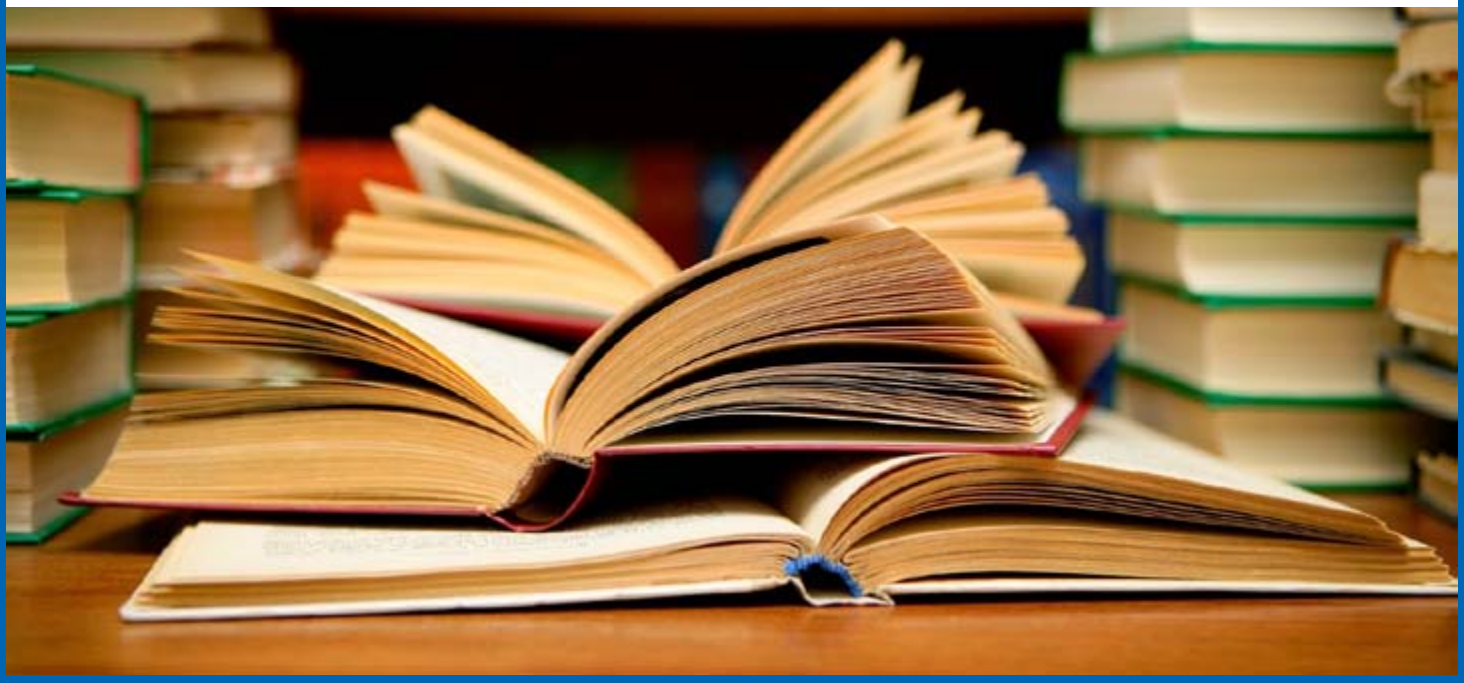
CAREERS 360
The Education Hub

JEE Main
Sample Papers

by

FIITJEE
LIMITED



FIITJEE - JEE (Main)

SAMPLE TEST - 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*** sections in the question paper I, II, III consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each section of equal weightage. Each question is allotted **4 (four)** marks for correct response.
6. *Candidates will be awarded marks as stated above in instruction No.5 for correct response of each question. ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
7. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.
8. Use ***Blue / Black Ball Point Pen only*** for writing particulars / marking responses on ***Side-1*** and ***Side-2*** of the Answer Sheet. ***Use of pencil is strictly prohibited.***
9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall / room.
10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room / Hall. ***However, the candidates are allowed to take away this Test Booklet with them.***
11. **Do not fold or make any stray marks on the Answer Sheet.**

Name of the Candidate (in Capital Letters) :_____

Enrolment Number :_____

Batch :_____ **Date of Examination :** _____

Useful Data Chemistry:

Gas Constant	R	=	$8.314\ J\ K^{-1}\ mol^{-1}$
		=	$0.0821\ Lit\ atm\ K^{-1}\ mol^{-1}$
		=	$1.987 \approx 2\ Cal\ K^{-1}\ mol^{-1}$
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's Constant	h	=	6.626×10^{-34} Js
		=	6.25×10^{-27} erg.s
1 Faraday		=	96500 Coulomb
1 calorie		=	4.2 Joule
1 amu		=	1.66×10^{-27} kg
1 eV		=	1.6×10^{-19} J

Atomic No : H=1, D=1, Li=3, Na=11, K=19, Rb=37, Cs=55, F=9, Ca=20, He=2, O=8, Au=79.

Atomic Masses: He=4, Mg=24, C=12, O=16, N=14, P=31, Br=80, Cu=63.5, Fe=56, Mn=55, Si = 28 Pb=207, u=197, Ag=108, F=19, H=2, Cl=35.5

Useful Data Physics:

Acceleration due to gravity $g = 10\ m/s^2$

Section – I (Physics)

1. A particle is projected vertically upwards with a velocity of 20 m/sec. Find the time at which the distance travelled is twice the displacement

(A) $2 + \sqrt{4/3}$ sec. (B) 1 sec. (C) $2 + \sqrt{3/4}$ (D) 3 sec

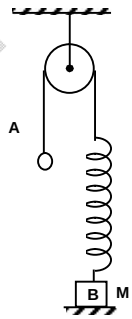
2. Two men who can swim with a speed v_1 in still water start from the middle of a river of width d and move in opposite directions always swimming at an angle θ with the banks. What is the distance between them along the river when they reach the opposite banks, if the velocity of the river is v_2

(A) $\frac{dv_1}{dv_2}\cot\theta$ (B) $\frac{dv_1\cos\theta}{v_1+v_2}$ (C) $\frac{dv_2}{v_1}\tan\theta$ (D) $\frac{v_2 d}{v_1\sin\theta}$

3. A uniform chain of mass m hangs from a light pulley, with unequal lengths of the chain hanging from the two sides of pulley the force exerted by moving chain on the pulley is

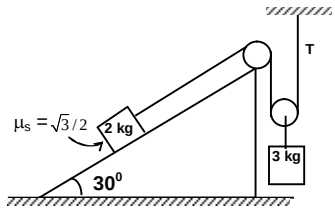
(A) = mg
(B) > mg
(C) < mg
(D) either b or c depending upon acceleration of chain

4. In the figure ball A is released from rest, when the spring is at its natural length. For the block B of mass M to leave contact with the ground at some stage, the minimum mass of A must be



(A) 2M
(B) M
(C) M/2
(D) a function of M and force constant of spring.

5. A system is shown in figure pulleys and strings are ideal system is released from rest



$a_1 \rightarrow$ acceleration of 2 kg, a_2 = acceleration of 3 kg
(i) $a_1 = 2a_2$ (ii) $a_2 = 2a_1$ (iii) $a_1 = a_2 = 0$
(iv) Tension T in the string = 15 N
(v) frictional force between 2 kg & incline = 5N
(vi) frictional force between 2 kg & incline = 15N
(A) (ii), (iv) & (vi) are correct (B) (iii), (v) are correct
(C) (iii), (iv) & (v) are correct (D) (i), (iv) & (vi) are correct

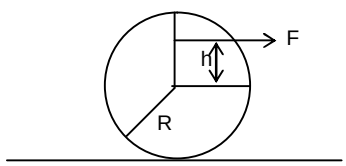
6. A bullet of mass 10 gm is fired from a rifle with a velocity of 800 m/s. After passing through a mud wall 180 cm thick, the velocity drops to 100 m/s. The average resistance of the wall is

(A) 750 N (B) 1250 N (C) 1750 N (D) 2250 N

7. A body is gently dropped on a conveyor belt moving 3 m/s. If μ = 0.5 how far will the body move relative to the belt before coming to rest? ($g = 10 m/s^2$)

(A) 0.3 m (B) 0.6 m (C) 0.9 m (D) 0.8 m

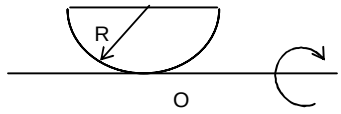
8. Consider the disc kept on a rough horizontal surface as shown in the diagram. If a horizontal force 'F' has to be applied such that the disc starts pure rolling, what should be the value of 'h' ?



(A) R
(B) R/3
(C) R / 2

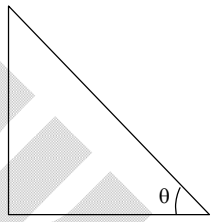
(D) Body can't start pure rolling for any value of 'h'

9. Moment of inertia of a half shell of mass 'M' about an axis tangential to it, as shown, would be



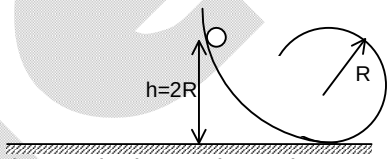
(A) $\frac{2}{3}MR^2$ (B) $\frac{1}{3}MR^2$ (C) MR^2 (D) none of these

10. Consider '3' bodies namely a disc 'A', a sphere 'B' and a hollow cylinder all with same mass and radius being released from top of fixed inclined plane. If t_A, t_B & t_c be the time they take to reach the bottom, find the correct alternative for each of given situations.



In absence of any friction
(A) $t_C > t_A > t_B$ (B) $t_C < t_A < t_B$ (C) $t_C = t_A = t_B$ (D) none of these

11. A small ball starts rolling on an inclined track which becomes loop if radius R in vertical plane.



(A) speed of the ball at highest point is zero but and highest point is 2R above the ground.
(B) speed of the ball at highest point is non zero but highest point is 2R above the ground
(C) speed of the ball is along horizontal at highest point and highest point is less than the 2R above the ground.
(D) speed of the ball is along horizontal at highest point but height of highest point above the ground can not be calculated.

12. A double star consists of two stars having mass M and 2M. The distance between their centre is equal to r. They revolve under their mutual gravitational interaction. Then which of the following statements is/are correct.
(A) heavier star revolves in orbit of radius r/3
(B) kinetic energy of heavier star is twice of that of the other star.
(C) lighter star revolves in orbit of radius $\frac{2r}{5}$
(D) all above are correct.

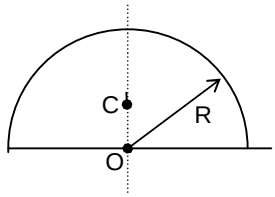
13. Three small identical bodies each of mass m are moving in circular orbit around a fixed point with same angular velocity under their gravitational interaction. If the separation between any two bodies is R, the total energy possessed by the system is given by

(A) $-\frac{3GM^2}{2R}$ (B) $-\frac{3GM^2}{4R}$ (C) $-\frac{3GM^2}{2R\cos 30^\circ}$ (D) $-\frac{3GM^2}{R}$

14. A man of mass M stands at one end of a plank of length L which lies at rest on a frictionless surface. The man walks to the other end of the plank. If the mass of the plank is M/3, the distance that the man moves relative to the ground is

(A) $\frac{3L}{4}$ (B) $\frac{4L}{5}$ (C) $\frac{L}{4}$ (D) $\frac{L}{3}$

15. The centre of mass of a half disc shown is at C while O is the centre. Thus OC is



(A) R/2 (B) $2R/\pi$

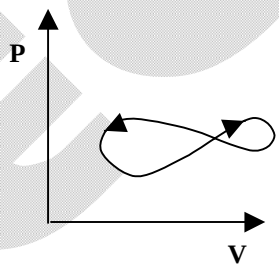
(C) $\frac{4R}{3\pi}$ (D) none of the above

16. If the tension in a stretched string fixed at both ends in changed by 20%, the fundamental frequency is found to change by 15 Hz. Then the
(A) original frequency is 150 Hz
(B) velocity of propagation of the transverse wave along the string changes by 5 %
(C) velocity of propagation of the transverse wave along the string change by 10 %
(D) fundamental wavelength on the string does not change.

17. Beats are produced by two progressive waves. Maximum loudness at the waxing is x times the loudness of each wave. The value of x is

(A) 1 (B) $\sqrt{2}$ (C) 2 (D) 4

18. A thermodynamic system undergoes a cyclic process as shown in the figure. The cycle consists of two closed loops. Over one complete cycle, the system performs
(A) positive work
(B)negative work
(C) zero work
(D) nothing can be predicted



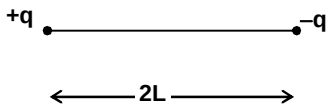
19. A half ring of radius R is charged with a linear charged density λ. The field at the centre is

(A) 0 (B) $k\lambda/R$ (C) $2k\lambda/R$ (D) $k\pi\lambda/R$

20. The maximum electric field strength E due to a uniformly charged ring of radius r, happens at a distance x, where value of x is (x is measured from the centre of the ring)

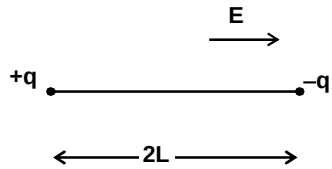
(A) x = R (B) x = R/2 (C) $x = \frac{R}{\sqrt{2}}$ (D) $x = \sqrt{2}\,R$

21. Two charges +q and –q are placed fixed on the corner of a massless rigid rod of length 2L.Calculate the potential energy of the dipole thus formed.



