

FIITJEE - JEE (Main)

PHYSICS, CHEMISTRY & MATHEMATICS JEE Main 2019 Mock Test-1 (Additional) Code: 100382.1

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 A, B, C consisting of **Physics, Chemistry and Mathematics** having 30 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. $\frac{1}{4}$ (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.**

Atomic No.: H=1, He=2, Li=3, Be=4, B=5, C=6, N=7, O=8, F=9, Na=11, Mg=12, Al = 13, Si = 14, P = 15, S = 16, Cl = 17, Ar =18, K=19, Ca=20, Cr=24, Mn=25, Fe=26, Co=27, Ni=28, Cu=29, Zn=30, As=33, Br = 35, Ag = 47, Si = 21, Sn = 50, Ti = 22, I = 53, Xe = 54, Ba = 56, Pb = 82, U = 92, V = 50.

Atomic masses: H =1, He=4, Li=7, Be=9, B=11, 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, Co=59, Ni=58.7, Cu=63.5, Zn = 65.4, As = 75, Br = 80, Ag = 108, Sn = 118.7, I = 127, Xe = 131, Ba = 137, Pb = 207, U = 238.

Name of the Candidate (in Capital Letters) : _____

Enrolment Number : _____

Batch : _____ Date of Examination : _____

Physics

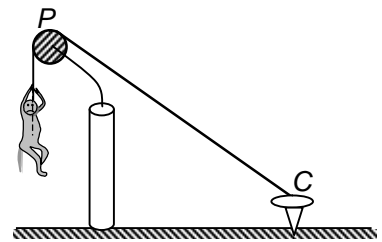
PART – I

SECTION – A

Single Correct Choice Type

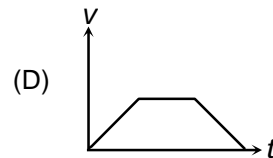
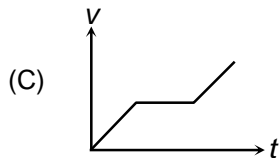
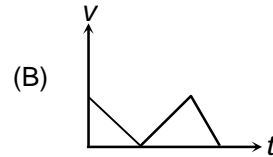
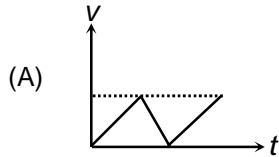
This section contains **30 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

- Which of the following numbers has maximum number of significant figure?
 (A) 1001 (B) 100.1
 (C) 100.10 (D) 0.001001
- Two boys are standing at the points A and B on the ground, where $AB = a$. The boy at B starts running in a direction perpendicular to AB with velocity v_1 . The boy at A starts running simultaneously with velocity v and catches the other in time t then t is
 (A) $\frac{a}{\sqrt{v^2 + v_1^2}}$ (B) $\frac{a}{v + v_1}$
 (C) $\frac{a}{v - v_1}$ (D) $\frac{a}{\sqrt{v^2 - v_1^2}}$
- One end of a massless rope, which passes over a massless and frictionless pulley P is tied to a hook C while the other end is free. Maximum tension that the rope can bear is 360 N with what value of minimum safe acceleration (in ms^{-2}) can a monkey of 60 kg move down on the rope
 (A) 16 (B) 6
 (C) 4 (D) 8



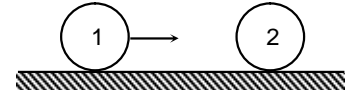
Space for Rough work

4. A particle mass m moves on a rough horizontal ground with some initial velocity say v_0 . If $(3/4)^{\text{th}}$ of its kinetic energy is lost due to friction in time t_0 then average power delivered by friction
- (A) $\frac{3}{8} \frac{mv_0^2}{t_0}$ (B) $\frac{3}{4} \frac{mv_0^2}{t_0}$
 (C) $\frac{1}{2} \frac{mv_0^2}{t_0}$ (D) $\frac{1}{4} \frac{mv_0^2}{t_0}$
5. A block of mass m is placed on an another rough block of mass M and both are moving horizontally together without slipping with acceleration a , then work done by friction on the upper block in moving a distance s will be
- (A) Mas (B) $(m + M) as$
 (C) $\frac{M^2}{m} as$ (D) mas
6. A ball falls from some height above a horizontal surface. If the collision is elastic, the graph between speed (v) and time (t) upto the second collision looks like



Space for Rough work

7. Ball 1 collides with another identical ball 2 at rest as shown in figure. For what value of coefficient of restitution e , the velocity of second ball becomes two times that of 1 after collision?



- (A) $1/3$ (B) $1/2$
(C) $1/4$ (D) $1/6$

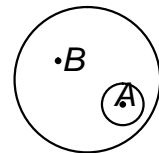
8. The radius of a planet is R_1 and a satellite revolves around it in a circle of radius R_2 . The time period of revolution of satellite is T . Acceleration due to the gravitation of the planet at its surface will be

- (A) $\frac{4\pi^2 R_2^3}{T^2 R_1^2}$ (B) $\frac{R_2^3}{4\pi^2 T^2 R_1^2}$
(C) $\frac{4\pi^2 R_1^3}{T^2 R_2^2}$ (D) $\frac{R_1^3}{4\pi^2 T^2 R_2^2}$

9. A spherical object of mass 1 kg and radius 1 m is falling vertically downward inside a viscous liquid in a gravity free space. At a certain instant the velocity of the sphere is 2 m/s. If the coefficient of viscosity of the liquid is $\frac{1}{18\pi}$ N-s/m², then acceleration of object

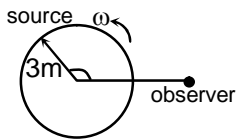
- (A) $3/2$ (B) $2/3$
(C) $1/2$ (D) $1/3$

10. There is an air bubble of radius R inside a drop of water of radius $3R$. Find the ratio of gauge pressure at point B to that at point A.



