JEE PREPARATORY TEST-2 (JPT-2)
(JEE ADVANCED PATTERN)

Target : JEE (Main+Advanced) 2017

Date: 14-05-2017 | Duration : 3 Hours | Max. Marks: 240

COURSE : VIJETA (ADP), VIJAY (ADR), VIVEK (JCC)

DO NOT BREAK THE SEAL WITHOUT BEING INSTRUCTED TO DO SO BY THE INVIGILATOR

PART - I : PHYSICS

SECTION – 1 : (Maximum Marks : 80)

Ñ   This section contains **TWENTY** questions

Ñ   Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct

Ñ   For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS

Ñ   For each question, marks will be awarded in <u>one of the following categories</u> :

Full Marks	:	+4 If only the bubble(s) corresponding to all the correct option(s) is(are) darkened.
Partial Marks	:	+1 For darkening a bubble corresponding to **each correct option,** provided NO incorrect option is darkened.
Zero Marks	:	0 If none of the bubbles is darkened.
Negative Marks	:	–2 In all other cases.

Ñ   For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will result in +4 marks ; darkening only (A) and (D) will result in +2 marks and darkening (A) and (B) will result in –2 marks, as a wrong option is also darkened.

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1. Consider a perfectly conducting uniform disc of mass m and radius 'a' hinged in vertical plane from its centre and free to rotate with respect to hinge. A resistance R is connected between centre of the disc and periphery by using two sliding contacts C_1 & C_2. A long non conducting massless string is wrapped around the disc, whose another end is attached with a block of mass m. There exist a uniform horizontal magnetic field B. Whole arrangement is shown in the figure.
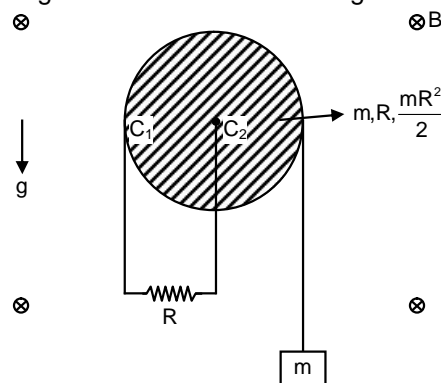

Given system is released from rest at t = 0. Assume friction between string and disc is sufficient so that there is no slipping between them. Let at any time t, velocity of block is v, angular velocity of disc is ω and current in resistance is i.

(A) From the energy equation $mgv = mv\dfrac{dv}{dt} + I\dfrac{\omega d\omega}{dt} + i^2R$

(B) The work done by the magnetic field is zero but it converts some part of the mechanical energy into heat.

(C) The velocity v, of the block as a function of time is $v = \dfrac{\alpha}{\beta}(1 - e^{-\beta t})$

(D) The acceleration of the block is $\dfrac{g}{3}e^{-\beta t}$

Space for Rough Work

2. A uniform wire of mass m has natural length ℓ_0, at temperature T_0. Wire is fixed at both the ends between two rigid supports which have separation equal to ℓ_0. Ambience temperature is T_0.
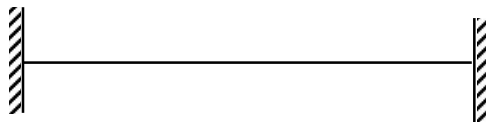
Now the temperature of ambience is slowly decreased and wire is vibrated with a tuning fork of constant frequency f_0. It is observed that at temperature T_1, T_2 and T_3 wire is in resonance with tuning fork in fundamental mode, 1st overtone and 2nd overtone respectively. Choose the correct relation(s).

(A) $T_1 > T_2$ (B) $T_2 < T_3$ (C) $4T_2 - T_1 = 3T_0$ (D) $9T_3 - 4T_2 = 5T_0$

3. A particle moving with constant acceleration on a straight line covers 20 m in 7th sec and 24 m in 9th sec. Choose the correct options regarding motion of particle.

(A) Acceleration of the particle is 2 m/s^2

(B) Acceleration of the particle is 4 m/s^2

(C) Distance travelled by particle in 10th sec is 26 m.

(D) Distance travelled by particle in 10th sec is 30 m.

4. Consider the given 3-block system.

$\mu_3 = 0.3$ (3)   (C)5kg

$\mu_3 = 0.2$ (2)   (B) 5kg

$\mu_3 = 0.1$(1)   (A)   5kg
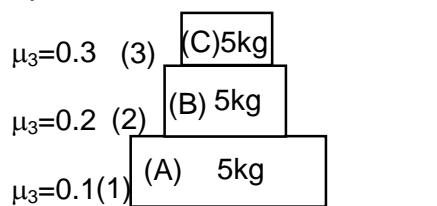
Friction coefficient (static as well as kinetic) between surfaces are μ_1, μ_2, μ_3, as shown. A horizontal force F of constant magnitude is to be applied on any of the block. Choose the correct options regarding motion of blocks .

(A) If force F is applied on block A, maximum possible value of F for which there will be no slipping between any blocks is 30 N.

(B) If force F is applied on block A, maximum value of friction force acting between B and C will be 10N.

(C) If force F is applied on block C, maximum value of F for which there will be no slipping between any blocks is 15 N.

(D) If force F is applied on block C, maximum value of friction force acting between A and B will be 20 N.