(A) $\frac{1}{4\pi\varepsilon_o}\frac{q^2}{4L^2}$ (B) $\frac{1}{4\pi\varepsilon_o}\frac{q^2}{2L}$ (C) $\frac{1}{2\pi\varepsilon_o}\frac{q^2}{2L}$ (D) None of these.

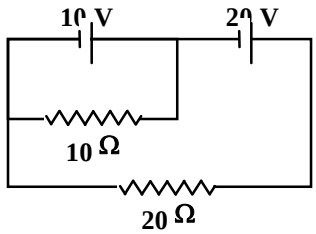
22. If the above discussed dipole is placed in a uniform electric field E as shown, calculate the proper potential energy of the dipole.



(A) $\frac{1}{4\pi\varepsilon_o}\frac{q^2}{2L}$ (B) $4qLE + \frac{1}{4\pi\varepsilon_o}\frac{q^2}{2L}$

(C) $2qLE - \frac{1}{4\pi\varepsilon_o}\frac{q^2}{2L}$ (D) $4qLE - \frac{1}{4\pi\varepsilon_o}\frac{q^2}{2L}$

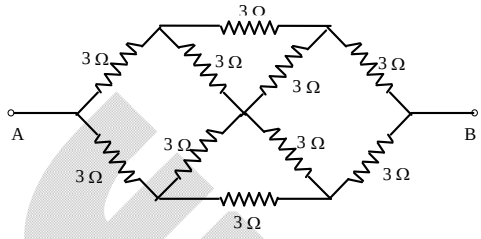
23. In the shown network current through $20\,\Omega$ resistor equals



(A) $\frac{3}{2}$A (B) $\frac{9}{2}$A

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

24. Equivalent resistance between the points A and B is



(A) $1\,\Omega$ (B) $2\,\Omega$

(C) $3\,\Omega$ (D) $4\,\Omega$

25. The two rails of a railway track; insulated from each other and the ground, are connected to millivoltmeter. What is the reading of the millivoltmeter when a train passes at a speed of 180 km/hr along the track, given that the horizontal component of earth's magnetic field is 0.2×10^{-4} wb/m^2 and rails are separated by 1 metre

(A) 10^{-2} V (B) 10 mV (C) 1 V (D) 1 mV

26. In an R-L-C circuit v = 20 sin (314 t + 5π/6) and i = 10 sin (314 t + 2π/3)
The power factor of the circuit is

(A) 0.5 (B) 0.966 (C) 0.866 (D) 1

27. A circular current carrying coil has a radius a. The distance from the centre of coil, on its axis, where the magnetic induction will be 1/8 th of its value at centre of coil is

(A) 3a (B) $+\sqrt{3a}$ (C) $\pm\sqrt{3a}$ (D) $\pm 2a/\sqrt{3}$

28. In photoelectric effect, the photo current

(A) increases with increase of frequency of incident photon
(B) decreases with increase of frequency of incident photon
(C) does not depend on the frequency of the photon but depends only on intensity of incident light.
(D) depends both on intensity and frequency of photon.

29. If refractive index of water is 4/3 and glass is 5/3 then critical angle so that light travelling form glass to water is completely reflected is

(A) $\sin^{-1}$ (4/5) (B) $\sin^{-1}$ (5/4) (C) $\sin^{-1}$ (3/5) (D) $\sin^{-1}$ (5/3)

30. When a ray of light enters a glass slab from air

(A) its wavelength decreases (B) its wavelength increases
(C) its frequency increases (D) neither wavelength nor frequency changes

space for rough work

Section – II (Chemistry)

1. For the equations
$C(diamond)+2H_2(g)\rightarrow CH_4(g);\Delta H_1$
$C(graphite)+2H_2(g)\rightarrow CH_4(g);\Delta H_2$
Predict whether
(A) $\Delta H_1=\Delta H_2$ (B) $\Delta H_1>\Delta H_2$
(C) $\Delta H_1<\Delta H_2$ (D) $\Delta H_1=\Delta H_2+\Delta H_{vap}(3)+\Delta H_{diss}(H_2)$

2. Which of the following can behave as both electrophile and nucleophile?
(A) $CH_3-C\equiv N$ (B) CH_3OH (C) $CH_2=CH-CH_3$ (D) CH_3NH_2

3. Steam reacts with iron at high temperature as follows:
$3Fe(s)+4H_2O(g)\Rightarrow Fe_3O_4(s)+4H_2(g)$
The correct expression for the equilibrium constant (K_P) is:
(A) $\frac{p_{H_2}^2}{p_{H_2O}^2}$ (B) $\frac{(p_{H_2})^4}{(p_{H_2O})^4}$ (C) $\frac{(p_{H_2})^4[Fe_3O_4]}{(p_{H_2O})^4[Fe]^3}$ (D) $\frac{[Fe_3O_4]}{[Fe]}$

4. In which of the following solvents, AgBr has the maximum solubility?
(A) 10^{-3} M NaBr (B) 10^{-3} M NH_4OH (C) Pure water (D) 10^{-3} M HBr

5. The electrode potential of a copper wire dipped in 0.1 M $CuSO_4$ solution at 25^0C (the standard reduction potential of copper is 0.34V):
(A) 0.34V (B) 0.31V (C) 0.349 V (D) 0.28 V

6. The strongest reducing agent among the following is
(A) F^- (B) Cl^- (C) Br^- (D) I^-

7. Diazonium salt decomposes as:
$C_6H_5N_2^+Cl^-\rightarrow C_6H_5Cl+N_2$
At 0^0C, the evolution of N_2 becomes two times faster when the initial concentration of the salt is doubled., Therefore, it is
(A) a first order reaction
(B) a second order reaction
(C) independent of the initial concentration of the salt
(D) a zero order reaction.

8. If 2.68×10^{-3} mole of a solution containing an ion A^{n+} requires 1.61×10^{-3} mole of MnO_4^- for the oxidation of A^{n+} to AO_3^- in an acidic medium, then what is the value of n?
(A) 3 (B) 2 (C) 5 (D) 4

9. The equivalent weight of $MnSO_4$ is half its molecular weight when it is converted to
(A) Mn_2O_3 (B) MnO_2 (C) MnO_4^- (D) MnO_4^{-2}

10. The largest number of molecules is in
(A) 36 g of H_2O (B) 28 g of CO
(C) 46 g of CH_3CH_2OH (D) 54 g of N_2O_5
(Use atomic weight: O = 16, C = 12, N = 14, H = 1)

11. Consider a titration of $K_2Cr_2O_7$ with acidified Mohr's salt solution $\left(FeSO_4.(NH_4)_2SO_4.6H_2O\right)$ using diphenylamine as indicator. The number of moles of Mohr's salt required per mole of dichromate is

$$Fe^{+2} + Cr_2O_7^{2-} \xrightarrow{H^+} Fe^{+3} + Cr^{+3}$$

(A) 3 (B) 4 (C) 5 (D) 6

12. The normality of 0.3 M phosphorus acid $\left(H_3PO_3\right)$ is

(A) 0.1 (B) 0.9 (C) 0.3 (D) 0.6

13. The energy of hydrogen atom in the ground state is -13.6 eV. Its energy corresponding to the quantum number n = 5 is

(A) $-0.54eV$ (B) $-5.40\ eV$ (C) $-0.85eV$ (D) $-2.72eV$]

14. If r_1 is the radius of first orbit of hydrogen atom, then the radii of second, third and fourth orbit in terms of r_1 are

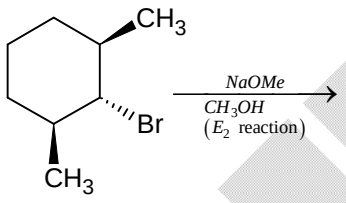
(A) $8r_1, 27r_1, 64r_1$ (B) $2r_1, 6r_1, 8r_1$ (C) $4r_1, 9r_1, 16r_1$ (D) $r_1, 2r_1, 3r_1$

15. If kinetic energy of an electron is increased nine times, the de-Broglie wavelength associated with it would become

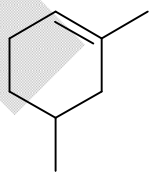
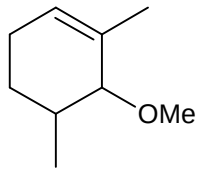
(A) 3 times (B) 9 times (C) $\frac{1}{3}$ times (D) $\frac{1}{9}$ times

16. Which electronic level allows the hydrogen atom to absorb a photon but not emit a photon?

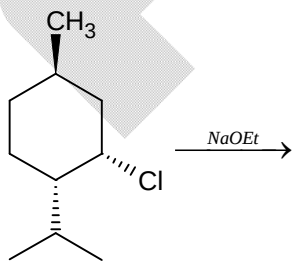
(A) 2s (B) 2p (C) 1s (D) 3d

17. 

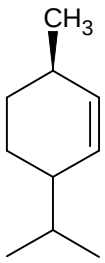
Product. Product of the reaction is:

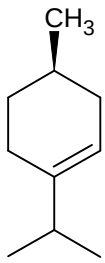
(A)  (B)  (C) 

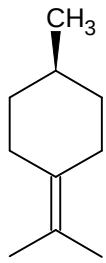
(D) No reaction

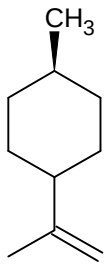
18. 

Major product of the reaction is:

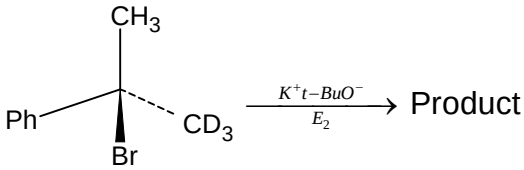
(A) 

(B) 

(C) 

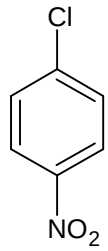
(D) 

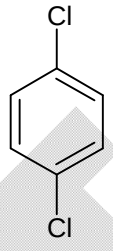
19. Which of the given options best describes the product of the following reaction?

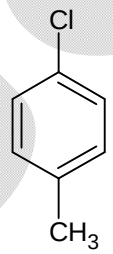


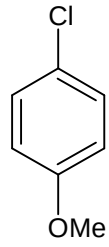
(A) Absolute configuration has been inverted
(B) Absolute configuration has been retained
(C) Racemisation (loss of absolute configuration)
(D) Loss of chirality has occurred (the product is achiral)

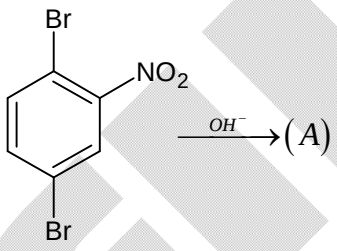
20. Which one of the following undergoes nucleophlic aromatic substitution at the fastest rate?

(A) 

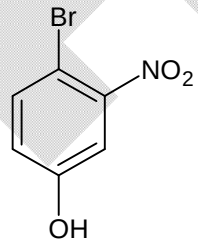
(B) 

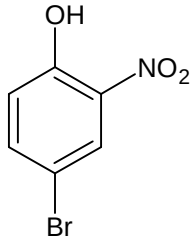
(C) 

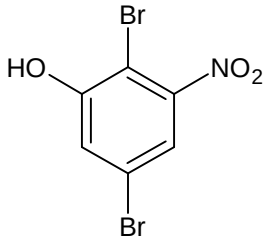
(D) 

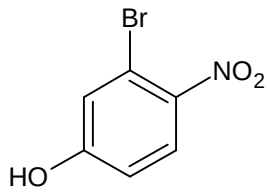
21. 

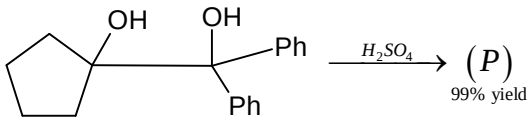
Product of the following reaction is:

(A) 

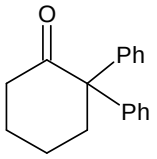
(B) 

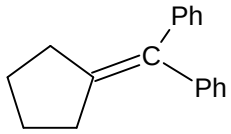
(C) 

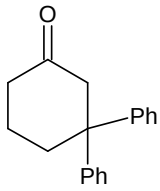
(D) 

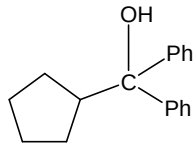
22. 

The product (P) is:

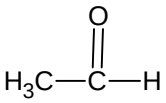
(A) 

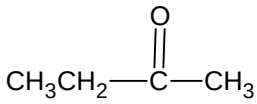
(B) 

(C) 

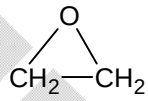
(D) 

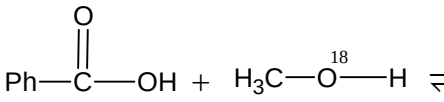
23. An organic compound 'B' is formed by the reaction of ethyl magnesium iodide $\left(CH_3CH_2MgI\right)$ with a substance 'A', followed by treatment with dil. aqueous acid. Compound 'B' doesnot react with PCC. Identify A?

