal particles

(C) Addition of sodium stearate to water decreases surface tension and increase viscosity

(D) Lyophobic sols are thermodynamically unstable

2. Two different first order reactions have rate constant k_1 and k_2 at T_1 $(k_1 > k_2)$. If the temperature is increased from T_1 to T_2 then the new constants becomes k_3 and k_4 respectively. Which among the following relations is correct?

(A) $k_1 > k_2 = k_3 = k_4$ **(B)** $k_1 = k_3 = k_4$

(C) $k_1 > k_2 > k_3 > k_4$ **(D)** $k_1 < k_3$ and $k_2 < k_4$

3. What would be pH of the solution in given galvanic cell $Hg\,|\,\underset{(s)}{Hg_2Cl_2}\,|\,HCl_{(aq.)}\,|\,QH_2\,|\,Q\,|\,Pt_{(s)}$ $(E_{cell} = 0.183 \text{ volt})$ if given that at 27°C S.R.P of calomel electrode is 0.42 volts and that of quinhydrone electrode is 0.699 volts. Assume that $[Q] = [QH_2]$ and ionisation of Hg_2Cl_2 is suppressed by HCl. (Take $2.303\frac{RT}{F} = 0.06$)

(A) 2 **(B)** 4 **(C)** 0.8 **(D)** 12

SPACE FOR ROUGH WORK

4. Using the following informations identify correct statement regarding elements X, Y, Z of 3rd period of periodic table:

Element	$\Delta_i H_1^\circ (kJ/mole)$	$\Delta_i H_2^\circ (kJ/mole)$	$\Delta_i H_3^\circ (kJ/mole)$	$\Delta_{eg} H^\circ (kJ/mole)$
X	850	2327	3562	–80
Y	2950	3677	5643	–300
Z	1109	1980	6537	+20

(A) Atomic number of x > y **(B)** Atomic number of y > z

(C) Atomic number of z > x **(D)** X is an alkali metal ; y is Flourine

5. Hydrolysis of methyl acetate in aqueous solution follows the following rate equation:

Rate = k' $[CH_3COOCH_3]$ $[H_2O]$

It was studied by titrating the liberated acetic acid against sodium hydroxide. The concentration of the ester at different times is given below.

t/min	0	30	60	90
C/mol L^{-1}	0.8500	0.8004	0.7538	0.7096

(I) Second order reaction with its rate constant $= 3.64 \times 10^{-5} mol^{-1}\ L\ min^{-1}$

(II) First order reaction with its rate constant $= 2.004 \times 10^{3}\ min^{-1}$

(III) Pseudo first order with its rate constant $(k') = 2.004 \times 10^{3}\ min^{-1}$

(IV) Pseudo first order with its rate constant $(k') = 3.64 \times 10^{-5} mol^{-1} L\ min^{-1}$

Which of the following is correct?

(A) I only **(B)** III only **(C)** I & III only **(D)** I, II & IV only

SPACE FOR ROUGH WORK

SECTION-1 | Type B

This section consists of 5 Multiple Correct Answers Type Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

6. Select the correct statements :

(A) Lyophillic sols are usually stable and do not coagulate easily

(B) For Lyophillic sols viscosity is high and surface tension is low as compared to dispersion medium

(C) Lyophobic sols are difficult to prepare than Lyophillic sols

(D) Protein in water is example of Lyophobic sol

7. Select incorrect statement/s from the following:

(A) Energy of 3d orbitals is lower than 4s orbitals in case of $Cr(Z=24)$

(B) Nuclear charge experienced by 2s electron by Li^{2+} ion is higher than that experienced by its electron in a 3p orbital

(C) Most probable location to 1s electron in any single electron atomic species is $\frac{a}{Z}$, here a is Bohr's radii

(D) First line of Balmer series of Be^{3+} ion belongs to visible region (i.e. wavelength falls in the range 380 nm to 760 nm)

8. Select Correct order/s:

(A) Electron gain enthalpy with negative sign : $N_{(g)} > Ne_{(g)}$

(B) Ionisation enthalpy : $O^{+}_{(g)} > F^{+}_{(g)}$

(C) Atomic radii : $Ga > Al$

(D) Stability of +4 state : $Sn > Pb$

SPACE FOR ROUGH WORK

9. A solution containing $Fe(NO_2)_2$ and $AgNO_3$, having initial conc. of 1 M each is allowed to attain equilibrium at 25°C. Which of the following are correct options?