- (A) $\frac{1}{2}$ (B) $\frac{1}{4}$
(C) $\frac{1}{3}$ (D) 1

Space for Rough work

11. A particle having mass m is hung with a string of length ℓ has same time period when oscillated with a horizontal spring of force constant k on a smooth floor. Then value of m will be
- (A) $\frac{k\ell}{2g}$ (B) $\frac{k\ell}{g}$
 (C) $\frac{2k\ell}{g}$ (D) $\frac{3k\ell}{2g}$
12. A uniform vertical electric field E is established in the space between two large parallel plates. A small conducting sphere of mass m is suspended in the field from a string of length L . If the spheres is given a positive charge q and the lower plate is charged positively, the period of oscillation of this pendulum is
- (A) $2\pi\sqrt{\frac{L}{g}}$ (B) $2\pi\sqrt{\frac{L}{g+(qE/m)}}$
 (C) $2\pi\sqrt{\frac{L}{g-(qE/m)}}$ (D) $2\pi\sqrt{\frac{L}{[g^2+(qE/m)^2]^{1/2}}}$
13. A source is moving on a circle of radius 3 m with constant angular velocity $\omega = 5$ rad/s. If the observer is at a distance 5 m from the centre of circle, the time interval between maximum and minimum frequency received by the observer is
- (A) $\frac{\pi}{5}$ (B) $\frac{2}{5}\cos^{-1}\left(\frac{3}{4}\right)$
 (C) $\frac{2}{5}\cos^{-1}\left(\frac{3}{5}\right)$ (D) $\frac{2}{5}\sin^{-1}\left(\frac{3}{5}\right)$
- 
14. A ℓ cm long string fixed at both ends, sustains a standing wave such that all the points on the string having displacement amplitude 1 mm (less than maximum amplitude) are separated by d cm. The string is oscillating in its third overtone then
- (A) $\frac{\ell}{d} = 2$ (B) $\frac{\ell}{d} = 3$
 (C) $\frac{\ell}{d} = 6$ (D) $\frac{\ell}{d} = 8$

Space for Rough work

15. The air in an open pipe of length 36 cm long is vibrating with 2 nodes and 2 antinodes. The temperature of the air inside the pipe is 51°C . What is the wavelength of waves produced in air outside the tube where the temperature of air is 16°C ?
- (A) 32.1 cm (B) 68 cm
(C) 34 cm (D) 10.2 cm
16. A closed conducting vessel is placed in surroundings having temperature T_0 . It is filled with an ideal gas having initial temperature $\frac{3T_0}{2}$ and pressure P_0 . Pressure of gas after long time will be (neglect expansion of container)
- (A) P_0 (B) $P_0/3$
(C) $2P_0/3$ (D) $P_0/2$
17. One mole monoatomic ideal gas is enclosed in a cylinder fitted with a frictionless piston. It is subjected to a process given by equation $T = \alpha V^2$. Choose the wrong statement.
- (A) the P-V diagram of the process is a straight line.
(B) V-T diagram is parabola.
(C) Process is not isobaric.
(D) Molar specific heat of capacity of gas is $R/2$.
18. A point charge is placed at a distance r from center of a conducting neutral sphere of radius R ($r > R$). The potential at any point P inside the sphere at a distance r_1 from point charge due to induced charge of the sphere is given by $[k = \frac{1}{4\pi\epsilon_0}]$
- (A) kq/r_1 (B) kq/r
(C) $kq/r - kq/r_1$ (D) $-kq/R$

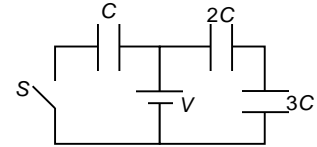
Space for Rough work

19. A charge q is placed at some distance along the axis of a uniformly charged disc of surface charge density σ . The flux due to the charge q through the disc is ϕ . The electric force on charge q exerted by the disc is

(A) $\sigma\phi$ (B) $\frac{\sigma\phi}{4\pi}$
 (C) $\frac{\sigma\phi}{2\pi}$ (D) $\frac{\sigma\phi}{3\pi}$

20. In the given circuit diagram, find the heat generated on closing the switch S . (Initially the capacitor of capacitance C is uncharged)

(A) $\frac{3}{2}CV^2$ (B) CV^2
 (C) $\frac{1}{2}CV^2$ (D) $2CV^2$

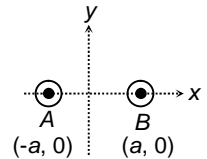


21. A spherical conductor A of radius r is placed concentrically inside a conducting shell B of radius R ($R > r$). A charge Q is given to A, and then A is joined to B by a metal wire. The charge flowing from A to B will be