(A) 

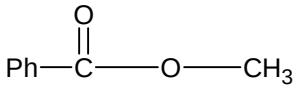
(B) 

(C) $CH_2 = O$

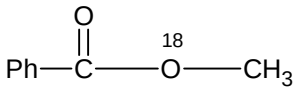
(D) 

24. 

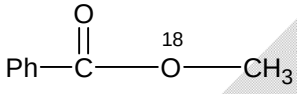
Identify $\left(X\right)$

(A) $X =$ 

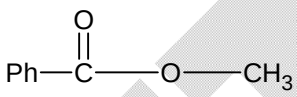
(Esterification)

(B) $X =$ 

(Esterification)

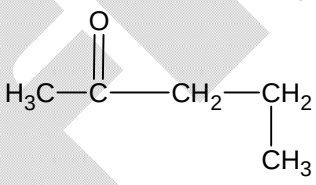
(C) $X =$ 

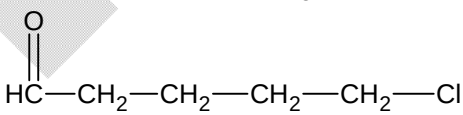
(Saponification)

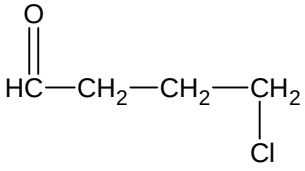
(D) $X =$ 

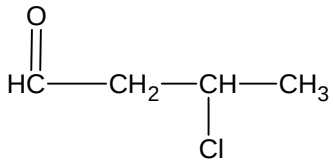
(Hydrolysis)

25. $CH_2 = CH - CH_2 - CH_2 - CH_2OH \xrightarrow[\text{pyridine}]{SOCl_2} (A) \xrightarrow[(H_2O)]{O_3/Zn} (B)$
$\left(C_4H_7ClO\right)$
Compound (B) is

(A) 

(B) 

(C) 

(D) 

26. Equimolar solutions of two non – electrolytes in the same solvent have
(A) same b.pt but different f.pt (B) same f.pt but different b.pt
(C) same b.pt and same f.pt (D) different b.pt and different f.pt

27. The degree of dissociation (α) of weak electrolyte A_xB_y is related to van't Hoff's factor (i) by the expression:
(A) $\alpha = \frac{i-1}{(x+y-1)}$ (B) $\alpha = \frac{i-1}{(x+y+1)}$ (C) $\alpha = \frac{(x+y-1)}{i-1}$ (D) $\alpha = \frac{(x+y+1)}{i-1}$

28. When 20 gm of naphthoic acid $(C_{11}H_8O_2)$ is dissolved in 50 gm of benzene $(k_f = 1.72)$, a freezing point depression of 2k is observed. The van't Hoff factor (i) is
(A) 0.5 (B) 1 (C) 2 (D) 3

29. A 0.004 M solution of Na_2SO_4 is isotonic with a 0.01 M solution of glucose at same temperature. The apparent degree of dissociation of Na_2SO_4 is
(A) 25% (B) 50% (C) 75% (D) 85%

30. If equal volumes of $BaCl_2$ and NaF solutions are mixed, which of these combination will not give a precipitate. $(K_{sp}$ of $BaF_2 = 1.7\times10^{-7})$
(A) $10^{-3}M$ $BaCl_2$ and $2\times10^{-2}M$ NaF (B) $10^{-3}M$ $BaCl_2$ and $1.5\times10^{-2}M$ NaF
(C) $1.5\times10^{-2}M$ $BaCl_2$ and $10^{-2}M$ NaF (D) $2\times10^{-2}M$ $BaCl_2$ and $2\times10^{-2}M$ NaF

pace for rough work

Section – III (Mathematics)

1. $\sum_{r=1}^{n}\left(\frac{{}^{n}C_{r}}{r+1}-\frac{{}^{n+1}C_{r}}{n+1}\right)$ equals to

(A) $\frac{1}{n+1}$ (B) $\frac{-n}{n+1}$

(C) $\frac{-(n+2)}{n+1}$ (D) $\frac{-1}{n+1}$

2. Statement -1: If a, b, c are distinct and x, y, z are not all zero, then

$ax+by+cz=0$

$bx+cy+az=0$

$cx+ay+bz=0$

Gives a + b + c $\neq 0$

Statement – 2: $a^2+b^2+c^2>ab+bc+ca$ if a, b, c are distinct.

(A) **Statement-1** is true, **Statement-2** is true, but Statement**-2** is a correct explanation for **Statement-1.**

(B) **Statement-1** is true, **Statement-2** is true, but Statement**-2** is not a correct explanation for **Statement-1.**

(C) **Statement-1** is true, **Statement-2** is false.

(D) **Statement-1** is false, **Statement-2** is true.

3. If $f(x)$ is an odd periodic function with period 2, then $f(4)$ equals

(A) 0 (B) 2 (C) 4 (D) - 4

4. The solution of the differential equation $2x\frac{dy}{dx}-y=3$ represents

(A) straight lines (B) circle (C) parabola (D) ellipse

5. If [x] denotes the greatest integer less than or equal to x, then the value of $\int_{1}^{5}\left[\left|x-3\right|\right]dx$ is

(A) 1 (B) 2 (C) 4 (D) 8

6. A tower AB leans towards west making an angle α with the vertical. The angular elevation of B, the top most point of the tower, is β, as observed from a point C due east of A at a distance d from A. If the angular elevation of B from a point due east of C is at a distance 2d from C is γ, then

(A) $2\tan\alpha=2\cot\beta-\cot\gamma$ (B) $2\tan\alpha=3\cot\beta-\cot\gamma$

(C) $\tan\alpha=\cot\beta-\cot\gamma$ (D) None of these

7. Let $f(x)=x^3+ax^2+bx+5\sin^2 x$ be an increasing function in the set of real number R. Then

(A) $a^2-3b-15>0$ (B) $a^2-3b+15>0$ (C) $a^2-3b-15<0$ (D) $a>0$ and $b>0$

8. If $a_1, a_2, a_3,...$ are in H.P. and $f(k)=\sum_{r=1}^{n}a_r-a_k$, then $\frac{a_1}{f(1)},\frac{a_2}{f(2)},\frac{a_3}{f(3)},...,\frac{a_n}{f(n)}$ are in

(A) A.P. (B) G.P. (C) H.P. (D) None of these

9. A problem in mathematics is given to 3 students whose chances of solving individually are $\frac{1}{2},\frac{1}{3}$ and $\frac{1}{4}$. The probability that the problem will be solved atleast by one is

(A) $\frac{1}{4}$ (B) $\frac{1}{24}$ (C) $\frac{23}{34}$ (D) $\frac{3}{4}$

10. If $a \in I$ and the equation $(x-a)(x-10)+1=0$ has integral roots, then the values of a are
(A) 6, 8 (B) 8, 10 (C) 10, 12 (D) 8, 12

11. If $2x+\sqrt{6}y=2$ touches the hyperbola $x^2-2y^2=4$, then the point of contact is
(A) $\left(-2,\sqrt{6}\right)$ (B) $\left(-5,2\sqrt{6}\right)$ (C) $\left(\frac{1}{2},\frac{1}{\sqrt{6}}\right)$ (D) $\left(4,-\sqrt{6}\right)$

12. Consider a circle with its centre lying on the focus of the parabola $y^2=2px$ such that it touches the directrix of the parabola. Then a point of intersection of the circle and the parabola is
(A) $\left(\frac{p}{2},p\right)$ or $\left(\frac{p}{2},-p\right)$ (B) $\left(\frac{p}{2},-\frac{p}{2}\right)$
(C) $\left(-\frac{p}{2},p\right)$ (D) $\left(-\frac{p}{2},-\frac{p}{2}\right)$

13. If $\left(a,a^2\right)$ falls inside the angle made by the linear equations $y=\frac{x}{2}, x>0$ and $y=3x, x>0$, then a belongs to
(A) $\left(-3,-\frac{1}{2}\right)$ (B) $\left(0,\frac{1}{2}\right)$ (C) $(3,\infty)$ (D) $\left(\frac{1}{2},3\right)$

14. The straight lines whose direction cosines satisfy $al+bm+cn=0,\ fmn+gnl+hlm=0$ are perpendicular if
(A) $\sqrt{af}+\sqrt{bg}+\sqrt{ch}=0$ (B) $\frac{a^2}{f}+\frac{b^2}{g}+\frac{c^2}{h}=0$
(C) $\frac{f}{a}+\frac{g}{b}+\frac{h}{c}=0$ (D) $a^2f+b^2g+c^2h=0$

15. Domain of derivative of the function f (x) = $|\sin^{-1}(2x^2-1)|$ is
(A) [–1, 1] (B) [–1, 1] ~ $\left\{0,\ \pm\frac{1}{\sqrt{2}}\right\}$
(C) [–1, 1] ~ {0} (D) [–1, 1] ~ $\left\{\pm\frac{1}{\sqrt{2}}\right\}$

16. $\sum_{r=1}^{\infty}\tan^{-1}\left(\frac{1}{r^2+5r+7}\right)$ equals to
(A) $\tan^{-1}3$ (B) $\frac{\pi}{4}$
(C) $\sin^{-1}\frac{1}{\sqrt{10}}$ (D) $\cot^{-1}2$

17. If P_1, P_2, P_3 be the lengths of perpendiculars from the vertices of the triangle ABC to the opposite sides, then
(A) $P_1P_2P_3 = abc$ (B) $P_1P_2P_3 = 8R^3$
(C) $P_1P_2P_3 = \frac{a^2b^2c^2}{R^3}$ (D) $P_1P_2P_3 = \frac{a^2b^2c^2}{8R^3}$
(where R is circumradius of triangle ABC).

18. A unit vector is orthogonal to $5\hat{i}+2\hat{j}+6\hat{k}$ and is coplanar to $2\hat{i}+\hat{j}+\hat{k}$ and $\hat{i}-\hat{j}+\hat{k}$, then the vector is

(A) $\frac{3\hat{j}-\hat{k}}{\sqrt{10}}$ (B) $\frac{2\hat{i}+5\hat{j}}{\sqrt{29}}$

(C) $\frac{6\hat{i}-5\hat{k}}{\sqrt{61}}$ (D) $\frac{2\hat{i}+2\hat{j}-\hat{k}}{3}$

19. If the curve $y = x^2 + bx + c$ touches the straight line $y = x$ at the point (1, 1), then b and c are given by

(A) –1, 1 (B) –1, 2

(C) 2, 1 (D) 1, 1

20. In the sequence 1, 2, 2, 3, 3, 3, 4, 4, 4, 4 ..... , where n consecutive terms have the value n, the 150^{th} term is

(A) 17 (B) 16 (C) 18 (D) none of these

21. The value of $\left\{\frac{5^{2n}}{24}\right\}$, $n \in N$ where {.} denotes the fractional part of x, is

(A) 5/24 (B) 9/24 (C) 1/24 (D) None of these

22. If z_1 and z_2 are two complex numbers satisfying the equation $\left|\frac{z_1+z_2}{z_1-z_2}\right|=1$, then $\frac{z_1}{z_2}$ is a number which is

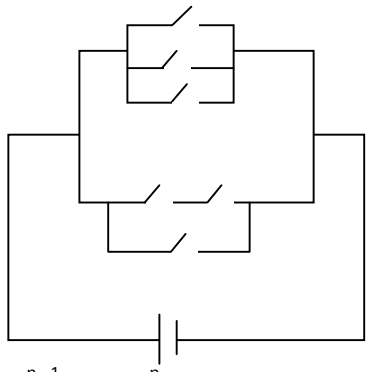
(A) Positive real (B) Negative real

(C) Zero or purely imaginary (D) None of these

23. The number of ways of switching the network such that the bulb glows is

(A) 61 (B) 60

(C) 63 (D) None of these



24. If $2 \sin\theta.\sec 3\theta = \tan 3\theta - \tan\theta$, then $2[\sin\theta.\sec 3\theta + \sin 3\theta.\sec 3^2\theta + ..+\sin 3^{n-1}\theta.\sec 3^n\theta] =$

(A) $\tan 3^n\theta - \tan\theta$ (B) $\tan 3^n\theta - n\tan\theta$ (C) $\tan 3^n\theta - \tan 3^{n-1}\theta$ (D) $\frac{1}{2}(\tan 3^n\theta - \tan\theta)$

25. The determinate $\begin{vmatrix} \cos C & \tan A & 0 \\ \sin B & 0 & -\tan A \\ 0 & \sin B & \cos C \end{vmatrix}$ has the value where A, B, C are angles of a triangle

(A) 0 (B) 1 (C) sinA. sinB (D) cosA cosB cosC

26. The equation of the image of the circle $x^2+y^2+16x-24y+183=0$ by the line mirror $4x+7y+13=0$ is

(A) $x^2+y^2+32x+4y+235=0$ (B) $x^2+y^2-32x+4y+235=0$

(C) $x^2+y^2+32x+4y-235=0$ (D) None of these

27. For hyperbola $\frac{x^2}{\cos^2\alpha}-\frac{y^2}{\sin^2\alpha}=1,$ which of the following remains constant with change in 'α'?

