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## ALL INDIA RANKS IN JEE-ADVANCED 2022



**JEE MAIN (JAN) 2023 (24-01-2023-Session-1)**

*Memory Based Question Paper*  
**MATHS, PHYSICS & CHEMISTRY**



## JEE Mains 2023 Memory based paper 24<sup>th</sup> Jan (morning Shift)

### Maths

1. If  $I = \int_0^{\frac{\pi}{2}} \frac{(\sin x)^{2023}}{(\sin x)^{2023} + (\cos x)^{2023}} dx$ , then the value of  $I$  is

- (1)  $\frac{\pi}{4}$
- (2)  $\frac{\pi}{2}$
- (3)  $\frac{3\pi}{4}$
- (4)  $\frac{3\pi}{2}$

**Ans. (1)**

2. If  $I = \int_0^3 |x^2 - 3x + 2| dx$ , then find the value of  $12I$

**Ans. (22)**

3. A tangent at P on the ellipse  $\frac{x^2}{36} + \frac{y^2}{16} = 1$  is drawn. If this tangent cuts x-axis & y-axis at the points A and B respectively then find minimum possible value of AB.

**Ans. (10)**

4. If  $\sum_{r=0}^{2023} r^2 \cdot {}^{2023}C_r = 2023 \times \alpha \times 2^{2022}$ , then the value of  $\alpha$  is-

- (1) 1011
- (2) 1012
- (3) 2022
- (4) 2024

**Ans. (2)**

5. There are 12 subjects in a class, out of which 5 are language subjects. A student has to choose 5 subjects in which almost 2 are language subjects. Find no. of ways to do so.

- (1) 546
- (2) 540
- (3) 456
- (4) 567

**Ans. (1)**

6. Find the area bounded by the curves  $y^2 = -4x + 4$  and  $y = 2x + 2$ .

- (1) 27
- (2) 9



- (3)  $\frac{27}{4}$   
(4)  $\frac{9}{2}$

**Ans. (2)**

7. If  $x^2 - 4x + 3 = x[x] - [x]$ , where  $[.]$  represents the greatest integer function then :
- (1) No. of solutions in  $(-\infty, 1)$  are 1  
(2) No. of solutions in  $(-\infty, \infty)$  are 1  
(3) No. of solutions in  $(1, \infty)$  are 2  
(4) No. of solutions in  $(3, \infty)$  are infinite

**Ans. (2)**

8. If  $\begin{bmatrix} 1 & a & a^2 \\ c & a & b \\ 1 & 1 & 1 \end{bmatrix}$  is a singular matrix and  $a$  is a root of the equation  $(a - b)x^2 + (b - c)x + (c - a) = 0$ , then the value of  $\frac{(a-b)^2}{(b-c)(c-a)} + \frac{(b-c)^2}{(c-a)(a-b)} + \frac{(c-a)^2}{(a-b)(b-c)}$  is
- (1) 3  
(2) 6  
(3) 9  
(4) 12

**Ans. (1)**

9. Two lines are given by  $\frac{x-2}{3} = \frac{y-1}{3} = \frac{z-0}{2}$  and  $\frac{x-1}{3} = \frac{y-2}{2} = \frac{z-1}{3}$  then shortest distance between lines is-
- (1)  $\frac{6}{\sqrt{43}}$   
(2)  $\frac{11}{\sqrt{43}}$   
(3)  $\frac{3}{\sqrt{43}}$   
(4)  $\frac{5}{\sqrt{43}}$

**Ans. (2)**

10. Let  $f(x) = \begin{cases} x^2 \sin \frac{1}{x} & ; x \neq 0 \\ 0 & ; x = 0 \end{cases}$ , then
- (1)  $f$  is continuous and  $f'$  is discontinuous at  $x = 0$   
(2)  $f$  and  $f'$  both are continuous at  $x = 0$   
(3)  $f$  and  $f'$  both are discontinuous at  $x = 0$   
(4)  $f$  is discontinuous and  $f'$  is continuous at  $x = 0$

**Ans. (1)**

11.  $\lim_{t \rightarrow 0} \left( 1^{\frac{1}{\sin^2 t}} + 2^{\frac{1}{\sin^2 t}} + \dots + n^{\frac{1}{\sin^2 t}} \right)^{\sin^2 t}$  is equal to
- (1)  $n^2$



- (2)  $n$   
(3)  $\frac{n(n+1)}{2}$   
(4)  $n^2 + n$

**Ans. (1)**

12. Find the minimum distance of the point  $(7, -4, -3)$  from the plane formed by the points  $(2, 2, -1)$ ,  $(3, 4, 2)$  and  $(7, 0, 6)$ .