(A) $Q \left(\frac{R}{R+r} \right)$ (B) $Q \left(\frac{r}{R+r} \right)$
 (C) Q (D) zero

22. Two very long current carrying wires A and B carrying current I_0 (along z -axis) are placed at $(-a, 0)$ and $(a, 0)$ as shown. Find the value of magnetic field at $(0, a)$

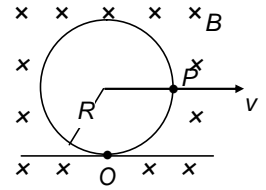
(A) $\frac{\mu_0 I_0}{\sqrt{2}\pi a}$ (B) $\frac{\mu_0 I_0}{2\pi a}$
 (C) $\frac{\mu_0 I_0}{4\pi a}$ (D) $\frac{\mu_0 I_0}{2\sqrt{2}\pi a}$



Space for Rough work

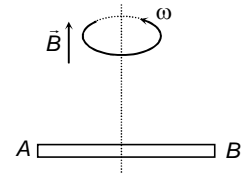
23. A metallic ring of radius R moves in a vertical plane in the presence of a uniform magnetic field B perpendicular to the plane of the ring. At any given instant of time its centre of mass moves with a velocity v . The magnitude of induced e.m.f. between points O and P is

- (A) zero
(B) $vBR\sqrt{2}$
(C) vBR
(D) $2vBR$



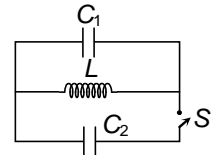
24. A conducting rod of length $2l$ is rotating with constant angular speed ω about its perpendicular bisector. A uniform magnetic field \vec{B} exists parallel to the axis of rotation. The emf induced between two ends of the rod is

- (A) $B\omega l^2$
(B) $\frac{1}{2}B\omega l^2$
(C) $\frac{1}{8}B\omega l^2$
(D) zero



25. At a moment ($t = 0$), when the charge on capacitor C_1 is zero, the switch is closed. If i_0 be the current through inductor at $t = 0$. Then potential of capacitor C_1 when current in inductor is zero. (initially C_2 is uncharged)

- (A) $\sqrt{\frac{L}{C_1}} i_0$
(B) $\sqrt{\frac{2L}{C_1 + C_2}} i_0$
(C) $\sqrt{\frac{L}{C_2}} i_0$
(D) $\sqrt{\frac{L}{C_1 + C_2}} i_0$

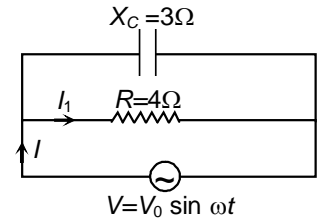


Space for Rough work

26. A capacitor and resistor are connected with an A.C. source as shown in figure. Reactance of capacitor is $X_C = 3\Omega$ and resistance of resistor is 4Ω . Phase difference between current I and I_1 is

$$\left[\tan^{-1}\left(\frac{3}{4}\right) = 37^\circ \right]$$

- (A) 90° (B) zero
(C) 53° (D) 37°

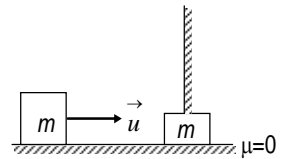


27. In Young's double slit experiment the two slits act as coherent sources of equal amplitude A and wavelength λ . In another experiment with the same set-up the two slits are source of equal amplitude A and wavelength λ , but are incoherent. The ratio of the intensity of light at the midpoint of the screen in the first case to that in second case is

- (A) 1 (B) 2
(D) 3 (D) 4

28. An object of mass m is moving with velocity \vec{u} towards a plane mirror kept on a stand as shown in the figure. The mass of the mirror and stand system is m . A head-on elastic collision takes place between the object and the mirror stand, the velocity of image before and after the collision is

- (A) $\vec{u}, 2\vec{u}$ (B) $-\vec{u}, -2\vec{u}$
(C) $-\vec{u}, 2\vec{u}$ (D) $\vec{u}, -2\vec{u}$



29. A silver sphere (work function 4.6 eV) is suspended in a vacuum chamber by an insulating thread. Ultraviolet light of wavelength $0.2 \mu\text{m}$ strike on the sphere. The maximum electric potential of the sphere will be ($hc = 12400 \text{ eV}\text{\AA}$)

- (A) 4.6 V (B) 6.2 V
(C) 1.6 V (D) 3.2 V

30. If light of wavelength λ is used to cause photoelectric emission from a metallic surface, the maximum kinetic energy of the emitted electron is 6 eV , which is 3 times the work function of the metallic surface. If light of wavelength 2λ is used, the maximum kinetic energy of the photoelectrons emitted is

- (A) 2 eV (B) 4 eV
(C) 14 eV (D) 18 eV

Space for Rough work

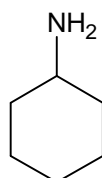
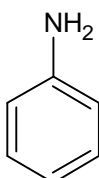
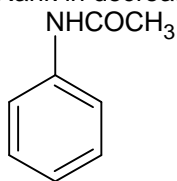
Chemistry**PART – II****SECTION – A****Single Correct Choice Type**