(A) abscissae of vertices
(B) abscissae of foci
(C) eccentricity
(D) directrix

28. If $f(x)=\begin{cases}\frac{\sin[x]}{[x]}, & [x]\neq 0\\ 0, & [x]=0\end{cases}$

Where, [x] denotes the greatest integer less than or equal to x, then $\lim_{x\to 0} f(x)$ equals:

(A) 1 (B) 0 (C) -1 (D) None of these

29. For a real number y, let [y] denote the greatest integer less than or equal to y. Then the function $f(x)=\frac{\tan\pi[(x-\pi)]}{1+[x]^2}$ is:

(A) discontinuous at some x
(B) continuous at all x, but the derivative $f'(x)$ does not exist for some x
(C) $f'(x)$ exists for all x, but the derivative $f''(x)$ does not exist for some x
(D) $f''(x)$ exists for all x

30. $\int\frac{1+(\sin x)^{2/3}}{1+(\sin x)^{4/3}}d(\sin x)^{1/3}$ is equal to

(A) $\frac{1}{\sqrt{2}}\frac{(\sin x)^{2/3}-1}{\sqrt{2}(\sin x)^{1/3}}+c$
(B) $\frac{1}{\sqrt{2}}\tan^{-1}\left(\frac{(\sin x)^{2/3}-1}{\sqrt{2}(\sin x)^{1/3}}\right)+c$
(C) $\frac{1}{\sqrt{2}}\tan^{-1}\left(\frac{(\sin x)^{1/3}-1}{\sqrt{2}(\sin x)^{2/3}}\right)+c$
(D) none of these

space for rough work

FIITJEE - JEE (Main)

SAMPLE TEST - 2

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*** sections in the question paper I, II, III consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each section of equal weightage. Each question is allotted **4 (four)** marks for correct response.
6. *Candidates will be awarded marks as stated above in instruction No.5 for correct response of each question. ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
7. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.
8. Use ***Blue / Black Ball Point Pen only*** for writing particulars / marking responses on ***Side-1*** and ***Side-2*** of the Answer Sheet. ***Use of pencil is strictly prohibited.***
9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall / room.
10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room / Hall. ***However, the candidates are allowed to take away this Test Booklet with them.***
11. **Do not fold or make any stray marks on the Answer Sheet.**

Name of the Candidate (in Capital Letters) :_____

Enrolment Number :_____

Batch :_____ **Date of Examination :** _____

Useful Data Chemistry:

Gas Constant	R	=	$8.314\ J\ K^{-1}\ mol^{-1}$
		=	$0.0821\ Lit\ atm\ K^{-1}\ mol^{-1}$
		=	$1.987 \approx 2\ Cal\ K^{-1}\ mol^{-1}$
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's Constant	h	=	6.626×10^{-34} Js
		=	6.25×10^{-27} erg.s
1 Faraday		=	96500 Coulomb
1 calorie		=	4.2 Joule
1 amu		=	1.66×10^{-27} kg
1 eV		=	1.6×10^{-19} J

Atomic No : H=1, D=1, Li=3, Na=11, K=19, Rb=37, Cs=55, F=9, Ca=20, He=2, O=8, Au=79.

Atomic Masses: He=4, Mg=24, C=12, O=16, N=14, P=31, Br=80, Cu=63.5, Fe=56, Mn=55, Si = 28 Pb=207, u=197, Ag=108, F=19, H=2, Cl=35.5

Useful Data Physics:

Acceleration due to gravity $g = 10\ m/s^2$

Section – I (Physics)

1. If $\vec{A}\times\vec{B}=\vec{B}\times\vec{A}$ then the angle between A and B is

(A)π (B) $\pi/3$ (C) $\pi/2$ (D) $\pi/4$.

2. A ball is projected from the top of a tower of height 40 m with a velocity of 20 m/s at an angle of 30^0 with horizontal. The ratio of time of flight to the time taken to reach the ground is

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

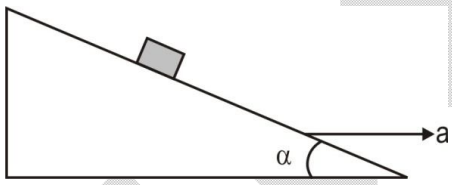
3. A particle starting from the origin (0, 0) moves in a straight line in (x, y) plane. Its coordinates at a later time are ($\sqrt{3}$, 3). The path of the particles makes with the x-axis an angle of.

(A) 45° (B) 60° (C) 0° (D) 30°.

4. A body of mass 1 kg is projected with a velocity of 10m/s at an angle 60^0 w.r.t. horizontal ground. The maximum value of gravitational potential energy in its motion is

(A) 50J (B) 25J
(C) 35J (D) 37.5J

5. A block is kept on a frictionless inclined surface with angle of inclination 'α' as shown in fig. the incline is given an acceleration 'a' to keep the block stationary. Then a is equal to



(A) gtanα (B) g (C) gcosecα (D) g /tan α.

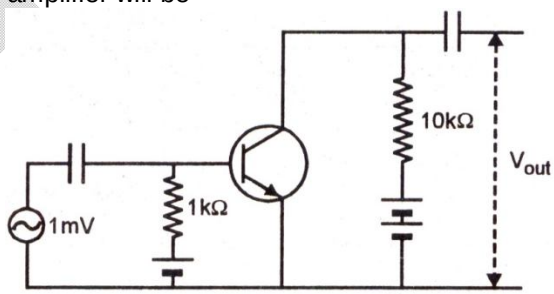
6. A stationary particle explodes into two particles of masses m_1 and m_2, which move in opposite directions, with velocities v_1 and v_2. The ratio of their kinetic energies (E_1/E_2) is

(A) m_2/m_1 (B) m_1/m_2 (C) 1 (D) m_1v_2/m_2v_1

7. Two spheres of masses m and M are situated in air and the gravitational force between them is F. the space around the masses is now filled with a liquid of specific gravity 3. The gravitational force will now be.

(A) 3 F (B) F (C) F / 3 (D) F / 9.

8. In the fig. a common emitter configuration on NPN transistor with current gain β = 100 is used. The output voltage of the amplifier will be



(A) 10 mV (B) 0.1 V (C) 1.0 V (D) 10 V

9. A particle is moving in a X-Y plane under the action of a force such that its instantaneous momentum $\vec{p}=3\cos t\,\hat{i}+3\sin t\,\hat{j}$. The instantaneous angle between the force and momentum is

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{4}$
(C) π (D) zero

10. A cylinder contains 10 kg of gas at pressure of 10^7 Nm^{-2}, the quantity of gas taken out of the cylinder, if final pressure is 2.5×10^6 Nm^{-2}
(A) 7.5 kg (B) 10.5 kg (C) 5.2 kg (D) none of these.

11. A particle of mass M and charge Q moving with velocity $\vec{v}$ describes a circular path of radius R when subjected to a uniform transverse magnetic field of induction B. The work done by the field when the particle completes one full circle is
(A) $\left(\frac{Mv^2}{R}\right) = 2\pi R$ (B) zero (C) BQ 2 π R (D) BQ υ 2π R

12. Two masses A of 0.5 kg and B of 0.3 kg having specific heat capacities of 0.85 J/kg K and 0.9 J/kg K respectively are at temperatures 60^0C and 90^0C respectively. When connected with each other with a conducting rod, heat will flow from
(A) A to B
(B) B to A
(C) Initially from A to B and then from B to A
(D) Heat can't flow

13. In an oscillating LC circuit, the maximum charge on the capacitor is Q. The charge on the capacitor, when the energy is stored equally between the electric and magnetic field is
(A) Q/2 (B) $Q/\sqrt{2}$ (C) $Q/\sqrt{3}$ (D) Q/3

14. In YDSE, two slits are made 5 mm apart and the screen is placed 2 m away. What is the fringe separation when light of wavelength 500 nm is used?
(A) 0.002 mm (B) 0.02 mm (B) 0.2 mm (D) 2 mm

15. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then its focal length will
(A) Become zero (B) become infinite (C) Reduce (D) increase.

16. Momentum of a photon of energy 1 MeV in kg ms^{-1} will be
(A) 5×10^{-22} (B) 0.33×10^6 (C) 7×10^{-24} (D) 10^{-22}

17. If a star converts all helium in its core to oxygen then energy released per oxygen nuclei is
[Mass of He – 4.0026 a.m.u., mass of O – 15.9994 a.m.u.]
(A) 10.24 MeV (B) 0 (C) 7.56 MeV (D) 5 MeV

18. In the middle of the depletion layer of reverse biased p-n junction, the
(A) Electric Field is zero (B) Potential is maximum
(C) Electric field is maximum (D) Potential is zero

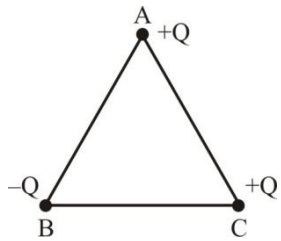
19. Consider telecommunication through optical fibres. Which of the following statements is not correct?
(A) Optical fibres have extremely low transmission loss
(B) Optical fibres may have homogeneous core with a suitable cladding
(C) Optical fibres can be graded refractive index
(D) Optical fibers are subject to electromagnetic interference from outside

20. A tuning fork of frequency 256 Hz produces a faint sound when kept near the mouth of a one end closed cylindrical tube. When water is poured, such that 31 cm of air column exists, the sound becomes loud. The speed of sound in air is
(A) $317\ ms^{-1}$ (B) $371 ms^{-1}$ (C) $340 ms^{-1}$ (D) $332 ms^{-1}$

21. A Carnot engine takes 3×10^6 cals of heat from a reservoir at 627°C and gives it to a sink at 27°C. the work done by the engine is
(A) 4.2×10^6J (B) 8.4×10^6 J (C) 16.8×10^6J (D) 3×10^6J

22. A car moving with a speed of 50 km/h, can be stopped by brakes after at least 6 m. if the same car is moving at a speed of 100 km/h, the minimum stopping distance is
(A) 12 m (B) 18 m (C) 24 m (D) 6 m.

23. Three charge are placed at the vertices of an equilateral triangle of side a as shown in Fig. The force experienced by the charge placed at the vertex A in a direction parallel to BC is



(A) $Q^2/4\pi\in_0 a^2$ (B) $-Q^2/4\pi\in_0 a^2$ (C) Zero (D) $Q^2/2\pi\in_0 a^2$

24. 2kg of ice at –20°C is mixed with 5 kg of water at 20°C in an insulating vessel having a negligible heat capacity. Calculate the final mass of water remaining in the container. It is given that the specific heats of water and ice are 1 kcal/kg./°C and 0.5 kcal/kg/°C. while the latent heat of fusion of ice = 80 kcal/kg
(A) 7 kg (B) 6 kg (C) 4 kg (D) 2 kg.

25. The rms value of the electric field of the light coming from the sun is 720 NC^{-1}. The average total energy density of the electromagnetic wave is
(A) 3.3×10^{-3} Jm^{-3} (B) 4.58×10^{-6} Jm^{-3} (C) 6.37×10^{-9} Jm^{-3} (D) 81.35×10^{-12} Jm^{-3}

26. The displacement of the body in metres varies with time as $x = 2t^3 + 5$. The mass of the body is 2 kg. What is the increase in its kinetic energy one second after the start of the motion
(A) 20 J (B) 30 J
(C) 36 J (D) 48 J

27. A closed organ pipe of length L and an open organ pipe contain gases of densities ρ_1 and ρ_2 respectively. The compressibility of gases are equal in both the pipes. Both the pipes are vibrating in their first overtone with same frequency. The length of the open organ pipe is
(A) $\frac{L}{3}$ (B) $\frac{4L}{3}$ (C) $\frac{4L}{3}\sqrt{\frac{\rho_1}{\rho_2}}$ (D) $\frac{4L}{3}\sqrt{\frac{\rho_2}{\rho_1}}$

28. The velocity of the small ball of mass M and density d_1 when dropped in a container filled with glycerin becomes constant after sometime. If the density of glycerin is d_2, the viscous force acting on the ball is.
(A) $Mg(1 - d_2/d_1)$ (B) $Mg\, d_1/d_2$ (C) $Mg(d_1 - d_2)$ (D) $Mg\, d_1d_2$.