Given that $\left[\begin{array}{l} Fe^{2+}_{(aq)} + Ag^{+} \rightleftharpoons Fe^{3+}_{(aq)} + Ag_{(s)} \text{ is a possible redox reaction and} \\ E^{\circ}_{Fe^{3+}|Fe^{2+}} = 0.770\ V,\ E^{\circ}_{Ag^{+}|Ag} = 0.7996\ V,\ 2.303\frac{RT}{F} = 0.0591, \log_{10} 3.15 = 0.5 \end{array}\right]$

(A) $\left[Fe^{3+}\right]_{equilibrium} = 0.574\ M,\quad \left[Ag^{+}\right] = 0.426\ M$

(B) $\left[Fe^{3+}\right]_{equilibrium} = 0.426\ M,\quad \left[Fe^{2+}\right]_{equilibrium} = 0.574\ M$

(C) $K_{eq} = 3.16\ M^{-1}$

(D) $K_{eq} = 0.316\ M^{-1}$

10. One mole of Ti_xO was treated with y moles of $KMnO_4$ in acidic medium to form a nearly colourless solution of Mn^{2+}_{aq} and $\left[Ti(H_2O)_6\right]^{4+}$. Select correct statement/s:

(A) Value of y is 0.400 for x = 1
(B) Value of y is 0.383 for x = 0.96
(C) Value of y is 0.532 for x = 0.98
(D) Value of y is independent of value of x

SPACE FOR ROUGH WORK

SECTION-1 | Type C

This section consists of ONE (01) paragraph. Based on each paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

PARAGRAPH FOR Q-11 & 12

For given electrochemical reaction $\frac{1}{2}H_{2(g)} + Ag^{+} \longrightarrow Ag + H^{+}$, variation of emf of cell with temperature is given as $E = 0.4 - 2\times10^{-4}\left(V/K\right)T$. The temperature coefficient of the emf of the cell $= \left(\frac{\partial E}{\partial T}\right)_P$ and $\Delta S = nF\left[\frac{\partial E}{\partial T}\right]_P$ on the basis of above data, answer the following questions :

11. emf of the cell at 27° C will be :

(A) 0.2 V **(B)** 0.3 V **(C)** 0.34 V **(D)** 0.9 V

12. Calculate the value of ΔS for the reaction:

$\frac{1}{2}H_2 + Ag^{\oplus} \longrightarrow Ag + H^{+}$, at 27°C

(A) $19.3\ JK^{-1}\ mol^{-1}$ **(B)** $-9.65\ JK^{-1}mol^{-1}$

(C) $-19.3\ JK^{-1}mol^{-1}$ **(D)** $48.5\ JK^{-1}mol^{-1}$

SPACE FOR ROUGH WORK

SECTION-2

This section consists of 6 Numerical Value Type Questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

1. For the cell $Cu(s)\,|\,Cu^{2+}(aq)\,(0.1M)\,||\,Ag^{+}(aq)\,(0.01M)\,|\,Ag(s)$

The cell potential $E_1 = 0.3095\,V$

For the cell $Cu(s)\,|\,Cu^{2+}(aq)\,(0.01M)\,||\,Ag^{+}(aq)\,(0.001)\,|\,Ag(s)$

the cell potential = _____ $\times 10^{-2}$V. (Round off to the Nearest Integer). $\left[\text{Use : } \frac{2.303RT}{F} = 0.059\right]$

2. How many of the following statements is/are correct?

(1) The adsorption of gases on the surface of metal is called occlusion

(2) Physical adsorption is usually multilayered, non-directional and non-specific

(3) Chemical adsorption is unilayer and specific

(4) Easily liquefiable gases (e.g. NH_3, HCl) are adsorbed to greater extent than non-easily liquefiable gases (e.g. H_2, N_2)

(5) The formation of micelles takes place above a particular temperature called Kraft temperature (T_k)

(6) As_2S_3 is positively charged colloid

3. 2.46 L of a gaseous Xenon Fluoride weighs 24.6 g at 300 K and 1 atm pressure. If atomic mass of Xe is 132 and that of F is 19 then find number of F atoms in a molecule of the Xenon Fluoride.

SPACE FOR ROUGH WORK

4. Radial wave function of a 3p orbital (i.e., R_{3p}) of certain single electron atomic species is given as follows:

$$R_{3p} = \frac{1}{81\sqrt{3}}\left[\frac{2Z}{a_0}\right]^{3/2}(6-\sigma)\sigma e^{-\sigma/3} \quad (\text{Here} \quad \sigma = Zr/a_0)$$

If its radial node is at distance r from the nuclei then value of $\frac{r}{a_0}$ for He^+ ion is _____.