This section contains **30 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. The ratio of difference of radius between 3rd and 2nd orbit of H-atom and Li⁺² ion is:
(A) 3 : 1 (B) 1 : 1
(C) 1 : 3 (D) 2 : 3

2. The slag obtained during the extraction of copper pyrites is composed mainly of:
(A) MgSiO₃ (B) CuSiO₃
(C) FeSiO₃ (D) CuFeS₂

3. Rank in decreasing order of basicity:

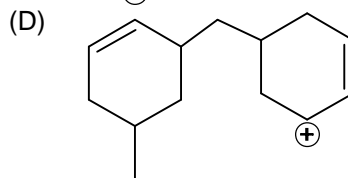
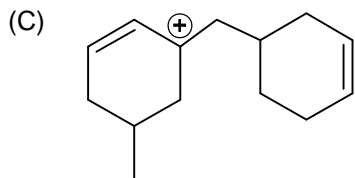
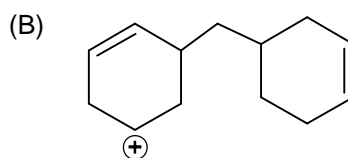
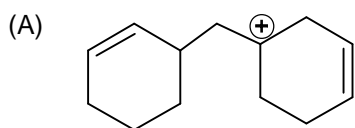


- (A) III, I, II
(C) II, I, III

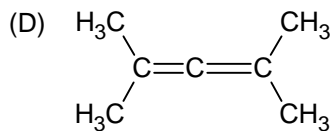
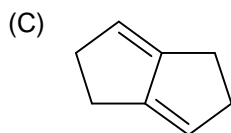
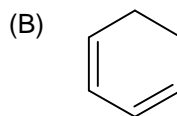
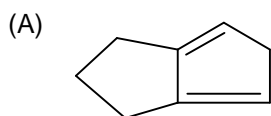
- (B) III, II, I
(D) II, III, I

Space for Rough work

4. Which of the following is the most stabilized carbocation?



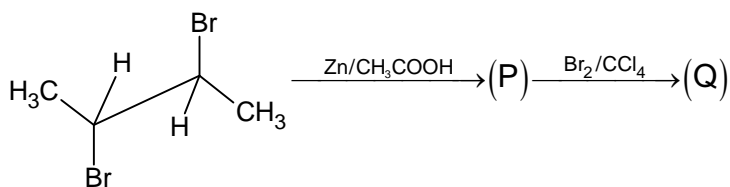
5. Which of the diene has highest heat of hydrogenation?



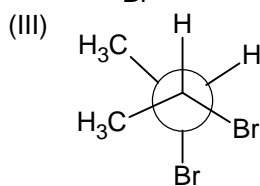
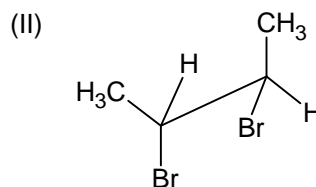
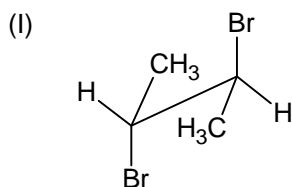
6. If the solubility of calcium phosphate $[\text{Ca}_3(\text{PO}_4)_2]$ is $s \text{ mol L}^{-1}$. The solubility product is equal to
 (A) $6s^5$ (B) $72s^5$
 (C) $54s^4$ (D) $108s^5$

Space for Rough work

7.



Q is major product?

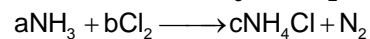


(A) I only

(B) II only

(C) III only

(D) I, II and III

8. The reaction of NH_3 and Cl_2 is as follows

The coefficient a, b and c are respectively.

(A) 8, 4, 6, 1

(B) 8, 3, 2, 1

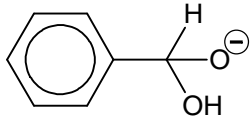
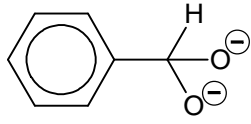
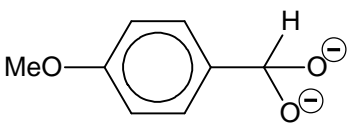
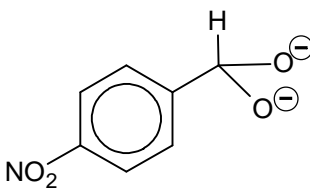
(C) 3, 8, 6, 4

(D) 8, 3, 6, 1

9. A crystal made up of A, B and C atoms, A occupy in all the tetrahedral voids and B occupied in octahedral void while 'C' forms face centred cubic. The molecular formula of the compound or crystal is:

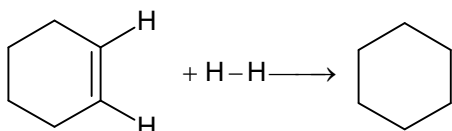
(A) AB_2C (B) $\text{A}_2\text{B}_3\text{C}_8$ (C) $\text{A}_3\text{B}_8\text{C}_3$ (D) A_2BC