29. The current flowing through wire depends on time as, $I = 3t^2 + 2t + 5$. The charge flowing through the cross-section of the wire in time t = 0 to t = 2 sec is
(A) 22 C (B) 20 C (C) 18 C (D) 5 C

30. If the maximum speed of a particle in SHM is 5 m/s. The average speed of the particle is SHM is equal to
(A) $\frac{5}{\pi}$ m/s (B) $\frac{10}{\pi}$ m/s (C) $\frac{5}{2}$ m/s (D) zero

space for rough work

Section – II (Chemistry)

1. What is the equivalent weight of $HClO_4$?
(A) 100.5 (B) 50.3 (C) 60.1 (D) 90.5

2. 1.82 gm of a metal requires 32.5 ml of 1N HCl to dissolve it. What is the equivalent weight of metal?
(A) 46 (B) 65 (C) 56 (D) 42

3. For a p-electron, the orbital angular momentum is
(A) $\sqrt{3}\frac{h}{2\pi}$ (B) $\frac{h}{2\pi}$ (C) $\sqrt{2}\frac{h}{2\pi}$ (D) $\frac{h}{\pi}$

4. Calculate the frequency of the spectral line emitted when the electron in n = 3 in H-atom de-excites to ground state.
(A) $2.92\times10^{15}\,\text{sec}^{-1}$ (B) $4.52\times10^{-15}\,\text{sec}^{-1}$ (C) $3.2\times10^{10}\,\text{sec}^{-1}$ (D) $1.9\times10^{10}\,\text{sec}^{-1}$

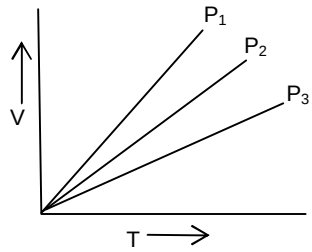
5. Which one of the following transition metal ions is diamagnetic?
(A) Co^{2+} (B) Ni^{2+} (C) Cu^{2+} (D) Zn^{2+}

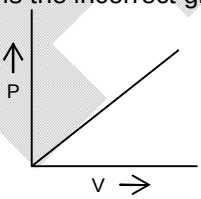
6. Which of the following is expected not to exist?
(A) H_3BO_3 (B) $NaBO_2$ (C) B_2N (D) B_2H_6

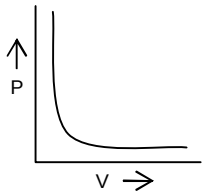
7. The hydrogen bond is strongest in
(A) $O-H---S$ (B) $S-H---O$ (C) $F-H---F$ (D) $F-H---O$

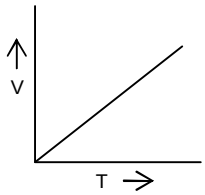
8. What is the increasing order of lattice energies of MgO, CaO, SrO and BaO
(A) $MgO < CaO < SrO < BaO$ (B) $CaO < MgO < BaO < SrO$
(C) $BaO < SrO < CaO < MgO$ (D) $BaO < MgO < CaO < SrO$

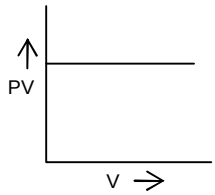
9. Which is the correct order for the graph below?
(A) $P_1 > P_2 > P_3$ (B) $P_2 > P_1 > P_3$
(C) $P_3 > P_2 > P_1$ (D) $P_3 > P_1 > P_2$



10. Which is the incorrect graph?
(A)


(B)


(C)


(D)


11. HI was heated in sealed tube at 400^0C till the equilibrium was reached. HI was found to be 22% decomposed. The equilibrium constant for dissociation is
(A) 1.99 (B) 0.0199 (C) 0.0796 (D) 0.282

12. When sulphur in the form of S_8 is heated at 900K, the initial pressure of 1 atm falls by 30% at equilibrium. This is because of conversion of same S_8 to S_2. Find the value of equilibrium constant for this reaction?

(A) 2.55 atm^3 (B) 2.96 atm^3 (C) 0.71 atm^3 (D) 3.4 atm^3

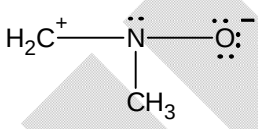
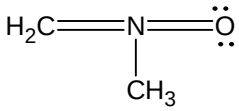
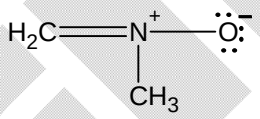
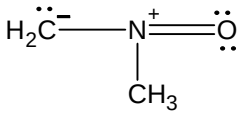
13. Catalyst is a substance which
(A) Supplies energy to the reaction
(B) Increases the equilibrium concentration of the product
(C) Changes the equilibrium constant of the reaction
(D) Lowers the activation energy barrier

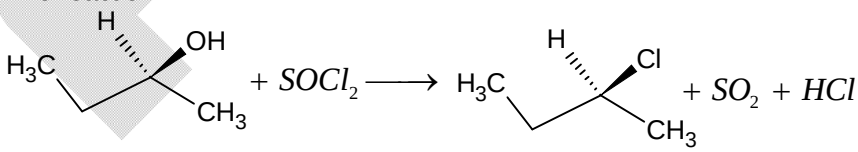
14. What is the pH of solution which have 0.1M NH_3 and 0.05 M NH_4Cl Given that $K_b\left(NH_3\right)=10^{-5}$
(A) 9.3 (B) 5 (C) 4.74 (D) 8.26

15. DDT is an example of
(A) Fungicide (B) Herbicide (C) Insecticide (D) Analgesic

16. The catalyst decrease the E_a from 100 kJ mol^{-1} to 80 $kJmol^{-1}$. At what temperature the rate of reaction in the absence of catalyst at 500 K will be equal to rate of reaction in presence of catalyst.
(A) 200 K (B) 400 K (C) 625 K (D) None of these

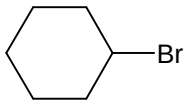
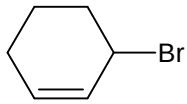
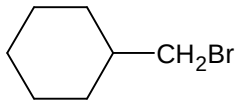
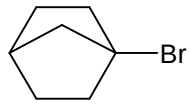
17. The increasing order of stability of the following free radicals is
(A) $\left(CH_3\right)_2\dot{C}H<\left(CH_3\right)_3\dot{C}<\left(C_6H_5\right)_2\dot{C}H<\left(C_6H_5\right)_3\dot{C}$
(B) $\left(C_6H_5\right)_3\dot{C}<\left(C_6H_5\right)_2\dot{C}H<\left(CH_3\right)_3\dot{C}<\left(CH_3\right)_2\dot{C}H$
(C) $\left(C_6H_5\right)_2\dot{C}H<\left(C_6H_5\right)_3\dot{C}<\left(CH_3\right)_3\dot{C}<\left(CH_3\right)_2\dot{C}H$
(D) $\left(CH_3\right)_2\dot{C}H<\left(CH_3\right)_3\dot{C}<\left(C_6H_5\right)_3\dot{C}<\left(C_6H_5\right)_2\dot{C}H$

18. Among the following structures which is not a correct resonance form:
(A) 
(B) 
(C) 
(D) 

19. The reaction

Proceeds by the …….mechanism.
(A) S_Ni (B) S_N2 (C) S_E2 (D) S_E1

20. Which of the following statement about the sulphates of alkali metal is correct?
(A) Except Li_2SO_4, all sulphates of other alkali metals are soluble in water
(B) All sulphates of alkali metals except Li_2SO_4 forms alum.
(C) The sulphates of alkali metals cannot be hydrolysed
(D) All of these

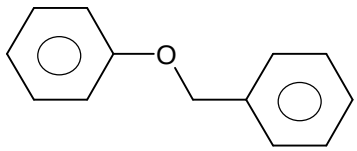
21. The compound which undergoes S_N1 reaction most rapidly is

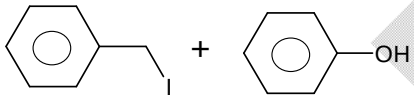
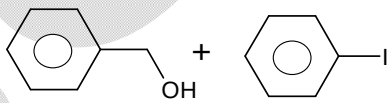
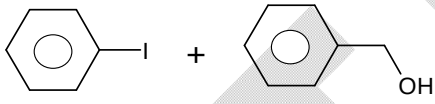
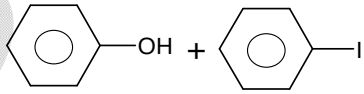
(A)  (B)  (C)  (D) 

22. A solution of (+) 1-chloro-1-phenylethane in toluene racemises slowly in the presence of small amount of $SbCl_5$, due to the formation of
(A) carbanion (B) carbene (C) free-radical (D) carbocation

23. A mixture of benzoic acid and phenol may be differentiated by treatment with
(A) $NaHCO_3$ (B) NaOH (C) NH_3 solution (D) KOH

24. The compound which reacts fastest with Lucas' reagent at room temperature is
(A) 1-butanol (B) 2-butanol
(C) 2-methyl propan-1-ol (D) 2-methyl propan-2-ol

25. The ether  when treated with HI produces

(A) 
(B) 
(C) 
(D) 

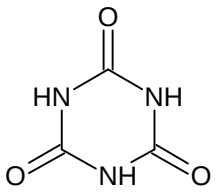
26. 1 g of a monobasic acid HB (having $pK_a = 5$) in 100g water lower the freezing point by 0.155K. If 0.45 g of same acid required 15 ml $\frac{M}{5}$ NaOH solution for complete neutralization $\left(k_f, H_2O = 1.86 K \text{ kg mol}^{-1},\ \text{density of } H_2O \text{ is } 1 \text{ g/ml}\right)$, then which of the following option is incorrect regarding above question
(A) degree of ionization of acid is 0.25
(B) the pH of the resultant solution at the end point of neutralization is greater than 7
(C) normal molecular mass of acid is 150
(D) 10 g of acid HB is hypotonic with 0.625 g urea at the same temperature and same volume of H_2O.

27. Which of the following electrolyte is most effective in the coagulation of gold sol?
(A) $NaNO_3$ (B) $K_4\left[Fe(CN)_6\right]$ (C) Na_3PO_4 (D) $MgCl_2$

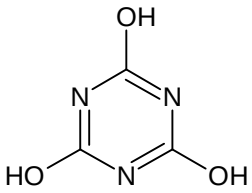
28. Which of the following is false?
(A) When NaCl is heated in the atmosphere of Na, metal excess defect arise due to the migration of Na from vapour to NaCl lattice.
(B) Both Schottky and Frenkel defects can effect electrical conductivity and this conduction is known as intrinsic semiconduction.
(C) Density decreases in Frenkel defect but remains same in Schottky defect
(D) In compounds having metal excess defect F-centres are present which makes them paramagnetic, coloured and help in n-type semiconduction.

29. Ammonia gas can be dried by
(A) conc. H_2SO_4 (B) P_2O_5 (C) quick lime (D) None of these

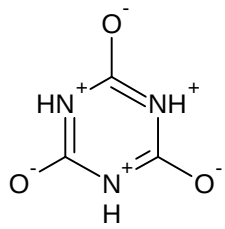
30. What is the relation between the following compounds?



(a)



(b)



(c)

(I) 'b' and 'c' are resonating structures.
(II) 'a' and 'b' are resonating structures.
(III) 'a' and 'b' are tautomers.
(IV) 'a' and 'c' are tautomers.
Which of the above statement/s is/are correct?
(A) (I), (III) only (B) (II), (IV) only (C) (III) only (D) (IV) only

pace for rough work

Section – III (Mathematics)

1. A man standing on a horizontal plane, observes the angle of elevation of the top of a tower to be α. After walking a distance equal to double the height of the tower, the angle of the elevation becomes 2α, then α is equal to

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{12}$ (D) $\frac{\pi}{18}$

2. If $\cos^{-1}x-\cos^{-1}\frac{y}{2}=\alpha$, then
$4x^2-4xy\cos\alpha+y^2$ is equal to:

(A) $-4\sin^2\alpha$ (B) $4\sin^2\alpha$ (C) 4 (D) $2\sin 2\alpha$

3. $\sin\left[2\cos^{-1}\left(-\frac{3}{5}\right)\right]$ is equal to

(A) $\frac{6}{25}$ (B) $\frac{24}{25}$ (C) $\frac{4}{5}$ (D) $-\frac{24}{25}$

4. If $\cos\alpha=\frac{12}{13},\cos\beta=\frac{3}{5},\cos\gamma=\frac{63}{65}$, then $\cos(\alpha+\beta+\gamma)$ is:

(A) 1 (B) 2 (C) 3 (D) 0

5. India plays two matches each with West Indies and Australia. In any match probabilities of India getting points 0, 1 and 2 are 0.45, 0.05 and 0.5 respectively. Assuming that the outcomes are independent, the probability of India getting at least 7 points is

(A) 0.8750 (B) 0.0875 (C) 0.0625 (D) 0.0250

6. The equation of the plane through intersection of planes $x+2y+3z=4$ and $2x+y-z=-5$ and perpendicular to the plane $5x+3y+6z+8=0$, is

(A) $7x-2y+3z+81=0$ (B) $23x+14y-9z+48=0$
(C) $23x+14y-9z+48=0$ (D) $51x+15y-50z+173=0$

7. Image of the point $A(1,6,3)$ in the line $\frac{x}{1}=\frac{y-1}{2}=\frac{z-2}{3}$ is

(A) $(7,1,0)$ (B) $(2,5,7)$ (C) $(1,0,7)$ (D) None of these

8. If $\left[2\vec{a}+4\vec{b}\ \ \vec{c}\ \ \vec{d}\right]=\lambda\left[\vec{a}\ \ \vec{c}\ \ \vec{d}\right]+\mu\left[\vec{b}\ \ \vec{c}\ \ \vec{d}\right]$, then $\lambda+\mu=$