Space for Rough Work

5. Imagine a light planet revolving around a very massive star in circular orbit of radius R in some other solar system, where gravitational force varies with r^{-3} (r is separation b/w the two particle) choose the correct curve(s) regarding motion of the planet. (V → speed of the planet, T → time period of planet)

(A) $\alpha \dfrac{1}{R}$ (V vs R)

(B) αR^2 (V vs R)

(C) $\alpha \dfrac{1}{R}$ (T vs R)

(D) αR^2 (T vs R)
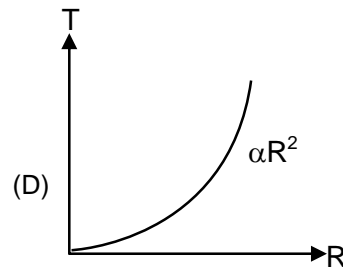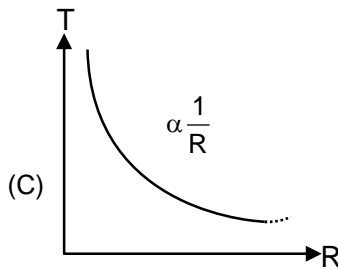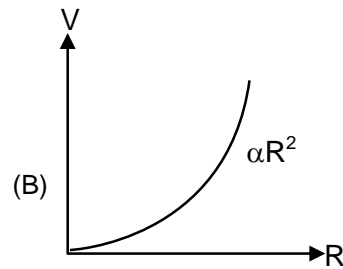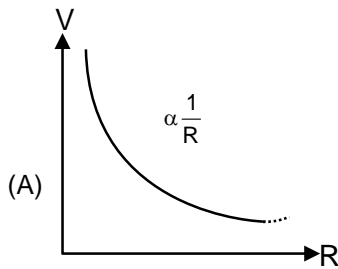
6. Which of the following statement(s) is/are correct.

(A) If work done by a force on a particle from initial position A to final position B via every path between the two points is found to be same, force is necessarily conservative.

(B) If work done by a force on a particle from initial position A to final position B via two different paths is found to be same, force is necessarily conservative.

(C) A conductor of irregular shape is kept in free space (i.e. there is no other source of electric field), then charge must be distributed uniformly on the surface of conductor.

(D) The motion of a copper plate is damped when it is allowed to oscillate between the magnetic pole pieces.

Space for Rough Work

7. Consider the given arrangement of resistance and on ideal battery on shown.
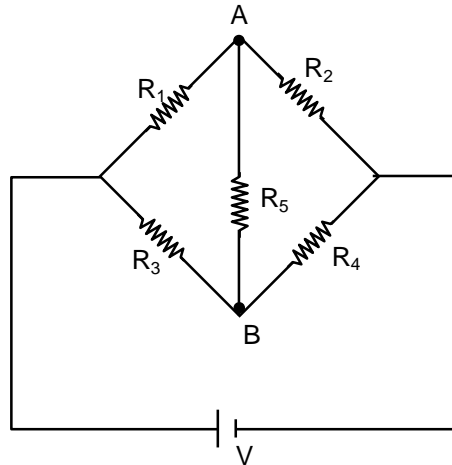
Choose the correct option(s) regarding current through resistance R_5 :

(A) If $\dfrac{R_1}{R_2} > \dfrac{R_3}{R_4}$, current in R_5 will be from A to B

(B) If $\dfrac{R_1}{R_2} > \dfrac{R_3}{R_4}$, current in R_5 will be from B to A

(C) If $\dfrac{R_1}{R_2} < \dfrac{R_3}{R_4}$, current in R_5 will be from A to B

(D) If $\dfrac{R_1}{R_2} < \dfrac{R_3}{R_4}$, current in R_5 will be from B to A

Space for Rough Work

8. The equation of a one dimensional transverse wave is given by

$\psi = \left(10^{-3}\right)\sin\pi\left(10t - 3x - 2y + z\right)$

where x, y and Ψ are expressed in meter and t in second. Choose the correct option(s)

(A) unit vector along the wave propagation is $\dfrac{3\hat{i} + 2\hat{j} - \hat{k}}{\sqrt{14}}$

(B) unit vector along the wave propagation is $\dfrac{-3\hat{i} - 2\hat{j} + \hat{k}}{\sqrt{14}}$

(C) wavelength of the wave is $\sqrt{\dfrac{2}{7}}$m

(D) wavelength of the wave is $\sqrt{\dfrac{3}{7}}$m

9. A converging lens of focal length 200 cm is placed parallel to x-y plane such that principal axis is along z-axis. The optical centre of the lens is at P (0, 0, 150 cm). Consider two points A (1 cm, 2 cm, 0) and B (2 cm, 2 cm, 0). The image of O, A and B is formed at O' A' and B'.

f = 200 cm
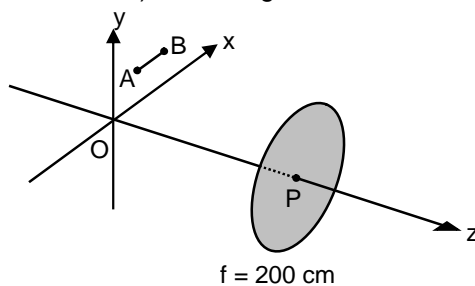
(A) Coordinates of A' = (4 cm, 8 cm, 0)   (B) Coordinates of B' = (8 cm, 8 cm, –450 cm)

(C) $\dfrac{\text{Area of }\Delta\text{O' A' B'}}{\text{Area of }\Delta\text{OAB}} = 16$ (D) The length A' B' = 4 cm


Space for Rough Work

10. In the arrangement shown in the figure, initially the block of mass m_1 is in limiting equilibrium. The coefficient of friction between the block of mass m_1 and floor is μ. Now the particle of mass m_2 is given a horizontal velocity v_0. The initial distance of the block of mass m_2 from the pulley is ℓ. The masses of pulley and threads are negligible. Choose the correct option(s):
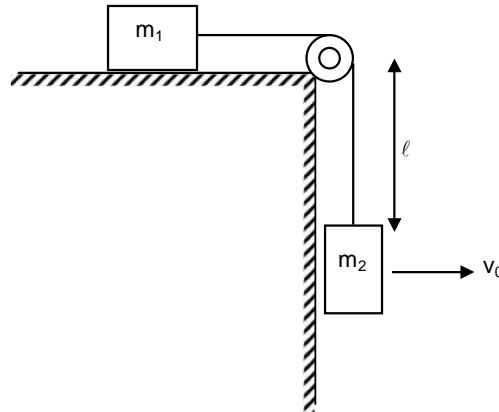