Space for Rough work

10. In a Cannizzaro reaction, the intermediate that will be best hydride donor is:
- (A) 
- (B) 
- (C) 
- (D) 
11. The number of revolutions made by an electron in Bohr's 2nd orbit of hydrogen atom in one second is (approx.)
- (A) 8.3×10^{14} (B) 6.66×10^{15}
 (C) 5.3×10^{6} (D) none of these
12. Two non reacting gases A and B, having the mole ratio of 3 : 5 in a container, exert a pressure of 8 atm. If B is removed, what would be pressure of A only, T remaining constant.
- (A) 3 atm (B) 4 atm
 (C) 5 atm (D) None of these
13. A liquid is kept in a closed vessel. If a glass plate with a small hole in kept on top of the liquid surface, what would be the vapour pressure of the liquid in the vessel? (Neglect weight of glass)
- (A) More than what would be if the glass plate were removed.
 (B) Less than what would be if the glass plate were removed.
 (C) Same as what would be if the glass plate were removed.
 (D) Can not predicted.
14. Two mole of ideal gas at 300 K is expanded isothermally from an initial volume of 1 litre to 10 litre. The change in internal energy in the process is:
- (A) 11.49 kJ (B) 2.73 kcal
 (C) zero (D) All are incorrect

Space for Rough work

15.



Bond energies of C – C, C = C, C – H and H – H are w, x, y and z kJ/mole respectively. What is the value of ΔH° for above reaction?

- (A) $2y - x - z$ kJ
 (B) $(x + z - w - 2y)$ kJ
 (C) $(x + z - y)$ kJ
 (D) $(x + z - 2y)$ kJ

16.

For a reaction
 $3A + B \longrightarrow 2C$

$-\frac{d[A]}{dt} = K[A][B]$, the expression for $\frac{d[C]}{dt}$ will be:

- (A) $\frac{2}{3}K[A][B]$
 (B) $\frac{3}{2}K[A][B]$
 (C) $\frac{1}{3}K[A][B]$
 (D) $\frac{1}{2}K[A][B]$

17.

For the reaction $\text{SrCO}_3(\text{s}) \rightleftharpoons \text{SrO}(\text{s}) + \text{CO}_2(\text{g})$

the pressure of $\text{CO}_2(\text{g})$ depends on

- (A) Amount of $\text{SrCO}_3(\text{s})$
 (B) Amount of $\text{SrO}(\text{s})$
 (C) Amounts of both $\text{SrCO}_3(\text{s})$ and $\text{SrO}(\text{s})$
 (D) Temperature of the system

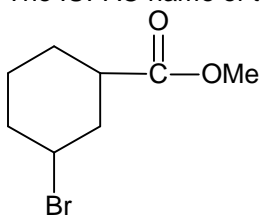
18.

On increasing temperature ionic product of water increases $[\text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{OH}^-, K_w = 10^{-14}$ at 25°C] which of the following statement is correct regarding dissociation of water.

- (A) water becomes basic on decreasing the temperature
 (B) pH of water increase on increasing the temperature
 (C) water will be neutral irrespective of temperature change
 (D) pH cannot be predicted on given information

Space for Rough work

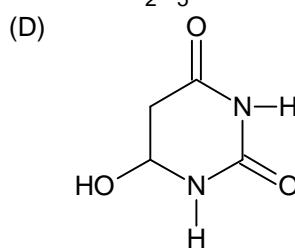
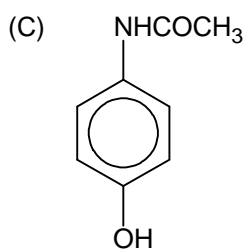
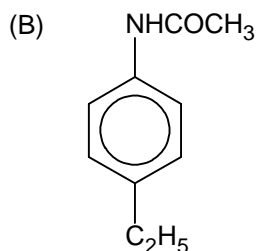
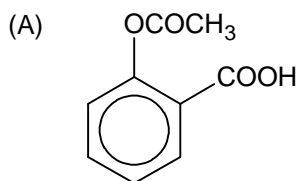
19. On adding few drops of dil. HCl to freshly precipitated ferric hydroxide, a red coloured colloidal solution is obtained. The phenomenon is known as:
(A) protective action (B) flocculation
(C) coagulation (D) peptisation
20. When sodium argentocyanide is treated with zinc dust, silver precipitates because
(A) Both Zn^{+2} and Ag^+ ions have d^{10} electronic configuration
(B) Zinc forms a complex readily with cyanide
(C) Zinc is more electropositive than silver
(D) Zinc is less electropositive than silver
21. Aqueous solution of carnalite gives a positive test for
(A) potassium ions only (B) chloride ions only
(C) magnesium and chloride ions (D) potassium, magnesium and chloride ions
22. Which compound is formed when excess of KCN is added to an aqueous solution of copper sulphate?
(A) $Cu(CN)_2$ (B) $K[Cu(CN)_2]$
(C) $K_4[Cu(CN)_6]$ (D) $K_3[Cu(CN)_4]$
23. In successive emission of α and β particles, how many α and β particles should be emitted for conversion ${}_{94}Pu^{241}$ to ${}_{92}U^{233}$?
(A) $2\alpha, 3\beta$ (B) $3\alpha, 2\beta$
(C) $2\alpha, 2\beta$ (D) none of them
24. The IUPAC name of the following compound



- (A) 3-bromo-1-methoxy cyclohexanone (B) 4-bromo-1-methoxy cyclo hexanone
(C) methyl-3-bromo cyclo hexanoate (D) methyl-3-bromo cyclo hexane carboxylate

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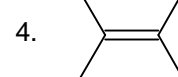
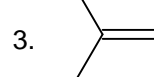
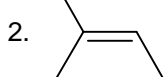
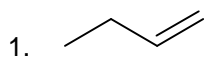
25. The excessive use of phosphates as water softners leads to aquatic pollution called
(A) eutrophication (B) phsophosylation
(C) deoxygenation (D) denitrification
26. Paracetamol is a common antipyretic, which is the correct formula among given options?