5. For a certain reaction the variation of rate constant with temperature is given by the equation :

$$\ell n k_t = \ell n K_o + \left(\frac{\ell n 7}{283}\right)T \; ; \; (T \geq 0°C)$$

The value of the temperature coefficient at 10°C will be _____.

6. For a hydrogen electrode $\underset{(pH=x)}{H_2SO_4} \,|\, \underset{(1\,atm)}{H_{2(g)}} \,|\, Pt_{(s)}$ value of reduction potential is – 0.3 volt.

Find value of x. (Take $\frac{2.303}{F}RT = 0.06$)

SPACE FOR ROUGH WORK

SUBJECT - III : MATHEMATICS 59 MARKS

SECTION-1 | Type A

This section consists of 5 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. Let $y = \ln(1+\cos x)^2$ then the value of $\frac{d^2y}{dx^2} + \frac{2}{e^{y/2}}$ equals:

(A) 0 **(B)** $\frac{2}{1+\cos x}$ **(C)** $\frac{4}{(1+\cos x)}$ **(D)** $\frac{-4}{(1+\cos x)^2}$

2. A straight line L through the point (3, –2) is inclined at an angle 60º to the line $\sqrt{3}x + y = 1$. If L also intersects the x-axis, then the equation of L is:

(A) $y + \sqrt{3}x + 2 - 3\sqrt{3} = 0$ **(B)** $y - \sqrt{3}x + 2 + 3\sqrt{3} = 0$

(C) $\sqrt{3}y - x + 3 + 2\sqrt{3} = 0$ **(D)** $\sqrt{3}y - x + 3 - 2\sqrt{3} = 0$

3. Which of the following is not correct?

(A) $f : R - \{0\} \to R,\ f(x) = x + \frac{1}{x}$ is many-one and into.

(B) $f : R \to R,\ f(x) = x^3 + x^2 + 3x + \sin x$ is one-one and onto.

(C) $f : R \to R,\ f(x) = \left[x + \frac{1}{2}\right] + \left[x - \frac{1}{2}\right] + 2[-x]$, where $[\cdot]$ denotes GIF, is a periodic function with time period 1.

(D) $f : R \to R,\ f(x) = e^{\sin\{x\}} + \sin\left(\frac{\pi}{2}[x]\right)$, where $\{\cdot\}$ denotes FPF and $[\cdot]$ denotes GIF, has the fundamental time period 2

4. The value of $\tan\left(\sum_{r=1}^{\infty} \tan^{-1}\left(\frac{4}{4r^2+3}\right)\right)$ is:

(A) 2 **(B)** 1 **(C)** 3 **(D)** 4

5. Sum of the values of x for which $\{x+5\}$, $[x]$, $x-1$ are in AP (where $\{\cdot\}$ denotes FPF and $[\cdot]$ denotes GIF) is:

(A) $\frac{1}{2}$ **(B)** $-\frac{1}{2}$ **(C)** 1 **(D)** – 1

SPACE FOR ROUGH WORK

SECTION-1 | Type B

This section consists of 5 Multiple Correct Answers Type Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

6. Which of the following is/are true?

(A) $f: R_0 \to R,\ f(x) = \dfrac{x}{e^{x-1}} + \dfrac{x}{2} + 1$ is even function

(B) $f: R \to R,\ f(x) = \begin{cases} 0, & x \in Q \\ 1, & x \notin Q \end{cases}$ is periodic function with no fundamental time period.

(C) $f: R \to R,\ f(0) \neq 0,$ then $f(x)$ must not be an odd function.

(D) The number of integral values of x satisfying the equation $\operatorname{sgn}\left(\left[\dfrac{15}{1+x^2}\right]\right) = [1 + \{2x\}]$ is 7

(where $\{\cdot\} = \text{FPF}, [\cdot] = \text{GIF}$)

7. Which of the following function(s) is/are discontinuous at $x = 0$?

(A) $f(x) = \sin\dfrac{\pi}{2x},\ x \neq 0$ and $f(0) = 1$

(B) $g(x) = x\sin\left(\dfrac{\pi}{x}\right),\ x \neq 0$ and $g(0) = \pi$

(C) $h(x) = \dfrac{|x|}{x},\ x \neq 0$ and $h(0) = 1$

(D) $k(x) = \dfrac{1}{1+e^{\cot x}},\ x \neq 0$ and $k(0) = 0$

SPACE FOR ROUGH WORK

8. Given $f(x)=\cos^{-1}x+\cos^{-1}\left(\frac{x}{2}+\frac{\sqrt{3-3x^2}}{2}\right)$ then:

(A) Range of $f(x)=\left[\frac{\pi}{3},\frac{5\pi}{3}\right]$ **(B)** $f(x)$ is a constant function for $x\in\left[\frac{1}{2},1\right]$