(A) Acceleration of m_1 just after the velocity given is $\left(\dfrac{\mu}{1+\mu}\right)\dfrac{v_0^2}{\ell}$

(B) Acceleration of m_1 just after the velocity given is $\left(\dfrac{\mu}{1+\mu}\right)\dfrac{v_0^2}{2\ell}$

(C) Radius of curvature of path of m_2 just after the velocity given is $\ell(1+\mu)$

(D) Radius of curvature of path of m_2 just after the velocity given is $2\ell(1+\mu)$

11. With a rise of temperature, which of the following is/are correct:
   (A) Surface tension of water decreases   (B) Viscosity of water decreases
   (C) Viscosity of air decreases   (D) Viscosity of air increases

Space for Rough Work

12. Length of arms are sufficient. Now tube is rotated with an angular velocity ω with respect to ARM-2 such that ARM-2 just becomes empty. Area of cross section of ARM-1 is A, ARM-2 is 2A and ARM-3 is 3A. Choose the correct option(s). ($\sqrt{A} <<< \ell$)
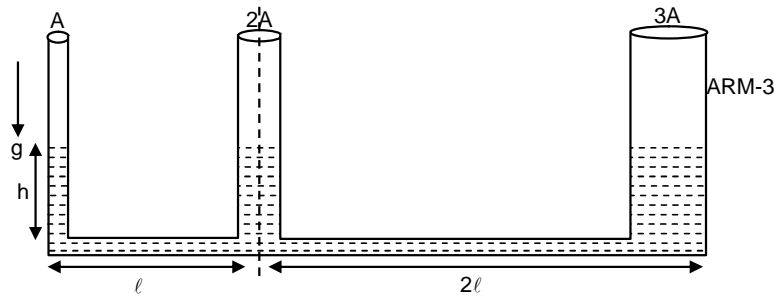
(A) Liquid Level in ARM-1 will fall.

(B) Liquid Level in ARM-3 will rise

(C) Difference of liquid level in ARM-3 and ARM-1 is $\dfrac{18h}{13}$

(D) Difference of liquid level in ARM-3 and ARM-1 is $\dfrac{5h}{13}$

13. Consider a uniformly charged sheet ABCD, which is a part of an equilateral triangular sheet of side a as shown in figure.
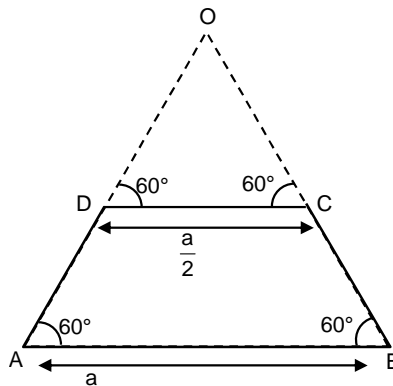
Choose the correct option(s) regarding the intensity of electric field $\vec{E}$ at point O due to this sheet.

(A) Magnitude of $\vec{E}$, increases with the increase in a (keeping charge density same)

(B) Magnitude of $\vec{E}$, decreases with the increase in a (keeping total charge same)

(C) If charge density is σ and a = 1m, magnitude of E is equal to $\dfrac{7\sigma}{44\varepsilon_0} \ell n \sqrt{2}$.

(D) If charge density is σ and a = 2m magnitude of E is equal to $\dfrac{7\sigma}{22\varepsilon_0} \ell n \sqrt{2}$.

Space for Rough Work

14. At t = 0, a sample of radionuclide A has the same decay rate as a sample of radionuclide B has at t = 60 min. The disintegration constants of A and B are λ_A and λ_B respectively, with $\lambda_A < \lambda_B$. Choose the correct option(s) :

(A) The half life of radionuclide A is greater than that of B.

(B) At t = 60 min, number of atoms in sample of material A is greater than that of sample B.

(C) The two samples will never have the same decay rate simultaneously.

(D) After certain time, the two samples will have the same decay rate simultaneously for an instant.

15. The emissive power of a black body at T = 300 K is 100 Watt/m². Consider a body B of area A = 10 m² coefficient of reflectivity r = 0.3 and coefficient of transmission t = 0.5. Its temperature is 300 K. Then which of the following is/are correct :

(A) The emissive power of B is 20 W/m²

(B) The emissive power of B is 200 W/m²

(C) The power emitted by B is 200 Watts

(D) The emissivity of B is = 0.2

16. An ideal monatomic gas expands in such a way that $TV^{1/2}$ = constant, where T and V are the temperature & volume of the gas. Choose the correct option(s) :

(A) The molar heat capacity is $C = C_V - 2R$.

(B) The internal energy of gas decreases.

(C) Temperature of gas decreases.

(D) Pressure of gas increases.

Space for Rough Work

17. A car moves towards a hill with speed v_c. It blows a horn of frequency f which is heard by an observer following the car with speed v_0. The speed of sound in air is v.

(A) the wavelength of sound reaching the hill is $\dfrac{v}{f}$

(B) the wavelength of sound reaching the hill is $\dfrac{v - v_c}{f}$

(C) The wavelength of sound of horn directly reaching the observer is $\dfrac{v + v_c}{f}$

(D) the beat frequency observed by the observer is $\dfrac{2v_c(v + v_o)f}{v^2 - v_c^2}$

18. The graph between $1/\lambda$, where λ is wavelength of incident light and stopping potential (*V*) of three metals having threshold wavelengths λ_{th_1}, λ_{th_2} and λ_{th_3} in an experiment of photo-electric effect is plotted as shown in the figure. Which of the following statements is/are correct?
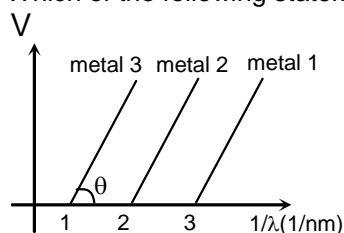
(A) Ratio of work functions $\phi_1 : \phi_2 : \phi_3 = 3 : 2 : 1$