27. Consider the following statements about lactose:
1. Lactose on hydrolysis yields equimolar mixture of D-glucose and D-galactose.
 2. Lactose is a poly-saccharide.
 3. Lactose is a reducing sugar.
 4. In lactose, the glycosidic linkage is between C-1 of galactose and C-4 glucose unit.
- Which of the statements are correct?
- (A) 1 and 3 only (B) 1 and 4 only
(C) 2 and 3 only (D) 1, 3 and 4 only

Space for Rough work

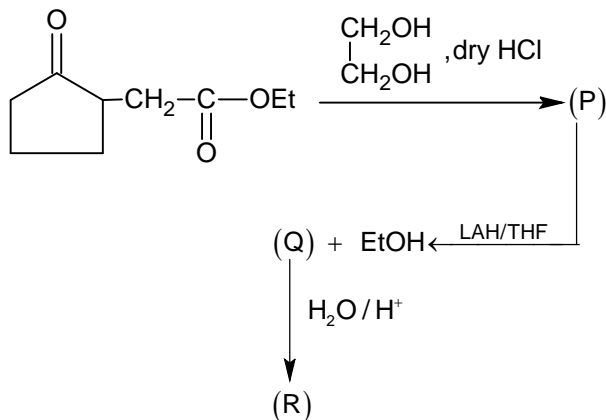
28. The correct order of reactivity of alkenes towards HBr is:



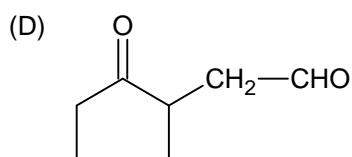
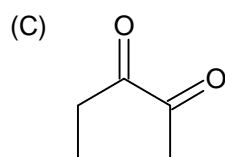
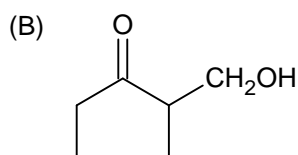
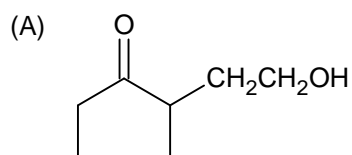
- (A) $1 > 2 > 3 > 4$
 (C) $3 > 2 > 4 > 1$

- (B) $1 > 3 > 2 > 4$
 (D) $4 > 2 > 3 > 1$

29.

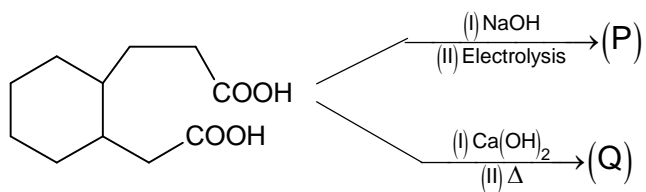


What is the structure of (R)?

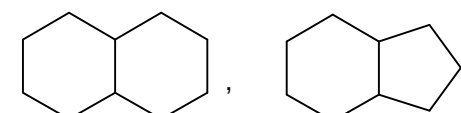
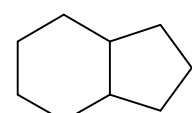
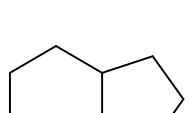
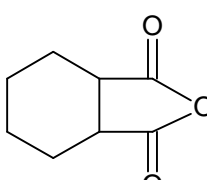
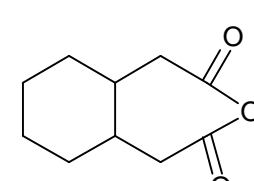
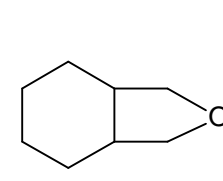
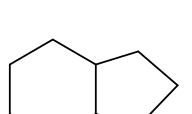
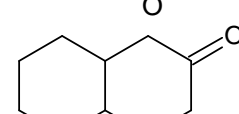


Space for Rough work

30.



If P and Q are main products then P and Q are:

- (A)  , 
- (B)  , 
- (C)  , 
- (D)  , 

Space for Rough work

Mathematics

PART – III

SECTION – A

Single Correct Choice Type

This section contains **30 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

- Number of words can be formed using all the letters of the word 'HIPHIPHURRAY' in which all H's lie somewhere between R's is
 (A) $(198)7!$ (B) $(99)7!$
 (C) $(99)8!$ (D) $(198)8!$
- Let a, b ($a \neq b$) are two non-zero complex numbers satisfying $|a^2 - b^2| = |a^2 + b^2 - 2\bar{a} \cdot \bar{b}|$, where $a = |\bar{a}|$ and $b = |\bar{b}|$, then
 (A) $\frac{a}{b}$ is purely real (B) $\frac{a}{b}$ is purely imaginary
 (C) $|\arg(a) - \arg(b)| = \pi$ (D) $|\arg(a) - \arg(b)| = \frac{\pi}{4}$
- Let I be the purchase value of an equipment and $V(t)$ be the value after it has been used for t years. The value $V(t)$ depreciates at a rate given by differential equation $\frac{dV(t)}{dt} = -K(T - t)$, where $K > 0$ is a constant and T is the total life in years of the equipment. Then the scrap value $V(T)$ of the equipment is
 (A) $I - \frac{KT^2}{2}$ (B) $I - \frac{K(T-t)^2}{2}$
 (C) e^{-KT} (D) $T^2 - \frac{1}{K}$