(C) $f(x)$ is one-one $\forall\ x\in\left[-1,\frac{1}{2}\right]$ **(D)** $f(x)$ is many one $\forall\ x\in\left[\frac{1}{2},1\right]$

9. If $f:R\to\left[\frac{-\pi}{4},\frac{\pi}{2}\right)$, $f(x)=\tan^{-1}\left(x^4-x^2-\frac{7}{4}+\tan^{-1}\alpha\right)$ is a surjective function then

(A) $\cos^{-1}\left(\frac{1-\alpha^2}{1+\alpha^2}\right)=2$ **(B)** $\alpha+\frac{1}{\alpha}=2\cos ec\ 2$

(C) $\sin^{-1}\left(\frac{2\alpha}{1+\alpha^2}\right)=\pi-2$ **(D)** $\tan^{-1}\left(\frac{2\alpha}{\alpha^2-1}\right)=2-\pi$

10. Let $x,\ y$ be real variable satisfying the $x^2+y^2+8x-10y-40=0$. Let $a=\max\{(x+2)^2+(y-3)^2\}$ and $b=\min\{(x+2)^2+(y-3)^2\}$, then:

(A) $a+b=18$ **(B)** $a+b=\sqrt{2}$ **(C)** $a\cdot b=49$ **(D)** $a\cdot b=73$

SPACE FOR ROUGH WORK

SECTION-1 | Type C

This section consists of ONE (01) paragraph. Based on each paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

PARAGRAPH FOR Q-11 & 12

If $\sin^{-1}x:[-1,1]\to\left[\frac{\pi}{2},\frac{3\pi}{2}\right]$ and $\cos^{-1}x:[-1,1]\to[\pi,2\pi]$ are defined. Then:

11. $\sin^{-1}(-x)=$

(A) $-\sin^{-1}x$ **(B)** $\pi-\sin^{-1}x$ **(C)** $2\pi-\sin^{-1}x$ **(D)** $\pi+\sin^{-1}x$

12. $\cos^{-1}(\cos 10)-\sin^{-1}(\sin 10)=$

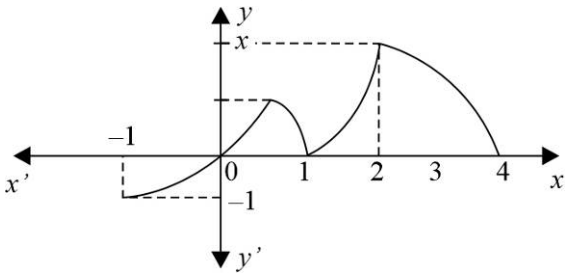
(A) $20-2\pi$ **(B)** $4\pi-20$ **(C)** 0 **(D)** 2π

SPACE FOR ROUGH WORK

SECTION-2

This section consists of 6 Numerical Value Type Questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

1. Graph of a function $y = f(x)$ is:



Then Domain and range of $f\left(-|x|\right)$ are $[a, b]$ and $[c, d]$ then find value of $b + d - a - c$.

2. The circles $x^2 + y^2 - 8x + 2y + 8 = 0$ and $x^2 + y^2 - 2x - 6y + 10 - a^2 = 0$ have exactly two common tangents then the least positive integral value of a is _____.

3. If $f : [-3, 2] \to R$ is a function $f(x)$, then domain of $f\left(\left|[x]\right|\right)$ is $[a, b)$, then find the value of $\left|\frac{b}{a}\right| - 1$

$(\text{Here } [\cdot] = \text{GIF})$

4. Triangle ABC with AB = 13, BC = 5 and AC = 12 slides on the coordinate axes with A and B on the positive x-axis and positive y-axis respectively. The locus of vertex C is a line $12x - ky = 0$. Then the value of k is _____.

5. The value of $\lim\limits_{x \to 0} \frac{e^{\tan x} - e^x}{\tan x - x}$ is $\tan k^\circ$. Sum of the digits of k is _____. (k is least positive)

6. If $x = \sin^{-1}(a^6 + 1) + \cos^{-1}(a^4 - 1) - \tan^{-1}(a^2 + 1), a \in R$ then $\cos^{-1}(\cos x) = \frac{m\pi}{n}$, where $m, n \in N$ then find minimum value of $(m + n)$.

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

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