(B) Ratio of work functions $\phi_1 : \phi_2 : \phi_3 = 2 : 3 : 6$

(C) $\tan \theta$ is directly proportional to $\dfrac{hc}{e}$, where *h* is Planck's constant and *c* is the speed of light

(D) $\tan \theta$ is inversely proportional to $\dfrac{hc}{e}$, where *h* is Planck's constant and *c* is the speed of light
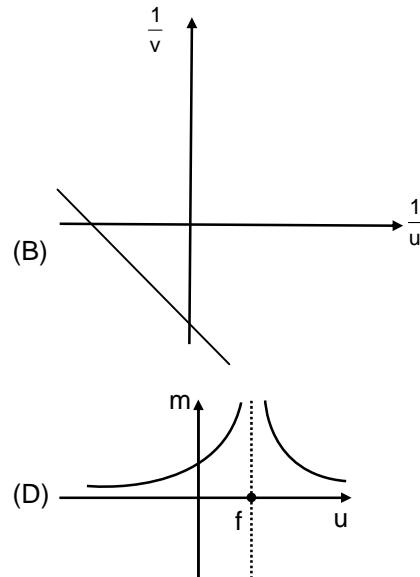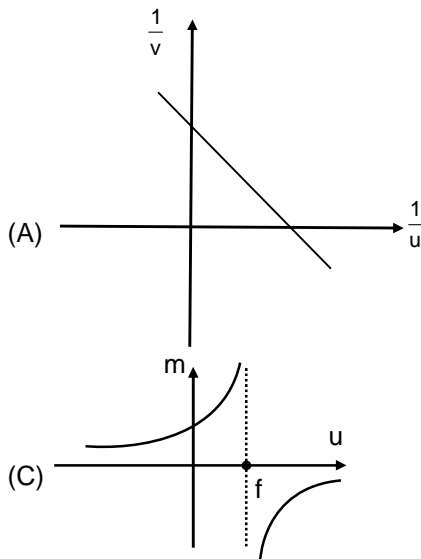
Space for Rough Work

19. The electron in hydrogen atom makes a transition $n_1 \rightarrow n_2$ where n_1 and n_2 are the principal quantum number of two states. Assuming the Bohr model to be valid, the time period of the electron in the initial state is eight times that in the final state. The possible value of n_1 and n_2 are:

(A) $n_1 = 2$ and $n_2 = 1$ 　　　　　　　(B) $n_1 = 8$ and $n_2 = 2$

(C) $n_1 = 8$ and $n_2 = 1$ 　　　　　　　(D) $n_1 = 6$ and $n_2 = 3$

20. Select correct curve for convex mirror :
u = position of object
v = position of image
m = transverse magnification

Space for Rough Work

PART - II : CHEMISTRY

Atomic masses : [H = 1, D = 2, Li = 7, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24, Al = 27, Si = 28, P = 31, S = 32, Cl = 35.5, K = 39, Ca = 40, Cr = 52, Mn = 55, Fe = 56, Cu = 63.5, Zn = 65, As = 75, Br = 80, Ag = 108, I = 127, Ba = 137, Hg = 200, Pb = 207]

SECTION – 1 : (Maximum Marks : 80)

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Ñ   For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will result in +4 marks ; darkening only (A) and (D) will result in +2 marks and darkening (A) and (B) will result in –2 marks, as a wrong option is also darkened.

Space for Rough Work

21. If $\left(\dfrac{\partial Z}{\partial P}\right)_T = \dfrac{1}{RT}\left(b - \dfrac{a}{RT}\right) + \dfrac{2a}{(RT)^3}\left(2b - \dfrac{a}{RT}\right)P + ...$ then which one is/are correct at low pressure ?

(A) If $b > \dfrac{a}{RT}$, the size effect dominate the behavior of gases

(B) If $b < \dfrac{a}{RT}$, the attractive forces dominates the behavior of gases

(C) If $b = \dfrac{a}{RT}$, slope of Z vs P curve will be zero

(D) None of these

22. Which of following represents equilibrium condition?

(A) 10 g ice and 5 g H_2O (ℓ) at 0°C & 1 atm

(B) 5 g ice and 5 g H_2O (ℓ) at 0°C & 1 atm

(C) 10 g H_2O (ℓ) and 5 g H_2O (v) at 100°C & 1 atm

(D) 5 g H_2O (ℓ) and 5 g H_2O (v) at 100°C & 1 atm

23. Salt AB undergoes anionic hydrolysis and its 0.1 M solution has pOH 5 then identify correct statement(s) :

(A) K_h is equal to K_b of B^-

(B) pK_a of HB is 5

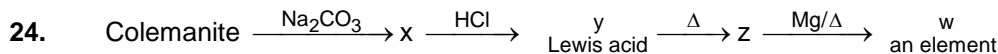(C) h is 0.01%

(D) pH of 0.1 M HB is 3

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24. Colemanite $\xrightarrow{Na_2CO_3}$ x $\xrightarrow{HCl}$ y (Lewis acid) $\xrightarrow{\Delta}$ z $\xrightarrow{Mg/\Delta}$ w (an element)

Identify incorrect statement.

(A) Oxidation number of boron in colemanite is +3

(B) z when heated with Co gives blue colour in oxidizing flame and red in reducing flame.

(C) Almost all compounds of w are ionic.

(D) Decahydrated x has 4 O–H bonds.

25. Which is/are correct about SO_2Cl_2 ?

(A) $O\hat{S}O > O\hat{S}Cl > Cl\hat{S}Cl$ bond angle

(B) Number of $p\pi-p\pi$ bonds < Number of $p\pi-d\pi$ bonds

(C) 1 mol of this reacts with 0.1 mol P_4

(D) Its aqueous solution does not give pink colour with phenolphthalein

26. Alternate tetrahedral void in FCC are not occupied in following :

(A) NaCl   (B) ZnS   (C) CaF_2 (D) Na_2O

27. Which of the following is/are correct ?

(A) A colloidal solution is a heterogeneous two phase system.