Space for Rough work

4. If $(\tan^{-1} x)^2 + (\cot^{-1} x)^2 = \frac{5\pi^2}{8}$, then x is equal to
 (A) -1 (B) 0
 (C) 1 (D) none of these
5. If the equation $\left| |x-1| - 6 \lim_{t \rightarrow \infty} \left(\frac{\sqrt{2t^2 - t - 1} - \sqrt{t^2 - t + 1}}{t \left(\tan \frac{\pi}{8} \right)} \right) \right| = k$ has four distinct solutions then the number of integral values of k is
 (A) 4 (B) 5
 (C) 6 (D) none of these
6. If f is a function such that $f(0) = 2$, $f(1) = 3$ and $f(x+2) = 2f(x) - f(x+1)$ for every real x, then f(5) is
 (A) 7 (B) 13
 (C) 1 (D) 5
7. If $f: [2, \infty[\rightarrow [8, \infty[$ is a surjective function defined by $f(x) = x^2 - (p-2)x + 3p - 2$, $p \in \mathbb{R}$ then sum of values of 'p' is $m + \sqrt{n}$, $m, n \in \mathbb{N}$ then $m + n$ is equal to
 (A) 20 (B) 10
 (C) 30 (D) 40
8. For $x, y \in \mathbb{R}$, if $x^2 - 2xy + 2y^2 - 6y + 9 = 0$ then the value of $(5x - 4y)$ is equal to
 (A) 2 (B) 3
 (C) 6 (D) 15
9. Let $f(x) = \begin{cases} 2 - x + a^2 - 9a - 9, & x < 2 \\ 2x - 3, & x \geq 2 \end{cases}$ where a is a positive constant. If f(x) has local minimum at $x = 2$, then a lies in the interval
 (A)]0, 1] (B) [10, ∞ [
 (C) [1, 10] (D) [2, 10[

Space for Rough work

10. The sum of an infinite G.P is 2 and the sum made from the cubes of the terms of this infinite series is 24. Then sum of first three terms of this series is
- (A) $\frac{21}{4}$ (B) $\frac{9}{4}$
 (C) $\frac{23}{4}$ (D) $\frac{11}{4}$
11. The probability that a randomly selected calculator from a store is of brand 'r' is proportional to r ($r = 1, 2, \dots, 6$). Further, the probability of a calculator of brand 'r' being defective is $\frac{7-r}{21}$, $r = 1, 2, 3, 4, 5, 6$. If probability that a calculator randomly selected from the store being defective is $\frac{p}{q}$, where p and q are co-prime then the value of (p + q) is
- (A) 63 (B) 60
 (C) 71 (D) 21
12. If $P(r)$ be number of points (x, y) , $x, y \in I$ which lie inside or on the curve $|xy| - r(|x| + |y|) + r^2 = 0$, $r \in \mathbb{N}$ and if $\lim_{n \rightarrow \infty} \left(\frac{\sum_{r=1}^{n-1} \sqrt{P(r)}}{an^3 + bn^2 + c} \right) = \frac{1}{2}$ then (a + b), is
- (A) 1 (B) 2
 (C) 3 (D) 4
13. If $ax + b \sec(\tan^{-1} x) = c$ and $ay + b \sec(\tan^{-1} y) = c$, then $\frac{x+y}{1-xy}$ is equal to
- (A) $\frac{2ac}{a-c}$ (B) $\frac{2ac}{a^2 - c^2}$
 (C) $\frac{a+c}{1-ac}$ (D) $\frac{ac}{a^2 + c^2}$

Space for Rough work

14. $\lim_{n \rightarrow \infty} (3^n + 4^n + 5^n + 6^n)^{\frac{1}{n}}$ is equal to
(A) 3 (B) 4
(C) 5 (D) 6
15. The absolute value of the expression $\left(\frac{1 + \sqrt{3}\tan 1^\circ}{\sqrt{3} + \tan 1^\circ}\right) \left(\frac{1 - \sqrt{3}\tan 1^\circ}{\sqrt{3} - \tan 1^\circ}\right) \frac{\tan 89^\circ}{\cot 3^\circ}$ is equal to
(A) 0 (B) 1
(C) 2 (D) 3
16. The value of $\lim_{x \rightarrow 0} \frac{1}{x} \int_0^x (1 + \sin 2t)^{1/t} dt$ is equal to
(A) 2 (B) 1
(C) e (D) e²
17. Let f be a polynomial function such that for all real x, $f(x^2 + 1) = x^4 + 5x^2 + 2$, then $\int f(x) dx$ is
(A) $\frac{x^3}{3} + \frac{3x^2}{2} - 2x + c$ (B) $\frac{x^3}{3} + \frac{3x^2}{2} + 2x + c$
(C) $\frac{x^3}{3} - \frac{3x^2}{2} - 2x + c$ (D) $\frac{x^3}{3} - \frac{3x^2}{2} + 2x + c$
18. If $f(x) = (x - 1)^4 (x - 2)^3 (x - 3)^2 (x - 4)$, then the value of $(f'''(1) + f''(2) + f'(3) + f'(4))$ is equal to
(A) 638 (B) $3(6^3)$
(C) 50 (D) 0
19. The first two terms of a geometric progression add up to 12. The sum of third and fourth terms is 48. If the terms are alternately positive and negative, then
(A) common ratio of G.P. is -2 (B) common ratio of G.P. is -3
(C) sixth term of G.P. is 128 (D) none of these