(A) 6 (B) -6 (C) 10 (D) 8

9. If $\vec{x}+\vec{y}=\vec{a},\ \vec{x}\times\vec{y}=\vec{b}$ and $\vec{x}\cdot\vec{a}=1$, then

(A) $\vec{x}=\frac{\vec{a}+\vec{a}\times\vec{b}}{a^2}, y=\frac{\left(a^2-1\right)\vec{a}-\left(\vec{a}\times\vec{b}\right)}{a^2}$ (B) $\vec{x}=\frac{\vec{a}-\left(\vec{a}\times\vec{b}\right)}{a^2}, y=\frac{a^2+\left(\vec{a}\times\vec{b}\right)}{a^2}$

(C) $\vec{x}=\frac{\vec{b}+\left(\vec{a}\times\vec{b}\right)}{a^2}, y$ can have any value (D) $\vec{y}=\frac{\left(b^2-1\right)\vec{b}-\vec{a}\times\vec{b}}{a^2}$,y can have any value

10. The product of the perpendicular and drawn from any point on a hyperbola to its asymptotes is

(A) $\frac{ab}{\sqrt{a}+\sqrt{b}}$ (B) $\frac{ab}{a^2+b^2}$ (C) $\frac{a^2b^2}{a^2+b^2}$ (D) $\frac{a^2+b^2}{a^2b^2}$

11. The number of values of c such that the straight line $y=4x+c$ touches the curve $\frac{x^2}{4}+y^2=1$ is

(A) 0 (B) 1 (C) 2 (D) infinite

12. If $\frac{x}{a}+\frac{y}{b}=\sqrt{2}$ touches the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1,$ then its eccentric angle θ is equal to

(A) 0^0 (B) 90^0 (C) 45^0 (D) 60^0

13. The latus rectum of a parabola whose focal chord is PSQ such that SP = 3 and SQ = 2 is given by

(A) $\frac{24}{5}$ (B) $\frac{12}{5}$ (C) $\frac{6}{5}$ (D) None of these

14. Let PQ and RS be tangent at the extremities of the diameter PR of a circle of radius r. If PS and RQ intersect at a point X on the circumference of the circle, then 2r equals

(A) $\sqrt{PQ.RS}$ (B) $\frac{PQ+RS}{2}$ (C) $\frac{2PQ.RS}{PQ+RS}$ (D) $\sqrt{\frac{PQ^2+RS^2}{2}}$

15. The line of the system $a(2x-y-2)+b(x-3y+4)=0$ situated farthest from the point (1, 1) is

(A) $x+y-4=0$ (B) $x+2y-6=0$ (C) $2x+y-6=0$ (D) None of these

16. Solution of the equation

$x\frac{dy}{dx}=y+x\tan\frac{y}{x}$ is

(A) $\sin\frac{x}{y}=Cx$ (B) $\sin\frac{y}{x}=Cx$ (C) $\sin\frac{x}{y}=Cy$ (D) $\sin\frac{y}{x}=Cy$

17. The solution of the equation

$\left(x^2-xy\right)dy=\left(xy+y^2\right)dx$ is

(A) $xy=Ce^{-y/x}$ (B) $xy=Ce^{-x/y}$ (C) $yx^2=Ce^{1/x}$ (D) None of these

18. $\int_0^{\pi/2}\frac{\sqrt{\sin x}}{\sqrt{\sin x}+\sqrt{\cos x}}dx=$

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{2}$ (C) 0 (D) 1

19. $\int_0^{10\pi}|\sin x|dx$ is

(A) 20 (B) 8 (C) 10 (D) 18

20. $\int\frac{dx}{x\sqrt{1-x^3}}$ is equal to

(A) $\frac{1}{3}\log\left(\frac{\sqrt{1-x^3}-1}{\sqrt{1-x^3}+1}\right)+c$ (B) $\frac{1}{3}\log\left(\frac{\sqrt{1-x^3}-3}{\sqrt{1-x^3}+3}\right)+c$

(C) $\frac{2}{3}\log\left(\frac{1}{\sqrt{1-x^3}}\right)+c$ (D) $\frac{1}{3}\log\left(\frac{1}{\sqrt{1-x^3}}\right)+c$

21. If $f(x)=\frac{1}{8}\log x-bx+x^2, x>0,$ where $b\geq 0$ is a constant, then

(A) $f(x)$ has local minimum at $x=\frac{1}{4}$ for b = 1

(B) $f(x)$ has no extremum for $0\leq b<1$

(C) $f(x)$ has a local minimum at $x=\frac{b-\sqrt{b^2-1}}{4}, b>1$

(D) $f(x)$ has a local maximum at $x=\frac{b+\sqrt{b^2-1}}{4}, b>1$

22. $y=2x+\cot^{-1}x+\log\left(\sqrt{1+x^2}-x\right)$, then y

(A) increases in $[0,\infty)$ only (B) decreases in $[0\ \infty)$

(C) neither increases nor decreases in $[0\ \infty)$ (D) increases in $(-\infty,\infty)$

23. $\lim\limits_{x\to 0}\left[1^{\frac{1}{\sin^2 x}}+2^{\frac{1}{\sin^2 x}}+...+n^{\frac{1}{\sin^2 x}}\right]^{\sin^2 x}$ =

(A) ∞ (B) 0 (C) $\frac{(n+1)}{2}$ (D) n

24. $C_0^2-C_1^2+C_2^2....(-1)C_n^2$, where n is an even integer is

(A) ${}^{2n}C_n$ (B) $(-1)^n\ {}^{2n}C_n$ (C) $(-1)^n\ {}^{2n}C_{n-1}$ (D) None of these

25. The digit at unit's place in the number $(13)^{1225}+(11)^{1915}-(23)^{1225}$ is equal to:

(A) 0 (B) 1 (C) 2 (D) None of these

26. The number of parallelograms that can be formed from a set of four parallel lines intersecting another set of three parallel lines is

(A) 6 (B) 10 (C) 12 (D) None of these

27. The number of triangles which can be formed from 12 points out of which 7 are collinear is

(A) 105 (B) 210 (C) 175 (D) 185

28. One root of the equation

$\begin{vmatrix}3x-8 & 3 & 3\\ 3 & 3x-8 & 3\\ 3 & 3 & 3x-8\end{vmatrix}=0$ is which of the following?

(A) $\frac{8}{3}$ (B) $\frac{2}{3}$ (C) $\frac{1}{3}$ (D) $\frac{16}{3}$.

29. If α is a complex number such that $\alpha^2+\alpha+1=0$, then α^{31} is

(A) α (B) α^2 (C) 0 (D) 1

30. The domain of

$f(x)=\cot^{-1}\frac{x}{\sqrt{x^2-\lfloor x^2\rfloor}}, x\in R$ is

(A) R (B) $R-\{0\}$ (C) $R-\left\{\pm\sqrt{n}, n\in N\right\}$ (D) None of these.

space for rough work

FIITJEE - JEE (Main)

SAMPLE TEST - 3

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*** sections in the question paper I, II, III consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each section of equal weightage. Each question is allotted **4 (four)** marks for correct response.
6. *Candidates will be awarded marks as stated above in instruction No.5 for correct response of each question. ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
7. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.
8. Use ***Blue / Black Ball Point Pen only*** for writing particulars / marking responses on ***Side-1*** and ***Side-2*** of the Answer Sheet. ***Use of pencil is strictly prohibited.***
9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall / room.
10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room / Hall. ***However, the candidates are allowed to take away this Test Booklet with them.***
11. **Do not fold or make any stray marks on the Answer Sheet.**

Name of the Candidate (in Capital Letters) :_____

Enrolment Number :_____

Batch :_____ **Date of Examination :** _____

Useful Data Chemistry:

Gas Constant	R	=	$8.314\ J\ K^{-1}\ mol^{-1}$
		=	$0.0821\ Lit\ atm\ K^{-1}\ mol^{-1}$
		=	$1.987 \approx 2\ Cal\ K^{-1}\ mol^{-1}$
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's Constant	h	=	6.626×10^{-34} Js
		=	6.25×10^{-27} erg.s
1 Faraday		=	96500 Coulomb
1 calorie		=	4.2 Joule
1 amu		=	1.66×10^{-27} kg
1 eV		=	1.6×10^{-19} J

Atomic No : H=1, D=1, Li=3, Na=11, K=19, Rb=37, Cs=55, F=9, Ca=20, He=2, O=8, Au=79.

Atomic Masses: He=4, Mg=24, C=12, O=16, N=14, P=31, Br=80, Cu=63.5, Fe=56, Mn=55, Si = 28 Pb=207, u=197, Ag=108, F=19, H=2, Cl=35.5

Useful Data Physics:

Acceleration due to gravity $g = 10\ m/s^2$

Section – I (Physics)

1. If L, R, C, V respectively represent inductance, resistance, capacitance and potential difference, then the dimensions of $\frac{L}{RCV}$ are the same as those of

(A) Current (B) $\frac{1}{\text{Current}}$ (C) Charge (D) $\frac{1}{\text{Charge}}$

2 A body starting from rest with acceleration α which varies with time t according as $\alpha = At + B$
where A and B are the constants.
The velocity of the particle after time t is:

(A) $(A+B)t$ (B) $\frac{At^2}{2} + 2Bt$ (C) $\frac{At^2}{2} + Bt$ (D) $At^2 + \frac{Bt}{2}$

3. A particle starts from origin at t = 0 and moves in the x – y plane with a constant acceleration 6 m/s^2 in y-direction. The equation of motion is $y = \frac{x^2}{3}$, then its velocity component along x-direction at x = 2 is (in m/s)

(A) $\frac{3}{2}$ (B) 3 (C) 6 (D) 2

4. From the surface of a certain planet a body is projected with a certain velocity at a certain angle from the horizontal surface. The horizontal and vertical displacements x and y are given by $x = 10\sqrt{3}t$ and $y = 10t - t^2$
where t is the time in second and x and y are in meter. The magnitude and direction of the velocity of projection are:
(A) 10 ms^{-1} at 30^0 from the horizontal (B) 20 ms^{-1} at 60^0 from the horizontal
(C) 10 ms^{-1} at 60^0 from the horizontal (D) 20 ms^{-1} at 30^0 from the horizontal

5. From the top of a tower of height 40m, a ball is projected upwards with a speed of 20 ms^{-1} at an angle of 30^0 to the horizontal. If $g = 10 ms^{-2}$, after how long will the ball hit the ground?
(A) 1 s (B) 2 s (C) 3 s (D) 4 s

6. A particle is moving in a circle of radius R. At t = 0 its speed is zero and during its motion speed varies as $v = 2s^2$ where s is the distance travelled. The angle made by acceleration vector with radial direction after one revolution.

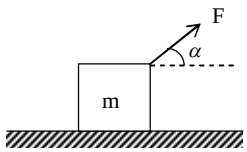
(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{4}$ (C) $\tan^{-1}\left(\frac{1}{\pi}\right)$ (D) π

7. The displacement x of a particle at any instant is related to its velocity as $v = \sqrt{2x+9}$. Its acceleration and initial velocity are:
(A) 1 unit and 3 unit (B) 3 unit and 9 unit (C) 9 unit and 3 unit (D) 2 unit and 9 unit

8. A body is moving down a long inclined plane of angle of inclination θ. The coefficient of friction between the body and the plane varies as $\mu = 0.5x$, where x is the distance moved down the plane. The body will have the maximum velocity when it has travelled a distance x given by

(A) $x = 2\tan\theta$ (B) $x = \frac{2}{\tan\theta}$ (C) $= \sqrt{2}\cot\theta$ (D) $x = \frac{\sqrt{2}}{\cot\theta}$

9. At the instant t = 0 a force $F = kt\left(k \text{ is a constant}\right)$ acts on a small body of mass m resting on a smooth horizontal surface. The time, when body leaves the surface is:



(A) $mgk\sin\alpha$ (B) $k\sin\alpha / mg$

(C) $mg\sin\alpha / k$ (D) $mg / k\sin\alpha$

10. If the potential energy of a gas molecule is

$U = \frac{M}{r^6} - \frac{N}{r^{12}}$,

M and N being positive constants, then the potential energy at equilibrium must be:

(A) zero (B) $M^2 / 4N$ (C) $N^2 / 4M$ (D) $MN^2 / 4$

11. A body is moving up an inclined plane of angle θ with an initial kinetic energy E. The coefficient of friction between the plane and the body is μ. The work done against friction before the body comes to rest is

(A) $\frac{\mu\cos\theta}{E\cos\theta + \sin\theta}$ (B) $\mu E\cos\theta$ (C) $\frac{\mu E\cos\theta}{\mu\cos\theta - \sin\theta}$ (D) $\frac{\mu E\cos\theta}{\mu\cos\theta + \sin\theta}$,

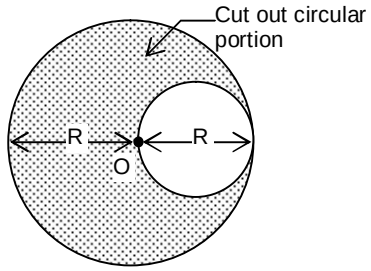
12. A body P strikes another body Q of mass that is p times that of body P and moving with a velocity that is $\frac{1}{q}$ of the velocity of body P. If body P comes to rest, the coefficient of restitution is