(B) Silver sol in water is an example of Lyophilic sol.

(C) Metal hydroxide sol in water are example of Lyophobic sol.

(D) Liquid-Liquid colloidal solution is generally not a very stable system.

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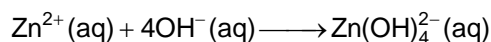
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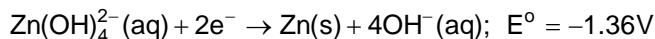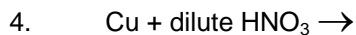**Website :** www.resonance.ac.in | E-mail : contact@resonance.ac.in
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28. For the cell reaction :

$$Zn^{2+}(aq) + 4OH^-(aq) \longrightarrow Zn(OH)_4^{2-}(aq)$$

Given : $Zn^{2+}(aq) + 2e^- \rightarrow Zn(s); E^o = -0.76V$

$Zn(OH)_4^{2-}(aq) + 2e^- \rightarrow Zn(s) + 4OH^-(aq); \ E^o = -1.36V$

$2.303\dfrac{RT}{F} = 0.06 \ V$

(A) the value of equilibrium constant (K_f) is 10^{10}

(B) the value of equilibrium constant (K_f) is 10^{20}

(C) E^o_{cell} is 0.6 V

(D) E^o_{cell} is 2.12 V

29. Select the correct option(s) :

(A) The spin only magnetic moment of cobalt in $Hg[Co(SCN)_4]$ is $\sqrt{15}$ BM

(B) The spin only magnetic moment of cobalt in $Hg[Co(SCN)_4]$ is $\sqrt{24}$ BM

(C) $Ni(CO)_4$ and $[Co(CO)_4]^-$ –both are tetrahedral and diamagnetic

(D) $[Co(H_2O)_6]^{3+}$ and $[Cr(H_2O)_6]^{3+}$ – both are paramagnetic and metal is d^2sp^3 hybridised.

30. Following metal cation gives amphoteric oxide :

(A) Al^{3+}　　　　　　(B) Cr^{3+}　　　　　　(C) Fe^{3+}　　　　　　(D) Zn^{2+}

Space for Rough Work

31. Consider the given reactions and select correct option(s).

     1. Zn + conc. $HNO_3 \rightarrow$

     2. Zn + dilute $HNO_3 \rightarrow$

     3. Cu + conc. $HNO_3 \rightarrow$

     4. Cu + dilute $HNO_3 \rightarrow$
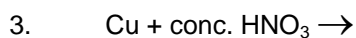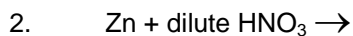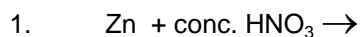
(A) n-factor of HNO_3 in 1st reaction is 1   (B) n-factor of HNO_3 in 2nd reaction is 4

(C) n-factor of HNO_3 in 3rd reaction is 3   (D) n-factor of HNO_3 in 4th reaction is 2

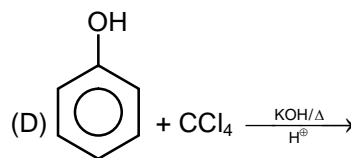**32.** Sulphur atoms in hypo exhibit following individual oxidation number(s) :

(A) –2   (B) +6   (C) +2   (D) +5

33. In which of the following reactions benzaldehyde will form in final product.

(A) $\underset{\text{CN}}{C_6H_5} \xrightarrow[H_3O^{\oplus}]{SnCl_2 + HCl}$

(B) $\underset{\text{CH}_3}{C_6H_5} \xrightarrow[H_3O^{\oplus}]{CrO_2Cl_2 / CS_2}$

(C) $C_6H_6 \xrightarrow[\text{Anhyd. AlCl}_3 / CuCl]{CO + HCl}$

(D) $\underset{\text{OH}}{C_6H_5} + CCl_4 \xrightarrow[H^{\oplus}]{KOH/\Delta}$
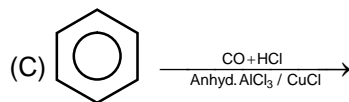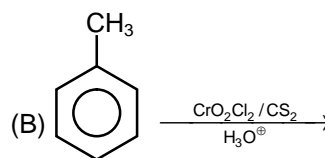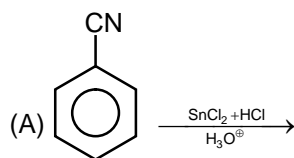
Space for Rough Work

34. Observe the following reaction
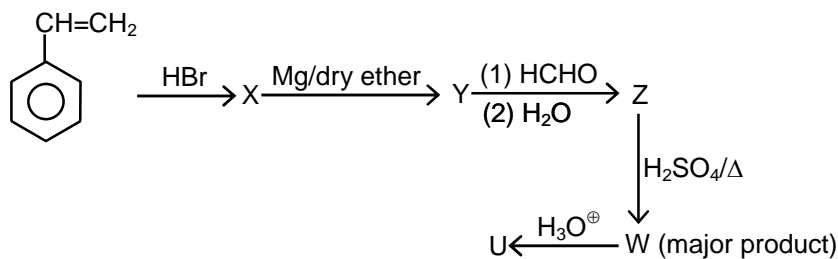
Choose the correct options/s

(A) Product U gives positive test with Lucas reagent

(B) Number of Hyperconjugable hydrogen is three in product W

(C) Product Z is 3º alcohol

(D) Product X show geometrical isomerism

35. Observe the following reaction
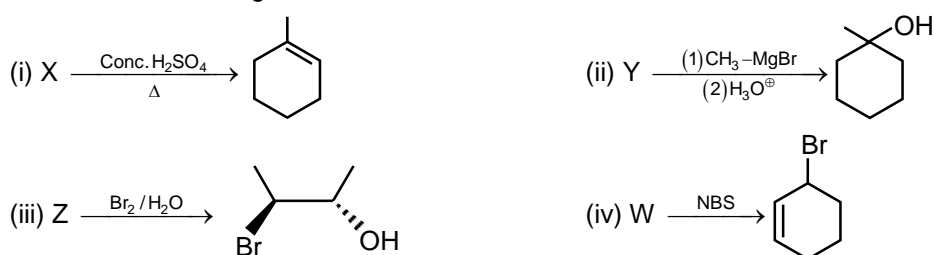
Choose the correct option/s

(A) In reaction (i), product formed by elimination reaction

(B) Y is cyclohexanone

(C) In reaction (iii), product formed by electrophilic addition reaction.