Space for Rough work

20. If $P(x, y, z)$ is a point on the line segment joining $Q(2, 3, 4)$ and $R(3, 5, 6)$ such that the projection of the vector \overline{OP} on the axes are $\frac{13}{5}, \frac{21}{5}, \frac{26}{5}$ respectively. The P divides QR in the ratio
- (A) 2 : 3 (B) 3 : 1
(C) 1 : 3 (D) 3 : 2
21. Area of triangle whose vertices are $(a, a^2), (b, b^2), (c, c^2)$ is $\frac{1}{2}$, and area of another triangle whose vertices are $(p, p^2), (q, q^2)$ and (r, r^2) is 4, then the value of $\begin{vmatrix} (1+ap)^2 & (1+bp)^2 & (1+cp)^2 \\ (1+aq)^2 & (1+bq)^2 & (1+cq)^2 \\ (1+ar)^2 & (1+br)^2 & (1+cr)^2 \end{vmatrix}$, is
- (A) 2 (B) 4
(C) 8 (D) 16
22. The line parallel to the x -axis and passing through the intersection of the lines $ax + 2by + 3b = 0$ and $bx - 2ay - 3a = 0$, where $(a, b) \neq (0, 0)$ is
- (A) below the x -axis at a distance of $\frac{3}{2}$ from it (B) below the x -axis at a distance of $\frac{2}{3}$ from it
(C) above the x -axis at a distance of $\frac{3}{2}$ from it (D) above the x -axis of distance of $\frac{2}{3}$ from it
23. The locus of feet of perpendicular from either foci of the ellipse $(x - y + 1)^2 + (2x + 2y - 6)^2 = 20$ on any tangent will be
- (A) $x^2 + y^2 + 2x + 4y + 5 = 0$ (B) $x^2 + y^2 + 2x + 4y - 5 = 0$
(C) $x^2 + y^2 - 2x - 4y - 5 = 0$ (D) $x^2 + y^2 - 2x - 4y + 5 = 0$
24. For $x \neq \frac{n\pi}{2}$, where $n \in I$, the range of function $f(x) = \operatorname{sgn}(\sin x) + \operatorname{sgn}(\cos x) + \operatorname{sgn}(\tan x) + \operatorname{sgn}(\cot x)$ is
- (A) $\{-2, 4\}$ (B) $\{-2, 0, 4\}$
(C) $\{-4, 0, -2, 4\}$ (D) $\{0, 2, 4\}$

Space for Rough work

25. If $\cos \theta = \frac{a}{b+c}$, $\cos \phi = \frac{b}{a+c}$, $\cos \psi = \frac{c}{a+c}$, where $\theta, \phi, \psi \in (0, \pi)$ and a, b, c are sides of triangle ABC then $\tan^2 \frac{\theta}{2} + \tan^2 \frac{\phi}{2} + \tan^2 \frac{\psi}{2}$ is equal to
 (A) 1 (B) 2
 (C) 3 (D) 4
26. Let $A = \{1, 2, 3, 4\}$. The number of different ordered pairs (B, C) that can be formed such that $B \subseteq A, C \subseteq A$ and $B \cap C = \phi$
 (A) 3 (B) 9
 (C) 27 (D) 81
27. If $\cos^2 x - (c-1)\cos x + 2c \geq 6$ for every $x \in \mathbb{R}$, then the true set of values of c is
 (A) $[4, \infty[$ (B) $[2, \infty[$
 (C) $]-\infty, -2]$ (D) $]-\infty, -4]$
28. If the equations $px^2 + qx + r = 0$ and $rx^2 + qx + p = 0$ ($p \neq r \neq 0$) have a negative common root, then the value of $(p - q + r)$ is equal to
 (A) -1 (B) 1
 (C) 2 (D) 0
29. If $f(x) = \left([\{x\}] \tan^{-1} \left(\frac{x^2 - 3x - 1}{x^2 - 3x + 5} \right) + 3 - x^7 \right)^{\frac{1}{7}}$. Where $[k]$ and $\{k\}$ denotes greatest integer and fractional part functions of k respectively, then the value of $f^{-1}(50) - f(50) + f(f(100))$, is
 (A) 0 (B) 25
 (C) 50 (D) 100
30. In triangle ABC, if $a \sin A \sin B + b \cos^2 A = \sqrt{2}a$, then the value of $\left(\frac{b}{a}\right)$ is
 (A) $\frac{1}{2}$ (B) 2
 (C) $\sqrt{2}$ (D) 1

Space for rough work