(A) $\frac{p+q}{p-q}$ (B) $\frac{p-q}{q(p-1)}$ (C) $\frac{p-q}{p(q-1)}$ (D) $\frac{p+q}{p(q-1)}$

13. A solid cylinder is rolling without slipping down an incline of inclination θ. Minimum coefficient of friction so that the cylinder does not slip on the incline is

(A) $\tan\theta$ (B) $\frac{\tan\theta}{2}$ (C) $\frac{\tan\theta}{3}$ (D) $\tan\left(\frac{\theta}{3}\right)$

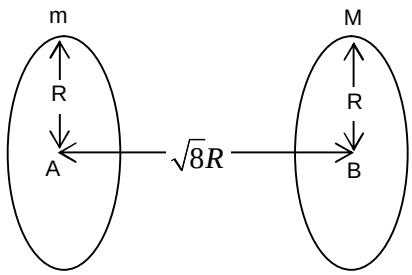
14. A circular portion of diameter R is cut out from a uniform circular disc of mass M and radius R as shown in Fig. The moment of inertia of the remaining (shaded) portion of the disc about an axis passing through the centre O of the disc and perpendicular to its plane is



A $\frac{15}{32}MR^2$ B $\frac{7}{16}MR^2$

C $\frac{13}{32}MR^2$ D $\frac{3}{8}MR^2$

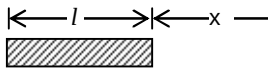
15. The centres of a ring of mass m and a sphere of mass M of equal radius R, are at a distance $\sqrt{8}R$ apart as shown in Fig The force of attraction between the ring and the sphere is



(A) $\frac{2\sqrt{2}}{27}\frac{GmM}{R^2}$ (B) $\frac{GmM}{8Rh2}$

(C) $\frac{GmM}{9R^2}$ (D) $\frac{\sqrt{2}}{9}\frac{GmM}{9R^2}$

16. The magnitude of gravitational force on a particle of mass m placed at a distance x from the rod of mass M and length l as shown in the figure is:



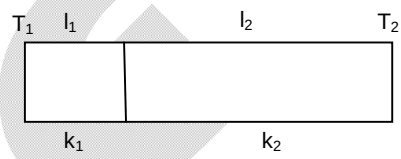
(A) $\frac{GMm}{l+x^2}$ (B) $\frac{GMm}{l(l+x)}$

(C) $\frac{GMm}{l^2+x}$ (D) $\frac{GMm}{x(l+x)}$

17. Water from a tap emerges vertically downwards with an initial speed of 1 ms^{-1}. The cross-sectional area of top is $10^{-4}m^2$. Assume that the pressure is constant throughout the stream of water and that the flow is steady. The cross-sectional area of the stream 0.15 m below the top is (take g = $10ms^{-2}$)

(A) $5\times10^{-4}m^2$ (B) $1\times10^{-5}m^2$ (C) $5\times10^{-5}m^2$ (D) $2\times10^{-5}m^2$

18. One end of a thermally insulated rod is kept at a temperature T_1 and the other at T_2. The rod is composed of two sections of lengths l_1 and l_2 and thermal conductivities k_1 and k_2 respectively. The temperature at the interface of the section is



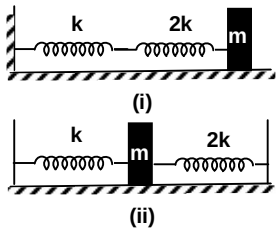
A $\left(k_1l_2T_1+k_2l_1T_2\right)/\left(k_1l_1+k_2l_2\right)$ B $\left(k_2l_1T_1+k_1l_2T_2\right)/\left(k_2l_1+k_1l_2\right)$

C $\left(k_1l_1T_1+k_2l_1T_2\right)/\left(k_1l_2+k_2l_1\right)$ D $\left(k_1l_1T_1+k_2l_2T_2\right)/\left(k_1l_1+k_2l_2\right)$

19. A body cools from 50.0 ^{0}C to 49.9 ^{0}C in 5s. How long will it take to cool from 40.0^{0}C to 39.9^{0}C? Assume the temperature of the surroundings to be 30.0^{0}C and Newton's law of cooling to be valid.

(A) 2.5s (B) 10 s (C) 20 s (D) 5 s

20. In the following figures, the block of mass m is slightly displaced from its mean position.
The ratio of time periods of oscillations in Fig(i) and Fig(ii) is:



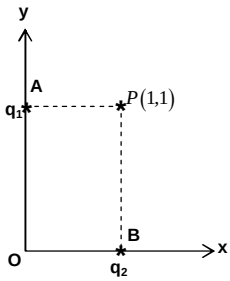
(A) 1 : 2 (B) 2 : 3

(C) 3 : $\sqrt{2}$ (D) 1 : 1

21. Third overtone of a closed organ pipe is in unison with fourth harmonic of an open organ pipe. Find the ratio of lengths of the pipes:

(A) 1 : 2 (B) 3 : 4 (C) 5 : 6 (D) 7 : 8

22. Two point charges q_1 and q_2 (q_1/2) are placed at points A(0, 1) and B(1,0) as shown in the figure. The electric field vector at point P(1,1) makes an angle θ with the x-axis, then the angle θ is:



(A) $\tan^{-1}\left(\frac{1}{2}\right)$ (B) $\tan^{-1}\left(\frac{1}{4}\right)$

(C) $\tan^{-1}(1)$ (D) $\tan^{-1}(0)$

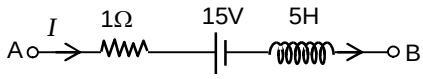
23. Three point charges $4q$, Q and q are placed in straight line of length l at points distant $0,\frac{l}{2},l$ respectively. If the net force on charge q is zero, the magnitude of the force on charge $4q$ is

(A) $\frac{q^2}{\pi\varepsilon_0 l^2}$ (B) $\frac{2q^2}{\pi\varepsilon_0 l^2}$ (C) $\frac{3q^2}{\pi\varepsilon_0 l^2}$ (D) $\frac{4q^2}{\pi\varepsilon_0 l^2}$

24. The capacitance of a sphere of radius R_1 is increased 3 times when it enclosed by an earthed sphere of radius R_2. The ratio R_2/R_1 is

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

25. The network shown in the following figure is part of a circuit. What is the potential difference $(V_B - V_A)$. When current I is 5A and is decreasing at a rate of $10^{-3} A/s$?

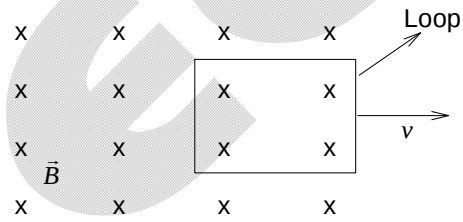


(A) 5 V (B) 10 V
(C) 15 V (D) zero

26. A particle of mass m and charge q moves with a constant velocity v along the positive x direction. It enters a region containing a uniform magnetic field B directed along the negative z direction, extending from $x = a$ to $x = b$. The minimum value of v required so that the particle can just enter the region x > b is

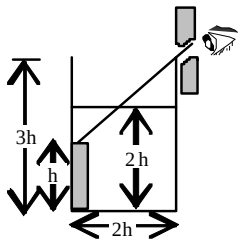
(A) qbB/m (B) $q(b-a)B/m$ (C) qaB/m (D) $q(b+a)B/2m$

27. A square loop is placed in a uniform magnetic field $\vec{B}$ as shown in figure. The power needed to pull it out of the field with a constant velocity v is proportional to



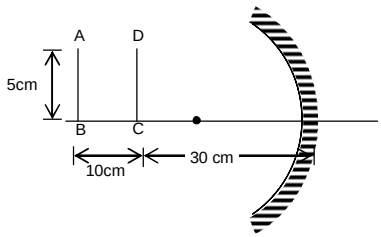
(A) $v^{1/2}$ (B) v
(C) v^2 (D) $v^{3/2}$

28. An observer can see through a pin-hole the top end of a thin rod of height h, placed as shown in the figure. The beaker height is 3h and its radius h. when the beaker is filled with a liquid up to a height 2h, he can see the lower end of the rod. Then the refractive index of the liquid is:



A $\frac{5}{2}$ B $\sqrt{\frac{5}{2}}$ C $\sqrt{\frac{3}{2}}$ D $\frac{3}{2}$

29. A U shaped wire is placed in front of a concave mirror of radius of curvature 20 cm as shown in the figure. The total length of the image of the wire ABCD is nearly:



(A) 2.5 cm (B) 6 cm
(C) 12.5 cm (D) 15 cm

30. Interference pattern is obtained with two coherent light sources of intensity ratio n. In the interference pattern, the ratio $\frac{I_{max} - I_{min}}{I_{max} + I_{min}}$ will be

(A) $\frac{\sqrt{n}}{(n+1)}$ (B) $\frac{2\sqrt{n}}{(n+1)}$ (C) $\frac{\sqrt{n}}{(\sqrt{n}+1)^2}$ (D) $\frac{2\sqrt{n}}{(\sqrt{n}+1)^2}$

space for rough work

Section – II (Chemistry)

1. For a hypothetical reaction

$$AB_{2(g)} + \frac{1}{2}B_{2(g)} \rightleftharpoons AB_{3(g)};\ \Delta H = -x\ kJ$$

More AB_3 could be produced by

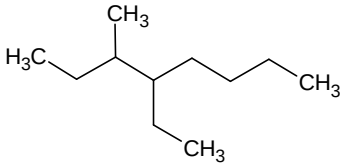
(A) using a catalyst (B) removing some of B_2
(C) increasing the temperature (D) increasing the pressure

2. The pK_b of CN^- is 4.7. The pH of solution prepared by mixing 2.5 mole of KCN and 2.5 moles of HCN in water and making the total volume upto 500 ml, is
(A) 10.3 (B) 9.3 (C) 4.7 (D)8.3

3. The pH of a solution of weak base at half neutralization with strong base is 8, K_b for base is
(A) 1×10^{-4} (B) 1×10^{-6} (C) 1×10^{-8} (D) 1×10^{-7}

4. HBr and HI reduce sulphuric acid, HCl can reduce $KMnO_4$ and HF can reduce
(A) H_2SO_4 (B) $KMnO_4$ (C) $K_2Cr_2O_7$ (D) None of these

5. The correct IUPAC name of the compound given below is:



(A) 4-Ethyl-3-methyloctane (B) 3-Methyl-4-ethyloctane
(C) 2, 3-Dimethylheptane (D) 5-Ethyl-6-methyloctance.

6. The transition metal ion with least magnetic moment has the electronic configuration
(A) $3d^4$ (B) $3d^9$ (C) $3d^2$ (D) $3d^8$

7. Potassium ferricyanide on ionization produces
(A) 2 ions (B) 1 ions (C) 5 ions (D) 4 ions

8. Arrange the following free radicals in order of stability: Benzyl (I), Allyl (II), Methyl (III), Vinyl (IV)
(A) IV > III > II > I (B) I > II > III > IV (C) I > III > IV > II (D) IV > III > I > II

9. A hydrocarbon 'A' with molecular mass 84 gives a single monochloride but four dichlorides on photochemical chlorination. The hydrocarbon 'A' is
(A) Cyclopentane (B) Cyclohexane
(C) 2, 3-Dimethylbutane (D) Methyl cyclopentane

10. What would be the expected formula of a compound which is formed of element X containing 2 electrons in the valence shell and element Y contains 7 electrons in the valence shell?
(A) X_2Y (B) XY_2 (C) XY (D) X_2Y_2

11. If one million atoms of silver weight $1.79\times10^{-16}g$, the gram atomic mass of silver is
(A) 107 g (B) 107.2 g (C) 107.8 g (D) 108.2 g

12. H_2O_2 can act as reducing as well as oxidising agent. In its reaction with NH_2OH and KIO_4, H_2O_2 is acting as
(A) Oxidising agent, reducing agent (B) Reducing agent, oxidising agent
(C) Oxidising agent, oxidising agent (D) Reducing agent, reducing agent

13. The blue colour developed when Lassaigne's extract is heated with fresh $FeSO_4$ in presence of alkali, cooled and acidified with dil. H_2SO_4 indicates…. and is due to the formation of…
(A) $N, Fe_4\left[Fe(CN)_6\right]_3$ (B) $N, Na_4\left[Fe(CN)_6\right]$
(C) $S, Na_4\left[Fe(CN)_5 NOS\right]$ (D) $N+S, Fe(CNS)_3$

14. If the critical temperature of the gas be $T_C = \frac{8a}{27Rb}$ and T_B is the Boyle's temperature, then which of the following, is the correct relation between T_C and T_B?
(A) $T_C = \frac{4}{27}T_B$ (B) $T_C = \frac{27}{4}T_B$ (C) $T_C = \frac{8}{27}T_B$ (D) $T_C = \frac{27}{8}T_B$

15. The composition of a sample of wustite is $Fe_{0.93}O$. What is the percentage of iron present as Fe^{3+}?
(A) 15% (B) 25% (C) 35% (D) 45%

16. The uncertainty in the position of a dust particle with mass equal to 1 mg (if uncertainty in its velocity is $5.5\times10^{-20} ms^{-1}$) is:
(A) $9.58\,\text{Å}$ (B) $958\,\text{Å}$ (C) 9.58 nm (D) None.