(D) W is cyclohexene

Space for Rough Work

36. Observe the following reaction and choose the correct options :

$$CH_3CHO + HCHO \xrightarrow{\text{conc. aq. NaOH}} \text{(polyol structure)} + HCOONa$$
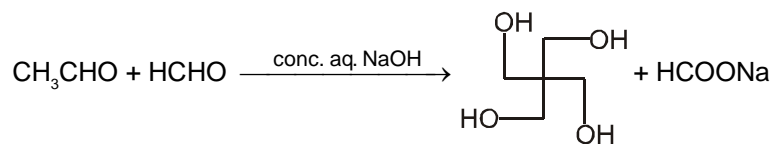
(A) Reaction shows three times aldol condensation.

(B) Reaction shows one time cannizzaro reaction.

(C) Four equivalent of formaldehyde are used in the given reaction.

(D) One equivalent of CH_3CHO is used in the given reaction.

37. Which of the following sequence of reactions will synthesis biphenyl.

(A) $C_6H_6 \xrightarrow{Br_2/Fe} \xrightarrow{Na/ether}$

(B) $C_6H_6 \xrightarrow[\Delta]{HNO_3+H_2SO_4} \xrightarrow[HNO_2]{Sn + HCl} \xrightarrow[NaOH]{C_6H_6}$

(C) $C_6H_6 \xrightarrow{Cl_2/AlCl_3} \xrightarrow[AlCl_3]{Ph-H}$

(D) $C_6H_6 \xrightarrow[AlCl_3]{CH_3Cl} \xrightarrow[1 \text{ eq}]{Cl_2/h\nu} \xrightarrow[AlCl_3]{Ph-H}$

Space for Rough Work

38. In which reaction, major product formed is correct.

(A)

(B)

(C)

(D)

Space for Rough Work

39. Which of the following are enantiomers of each other ?

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

40. "Trinitromethane is as much acidic as picric acid. "

Which of the following is/are correct for the above fact ?

(A) Conjugate base of both are more stable.

(B) Negative charge of conjugate base of both is delocalised over three nitro groups.

(C) Total 6 oxygen atoms hold the negative charge in both the acids.

(D) In picric acid negative inductive effect of nitro group is more powerful than in trinitromethane due to conjugation effect of benzene ring.

Space for Rough Work
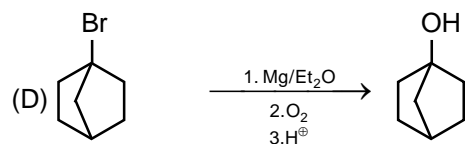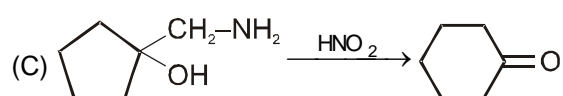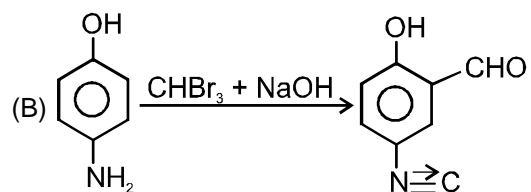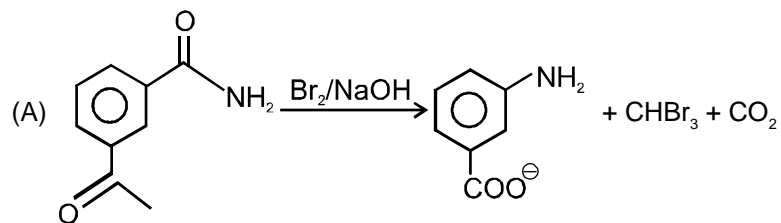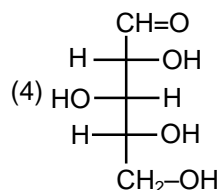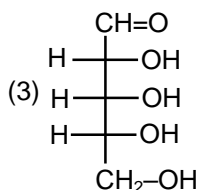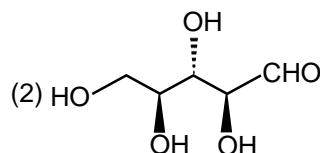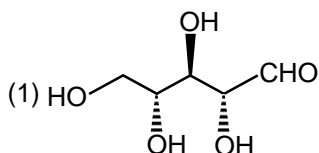
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PART : III MATHEMATICS

SECTION – 1 : (Maximum Marks : 80)

Ñ   This section contains **TWENTY** questions
Ñ   Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
Ñ   For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
Ñ   For each question, marks will be awarded in <u>one of the following categories</u> :

Full Marks   :   +4 If only the bubble(s) corresponding to all the correct option(s) is(are) darkened.
Partial Marks   :   +1 For darkening a bubble corresponding to **each correct option,** provided NO incorrect option is darkened.
Zero Marks   :   0 If none of the bubbles is darkened.
Negative Marks :   –2 In all other cases.

Ñ   For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will result in +4 marks ; darkening only (A) and (D) will result in +2 marks and darkening (A) and (B) will result in –2 marks, as a wrong option is also darkened.

41. If $\vec{a}$ and $\vec{b}$ non-zero and non-collinear vectors, then

(A) $\vec{a} \times \vec{b} = [\vec{a}\vec{b}\hat{i}]\hat{i} + [\vec{a}\vec{b}\hat{j}]\hat{j} + [\vec{a}\vec{b}\hat{k}]\hat{k}$

(B) $\vec{a}.\vec{b} = (\vec{a}.\hat{i})(\vec{b}.\hat{i}) + (\vec{a}.\hat{j})(\vec{b}.\hat{j}) + (\vec{a}.\hat{k})(\vec{b}.\hat{k})$

(C) if $\vec{u} = \hat{a} - (\hat{a}.\hat{b})\hat{b}$ and $\vec{v} = \hat{a} \times \hat{b}$, then $|\vec{v}| = |\vec{u}|$

(D) if $\vec{c} = \vec{a} \times (\vec{a} \times \vec{b})$, then $\vec{c}.\vec{a} = 0$

42. The number of ways of choosing triplets (x, y, z) such that $z \geq$ max {x, y} and x, y, z $\in$ {1, 2, …, n} is

(A) $^{n+1}C_3 + {}^{n+2}C_3$

(B) $\frac{1}{6}n(n + 1)(2n + 1)$

(C) $1^2 + 2^2 + \ldots\ldots + n^2$

(D) $2\left({}^{n+2}C_3\right) - {}^{n+1}C_2$

Space for Rough Work

43. The number of isosceles triangles with integer sides if no side exceeds 2016 is

(A) $(1008)^2$ if equal sides do not exceed 1008

(B) $2(1008)^2$ if equal sides exceed 1008

(C) $3(1008)^2$ if equal sides have any length not exceeding 2016

(D) $(2016)^2$ if equal sides have any length not exceeding 2016

44. If E_1 and E_2 are two events such that $P(E_1) = \dfrac{1}{4}$, $P\left(\dfrac{E_2}{E_1}\right) = \dfrac{1}{2}$ and $P = \left(\dfrac{E_1}{E_2}\right) = \dfrac{1}{4}$

(A) then E_1 and E_2 are independent

(B) E_1 and E_2 are exhaustive

(C) E_2 is twice as likely to occur as E_1

(D) probabilities of the events $E_1 \cap E_2$, E_1 and E_2 are in G.P.

45. $\displaystyle\lim_{n\to\infty} \dfrac{n}{3}\left\{\left(\dfrac{3}{n}+\dfrac{9}{n^2}\right)^2 + \left(\dfrac{3}{n}+\dfrac{18}{n^2}\right)^2 + \left(\dfrac{3}{n}+\dfrac{27}{n^2}\right)^2 + \dots\dots + \left(\dfrac{3}{n}+\dfrac{9}{n}\right)^2\right\}$ is less than or equal to

(A) 62   (B) 63   (C) 14   (D) 21

46. If the roots of the cubic equation, $x^3 + ax^2 + bx + c = 0$ are three consecutive positive integers. Then which of the following is/are **False**.

(A) $\dfrac{a^2}{b+1} = 3$ (B) $\dfrac{a^2}{b+1} = 1$ (C) $\dfrac{b+1}{a^2} = 3$ (D) $\dfrac{c^2}{a^2} = 1$

Space for Rough Work

47. $\displaystyle\sum_{n=1}^{\infty} \tan^{-1}\left(\frac{4n}{n^4+5}\right) =$

    (A) $\dfrac{\pi}{4} + \tan^{-1} 2$ (B) $\dfrac{3\pi}{4} - \tan^{-1} 2$ (C) $\tan^{-1} 3$ (D) $\dfrac{\pi}{4} + \cot^{-1} 2$

48. If A^5 is null square matrix and $(I - A)$ is the inverse of matrix $I + A + A^2 + \ldots\ldots + A^n$, then possible value of n can be (I is the identity matrix of same order as that of A).

    (A) 8   (B) 2   (C) 6   (D) 4

49. If $x = \dfrac{1^2}{1} + \dfrac{2^2}{3} + \dfrac{3^2}{5} + \ldots\ldots + \dfrac{1001^2}{2001}, y = \dfrac{1^2}{3} + \dfrac{2^2}{5} + \dfrac{3^2}{7} + \ldots\ldots + \dfrac{1001^2}{2003}$, then $[x - y]$ is greater than or equal to (where [.] denotes greatest integer function)

    (A) 500   (B) 450   (C) 510   (D) 555

50. Let a differentiable function $f : R \to R$ be such that for all x and y in R

$2|f(x) - f(y)| \le |x - y|$ and $f'(x) \ge \dfrac{1}{2}$. so then the number of points of intersection of the graph

$y = f(x)$ with

    (A) the line $y = x$ is one.   (B) the curve $y = -x^3$ is one.

    (C) the curve $2y = |x|$ is three.   (D) the curve $y^2 = -x$ may be more than one.

Space for Rough Work

51. The function $f(x) = \dfrac{2x-1}{x-2}$ $(x \neq 2)$ is such that

(A) it is inverse of itself

(B) decreases in $(-\infty, 2)$ and $(2, \infty)$

(C) it has a graph entirely above x–axis

(D) $\lim\limits_{x \to 0^+} f(e^{x^{-1}}) = 2$.

52. If r_1 and r_2 are distances of points on the ellipse $5x^2 + 5y^2 + 6xy - 8 = 0$ which are at maximum and minimum distance from the origin, then

(A) $r_1 + r_2 = 3$ 　　(B) $|r_1 - r_2| = 1$ 　　(C) $|r_1 - 2r_2| = 0$ 　　(D) $r_1 + 2r_2 = 4$

53. $\displaystyle\int \dfrac{dx}{ax^2 + bx + c} = k_1 \tan^{-1} \dfrac{x+A}{B} + C$ if

(A) $a > 0$, $b^2 - 4ac > 0$

(B) $a < 0$, $b^2 - 4ac > 0$

(C) $a > 0$, $b^2 - 4ac < 0$

(D) $a < 0$, $b^2 - 4ac < 0$

54. A plane cuts the rectangular prism, having $x + y = 0$, $x - y = 0$ and $x = 1$ as equation of its faces, in a section which forms the equilateral triangle, the direction ratio of plane can be :