17. Which of the following has highest bond dissociation energy?
(A) O_2 (B) O_2^+ (C) O_2^- (D) O_2^{2-}

18. Given, that the abundance of isotopes ^{54}Fe, ^{56}Fe and ^{57}Fe are 5%, 90% and 5% respectively, the atomic mass of Fe is
(A) 55.85 (B) 55.95 (C) 55.75 (D) 55.05

19. The volume strength of 1.5 N H_2O_2 solution is
(A) 4.8 (B) 8.4 (C) 3 (D) 8

20. Which of the following has the maximum number of atoms?
(A) 24 g of C(12) (B) 56 g of Fe(56) (C) 27 g of Al(27) (D) 108 g of Ag(108)

21. An aqueous solution of 6.3 g oxalic acid dihydrate ($H_2C_2O_4.2H_2O$) is made upto 250 ml. The volume of 0.1 N NaOH required to completely neutralize 10 ml of this solution is
(A) 40 ml (B) 10 ml (C) 20 ml (D) 4ml

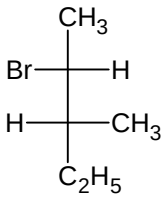
22. In the standardization of $Na_2S_2O_3$ using $K_2Cr_2O_7$ by iodometry, the equivalent weight of $K_2Cr_2O_7$ is:
(A) $\frac{molecular\ weight}{2}$ (B) $\frac{molecular\ weight}{6}$
(C) $\frac{molecular\ weight}{3}$ (D) $\frac{molecular\ weight}{1}$

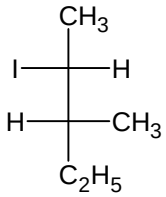
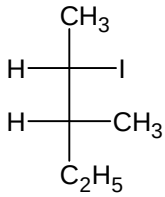
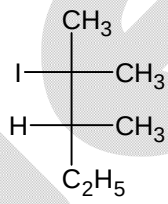
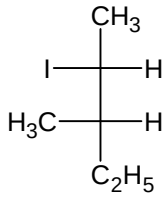
23. What volume of CO_2 at STP will evolve when 1 gm of $CaCO_3$ reacts with excess of dil HCl?
(A) 224 ml (B) 112 ml (C) 58 ml (D) 448 ml

24. The vapour pressure of benzene at 280 K is 40 mbar. When urea is mixed at the same temperature, the vapour pressure falls by 8 mbar. The mole fraction of benzene in the solution is
(A) 0.20 (B) 0.25 (C) 0.70 (D) 0.80

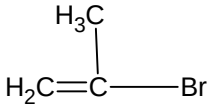
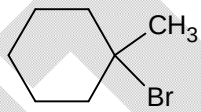
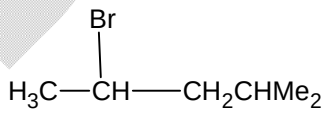
25. Ammonia gas is passed into water, yielding a solution of density 0.93 g/cm^3 and containing 18.6% NH_3 by weight. The mass of NH_3 per cc of the solution is
(A) 0.17 g/cm^3 (B) 0.34 g/cm^3 (C) 0.51 g/cm^3 (D) 0.68 g/cm^3

26. A sample of $NaHCO_3 + Na_2CO_3$ required 20 ml of HCl using phenolphthalein as indicator and 35 ml more is required if methyl orange is used as indicator. Then molar ratio of $NaHCO_3$ to Na_2CO_3 is
(A) $\frac{1}{2}$ (B) $\frac{2}{3}$ (C) $\frac{3}{4}$ (D) $\frac{1}{3}$

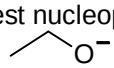
27.  $+NaI \xrightarrow{\text{acetone}}$ Product. The product of the reaction is:

(A) 
(B) 
(C) 
(D) 

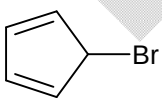
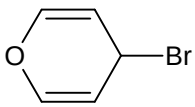
28. Rank the following in order of decreasing rate of solvolysis with aq. ethanol.


(1)

(2)

(3)

(A) 2 > 1 > 3 (B) 1 > 2 > 3 (C) 2 > 3 > 1 (D) 1 > 3 > 2

29. In each of the following groups, which is the strongest nucleophile?
(I) In MeOH (1) CH_3O^- (2)  (3) $Me-S^-$
(II) In DMF (1) OH^- (2) H_2O (3) $O^- - O - H$
(A) I, 3; II, 2 (B) I, 2; II, 1 (C) I, 1; II, 2 (D) I, 3; II, 3

30. Which of the following statement is correct regarding the rate of hydrolysis of the compounds (x) and (y) by S_N1 reaction?


(x)

(y)

(A) x reacts faster than y (B) y reacts faster than x
(C) Both x and y reacts at the same rate (D) Neither x nor y reacts

pace for rough work

Section – III (Mathematics)

1. Range of function $f\left(\{x\}\right)=\frac{2^{\{x\}}-1}{2^{\{x\}}+1}$ is [Where {x} represent fractional part of x]

(A) [-2, 3] (B) [0, 1/3) (C) $\left(\frac{1}{3},\frac{1}{2}\right)$ (D) $\left[⅓,1\right]$

2. If $0^0< x < 90^0$, cos x = $3/\sqrt{10}$, then value of $\log_{10}$ sin x + $\log_{10}$ cos x + $\log_{10}$ tan x is

(A) 0 (B) 1 (C) -1 (D) None of these

3. The function f(x)=[x] cos $\left(\frac{(2x-1)\pi}{2}\right)$ (Where [x] denotes the greatest integer function) is discontinuous.

(A) at all x (B) at all integer points
(C) at no x (D) at x which is not integer

4. Suppose a, b, c are in A.P and a^2, b^2, c^2 are in G.P. If a < b < c and a + b + c = 3/2 , then value of a is

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

5. If tan x tan y = a and x + y = $\pi/6$ then tan x and tan y satisfy the equation,

(A) $x^2-\sqrt{3}(1-a)x+a=0$ (B) $\sqrt{3}x^2-(1-a)x+a\sqrt{3}=0$
(C) $x^2+\sqrt{3}(1-a)x-a=0$ (D) $\sqrt{3}x^2+(1+a)x-a\sqrt{3}=0$

6. Let f (x) = $\frac{x}{x-1}$ *then* $\frac{f(P)}{f(P+1)}$ *is equal to*

(A) $f(P^2)$ (B) $f\left(-\frac{P}{P-1}\right)$ (C) $f\left(\frac{1}{P}\right)$ (D) $f(-P)$

7. The points (x_1, y_1), (x_2, y_2) , (x_1, y_2) and (x_2 , y_1) are always

(A) Vertices of a rhombus (B) Vertices of a square
(C) Con-cyclic (D) Collinear

8. A closet has 5 pair of shoes. The number of ways in which 4 shoes can be drawn such that there will be no complete pair is

(A) 80 (B) 160 (C) 200 (D) 240

9. Solution of the differential equation $\frac{dy}{dx}=\frac{x^2+y^2}{2xy}$ is

(A) k (x^2 + y^2) = x (B) k (x^2 – y^2) + x = 0 (C) k (x^2 – y^2) = x (D) k (x^2 + y^2) + x = 0

10. The complex number z =1 + i is rotated through an angle $3\pi/2$ in anticlockwise direction about the origin and stretched by additional $\sqrt{2}$ unit, then the new complex number is

(A) $-\sqrt{2}-\sqrt{2}\,i$ (B) $\sqrt{2}-\sqrt{2}\;\;i$ (C) $2-\sqrt{2}\,i$ (D) None of these

11. If $|z|<4$, *then* $|iz+3-4i|$ is less than
(A) 4 (B) 5 (C) 6 (D) 9

12. If 4a + 2b + c = 0, then the equation $3ax^2 + 2bx + c = 0$ has at least one real root lying between
(A) 0 and 1 (B) 1 and 2 (C) 0 and 2 (D) none of these

13. $\int sec^{2/3} x \cos ec^{4/3} x dx$ is equal to
(A) $3(\tan x)^{1/3}$ (B) $3(\cot x)^{-1/3}$ (C) $-3(\tan x)^{-1/3}$ (D) $-3(\cot x)^{-1/3}$

14. The value of $\int_0^{100} \{\sqrt{x}\}\, dx$ (where {x} is the fractional part of x) is
(A) 50 (B) 1 (C) 100 (D) None of these

15. If $f(x)=\begin{vmatrix} x & \cos x & e^{x^2} \\ \sin x & x^2 & \sec x \\ \tan x & 1 & 2 \end{vmatrix}$ then the value of $\int_{-\pi/2}^{\pi/2} f(x)\, dx$ *is equal to*
(A) 0 (B) 1 (C) 2 (D) None of these

16. The lines $p(p^2+1)x - y + q = 0$ and $(p^2+1)^2 x + (p^2+1) y + 2q = 0$ are perpendicular to a common line for
(A) No value of p (B) Exactly one value of p
(C) Exactly two values of p (D) More than two values of p

17. Tangents to the circle $x^2 + y^2 = a^2$ cut the circle $x^2 + y^2 = 2a^2$ at P and Q. The tangents at P and Q to the circle $x^2 + y^2 = 2a^2$ intersect at angle θ, then θ is equal to
(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{2}$

18. The length of the latus rectum of parabola $4y^2 + 2x - 20y + 17 = 0$ is
(A) 3 (B) 6 (C) ½ (D) 0

19. S and T are the foci of an ellipse and B is an end of the minor axis. If STB is an equilateral triangle, then the eccentricity of the ellipse is.
(A) 1/4 (B) 1/3 (C) 1/2 (D) 2/3

20. The tangent at any point P on the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ meets the straight lines bx – ay = 0 and bx + ay = 0 in the points Q and R respectively. If C is the centre of the hyperbola, then CQ.CR is
(A) $a^2 - b^2$ (B) $a^2 + b^2$ (C) ab (D) $\frac{a}{b}$

21. The number of points common to the line $\frac{x+3}{2}=\frac{y-4}{3}=\frac{z+5}{2}$ and the plane 4x – 2y – z =1 is
(A) 0 (B) 1 (C) infinite (D) none of these

22. *If* $4\bar{a}+5\bar{b}+9\bar{c}=0$, *then* $(\bar{a}\times\bar{b})\times\left[\left(\bar{b}\times\bar{c}\right)\times\left(\bar{c}\times\bar{a}\right)\right]$ is equal to
(A) A vector perpendicular to plane of $\bar{a}, \bar{b}$ and $\bar{c}$
(B) A scalar quantity
(C) $\vec{0}$

(D) None of these

23. A unit vector in xy-plane which makes an angle of 45^0 with the vector $\vec{i}+\vec{j}$ and an angle of 60^0 with the vector $3\vec{i}-\vec{4j}$ is

(A) $\vec{i}$ (B) $\frac{\vec{i}+\vec{j}}{\sqrt{2}}$ (C) $\frac{\vec{i}-\vec{j}}{\sqrt{2}}$ (D) None of these

24. If $x + y = a + b$, $x^2+ y^2 = a^2 + b^2$, then $x^n + y^n = a^n + b^n$ is true for

(A) $\forall n\in N$ (B) $n\geq 4$ (C) $n\geq 3$ (D) None of these

25. If $1 + |\sin x|+\sin^2 x+|sin^3x|+.....\infty=4+2\sqrt{3}, 0<x<\pi, x\neq \pi/2,$ *then*

(A) $x=\frac{\pi}{6}$ (B) $x=\frac{\pi}{3}, \frac{2\pi}{3}$ (C) $x=\frac{2\pi}{3}, \frac{5\pi}{6}$ (D) $x=\frac{5\pi}{6}$

26. The value of $\sum_{r=0}^{\infty}\tan^{-1}\left(\frac{1}{1+r+r^2}\right)$ is equal to

(A) π /2 (B) π /4 (C) π (D) 0

27. The centre and radius of the circle $z\bar{z}+(1-i)z+(1+i)\bar{z}-7=0$ is

(A) - 1 – i , 3 (B) 1 + i , 3 (C) 2 – i, 4 (D) 2 + i , 4

28. *If* $|x|<1 and |y|<1,$ then the sum to infinity of the series

$(x + y) + (x^2 + xy + y^2) + (x^3 + x^2y + xy^2 + y^3) +$ ..... to ∞ is

(A) $\frac{(x+y-xy)}{(1-x)(1-y)}$ (B) $\frac{(x-y+xy)}{(1-x)(1-y)}$ (C) $\frac{(x+y-xy)}{(1+x)(1+y)}$ (D) infinite

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

(A) Greater than 4ab (B) Less than 4ab (C) Greater than – 4ab (D) Less than – 4ab

30. The coefficient of x^{98} in the expansion of $\frac{1+x}{1-x}$ *if* $|x|<1$

(A) 1 (B) 2 (C) -1 (D) 0

space for rough work