(A) $(1, \sqrt{2}, 0)$ 　　(B) $(\sqrt{2}, 0, 1)$ 　　(C) $(-\sqrt{2}, 0, 1)$ 　　(D) $(-1, 0, \sqrt{2})$

55. Consider the circle $x^2 + y^2 = 1$ and the parabola $y = ax^2 - b$ $(a > 0)$. This circle and parabola intersect at

(A) four distinct points if $a > b > 1$

(B) no point if $b < -1$

(C) two distinct points if $-1 < b < 1$

(D) one point if $b = 1$

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56. If $\sqrt{\alpha_1 - 1} + 2\sqrt{\alpha_2 - 4} + 3\sqrt{\alpha_3 - 9} + 4\sqrt{\alpha_4 - 16} = \dfrac{\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4}{2}$ where $\alpha_1,\ \alpha_2,\ \alpha_3,\ \alpha_4$ are all real.

Then

(A) $\alpha_1 + \alpha_2 = 10$

(B) $\alpha_2 + \alpha_3 = 26$

(C) $\alpha_4 - \alpha_3 = 12$

(D) $\alpha_4 - \alpha_2 - \alpha_1 = 22$

57. Which of the following is **TRUE**.

(A) $\sin 82\dfrac{1}{2}^{\circ}\ \cos 37\dfrac{1}{2}^{\circ}$ and $\sin 127\dfrac{1}{2}^{\circ}\ \sin 97\dfrac{1}{2}^{\circ}$ have the same value

(B) The sign of the product sin 2 sin 3 sin 5 is negative

(C) For all α, β & γ; $\tan(\alpha - \beta) + \tan(\beta - \gamma) + \tan(\gamma - \alpha) = \tan(\alpha - \beta)\tan(\beta - \gamma)\tan(\gamma - \alpha)$

(D) There exists a value of θ between 0 & 2π which satisfies the equation; $\sin^4 \theta - \sin^2 \theta - 1 = 0$

58. Let $f : R \to R$, $f(x) = \begin{cases} |x - [x]|, & [x]\ \text{is odd} \\ |x - [x+1]|, & [x]\ \text{is even} \end{cases}$, where [.] denotes greatest integer function, then

(A) $\displaystyle\int_{2}^{4} f(x)dx = 1$

(B) $\displaystyle\int_{-2}^{4} f(x)dx = 3$

(C) $\displaystyle\int_{-10}^{10} f(x)dx = 10$

(D) $\displaystyle\int_{-1}^{1} f(x)dx = 0$

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59. Let $\begin{vmatrix} 1+x & x & x^2 \\ x & 1+x & x^2 \\ x^2 & x & 1+x \end{vmatrix} = \dfrac{1}{6}(x - \alpha_1)(x - \alpha_2)(x - \alpha_3)(x - \alpha_4)$ be an identity in x, where α_1, α_2, α_3, α_4

are independent of x. Then the value of $\alpha_1\alpha_2\alpha_3\alpha_4$ is

(A) 2   (B) 4   (C) 6   (D) 8

60. If a chord of the circle $x^2 + y^2 - 4x - 2y - 5k = 0$ is trisected at the points $\left(\dfrac{1}{3}, \dfrac{1}{3}\right)$ and $\left(\dfrac{8}{3}, \dfrac{8}{3}\right)$, then

the correct statement(s) is(are)

(A) the mid-point of the chord is $\left(\dfrac{3}{2}, \dfrac{3}{2}\right)$

(B) length of the chord is $7\sqrt{2}$

(C) the radius of the circle is $\sqrt{50}$

(D) k is equal to 9

Space for Rough Work

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

GENERAL :

1. The sealed booklet is your Question Paper. Do not break the seal till you are instructed to do so.
2. The question paper CODE is printed on the right hand top corner of this sheet and the right hand top corner of the back cover of this booklet.
3. Use the Optical Response Sheet (ORS) provided separately for answering the question.
4. Blank spaces are provided within this booklet for rough work.
5. Write your Name and Roll Number in the space provided on the below cover.
6. After the open booklet, verify that the booklet contains all the **60** questions along with the options are legible.

QUESTION PAPER FORMAT AND MARKING SCHEME :

7. The question paper has three parts : **Physics, Chemistry and Mathematics**. **Each part has one section.**
8. Each section as detailed in the following table :

Section	Question Type	Number of Questions	Category-wise Marks for Each Question				Maximum Marks of the Section
			Full Marks	**Partial Marks**	**Zero Marks**	**Negative Marks**	
1	One or More Correct Option(s)	20	+4 If only the bubble(s) corresponding to all the correct option(s) is(are) darkened	+1 For darkening a bubble corresponding to each correct option, provided NO incorrect option is darkened	0 If none of the bubbles is darkened	–2 In all other cases	80

OPTICAL RESPONSE SHEET :

9. Darken the appropriate bubbles on the original by applying sufficient pressure.
10. The original is machine-gradable and will be collected by the invigilator at the end of the examination.
11. Do not tamper with or mutilate the ORS.
12. Write your name, roll number and the name of the examination centre and sign with pen in the space provided for this purpose on the original. **Do not write any of these details anywhere else**. Darken the appropriate bubble under each digit of your roll number.

DARKENING THE BUBBLES ON THE ORS :

13. Use a **BLACK BALL POINT** to darken the bubbles in the upper sheet.
14. Darken the bubble **COMPLETELY.**
15. Darken the bubble **ONLY** if you are sure of the answer.
16. The correct way of darkening a bubble is as shown here : ●
17. There is **NO** way to erase or "un-darkened bubble.
18. The marking scheme given at the beginning of each section gives details of how darkened and **not darkened** bubbles are evaluated.

NAME OF THE CANDIDATE : ……………………………………………………………...……………………

ROLL NO. : …………………………..………………………

I have read all the instructions
   and shall abide by them

I have verified the identity, name and roll number
of the candidate.

- -
Signature of the Candidate

- -
Signature of the Invigilator

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