- (1)  $\frac{\sqrt{19}}{4}$   
(2)  $\sqrt{19}$   
(3)  $\frac{\sqrt{19}}{3}$   
(4)  $\sqrt{\frac{19}{2}}$

**Ans. (4)**

13. If 'N' is decided by rolling a normal die and  $\frac{k'}{6}$  is the probability that the system of equations

$$x + y + z = 0$$

$$Nx + y + z = 2$$

$$3x + (N - 3)y + z = 6$$

has a unique solution, then find sum of all possible values of 'k' and 'n'

**Ans. (20)**

14. Numbers are formed using digits 1,2,3,4,1,2,3,4&1 then the number of 9 digits numbers such that even digits occupy even places are-

**Ans. (60)**

15. A circle with centre  $\equiv (2, 0)$  with largest possible radius is inscribed in ellipse  $\frac{x^2}{36} + \frac{y^2}{16} = 1$ .

If circle passes through the point  $(1, \alpha)$ , then find value of  $5\alpha^2$ .

**Ans. 59**

16. If  $(1 - \sqrt{3}i)^{200} = 2^{199}(p + iq)$  then the equation whose roots are  $p + q + q^2$  and  $p - q + q^2$  is

(1)  $x^2 + 4x - 1 = 0$

(2)  $x^2 + 4x + 1 = 0$

(3)  $x^2 - 4x + 1 = 0$

(4)  $x^2 + 2x + 2 = 0$

**Ans. (3)**

17. Tangent is drawn at a point on the parabola  $y^2 = 24x$ , it intersects the hyperbola  $xy = 2$  at points A and B such that locus of mid point of AB is a parabola whose.



- (1) Directrix is  $x = \frac{3}{2}$
- (2) Latus rectum is 3
- (3) Directrix is  $x = -\frac{3}{4}$
- (4) Latus rectum is  $\frac{3}{2}$

**Ans. (2)**

18. If  $y = y(x)$  is solution of differential equation  $x^3 dy + (xy - 1)dx = 0$  and  $y\left(\frac{1}{2}\right) = (3 - e)$ , then  $y(1)$  is equal to

- (1) e
- (2) 1
- (3)  $e^e$
- (4)  $e^2$

**Ans. (2)**

19. If A and B are two square matrices of same order such that  $A^2 B = A^2 + B$ , then

- (1)  $A^2 B = BA^2$
- (2)  $A^2 B = -BA^2$
- (3)  $A = I$  or  $B = I$
- (4)  $A^2 = I$

**Ans. (1)**

20.  $\tan^{-1}\left(\frac{1+\sqrt{3}}{3+\sqrt{3}}\right) + \sec^{-1}\left(\sqrt{\frac{8+4\sqrt{3}}{6+3\sqrt{3}}}\right)$  is equal to

- (1)  $\frac{\pi}{6}$
- (2)  $\frac{\pi}{3}$
- (3)  $\frac{\pi}{2}$
- (4) 0

**Ans. (2)**

21. Consider a G.P. with 4<sup>th</sup> term 500. If  $S_n$  denotes sum of first 'n' terms of G.P. such that  $S_6 > S_5 + 1$  and  $S_7 < S_6 + 1$ . If common ratio of G.P. is  $\left(\frac{1}{m}\right)$  where  $m \in \mathbb{N}$ ; then find number of possible values of  $m$ .

**Ans. (15)**

22. If P, Q, R lies on the sides AB, BC and CA respectively of triangle ABC dividing them in the ratio 1: 2, then the ratio of areas of triangle ABC and triangle PQR is

- (1) 2
- (2) 3
- (3) 4
- (4)  $\frac{5}{2}$

**Ans. (2)**

23. If  $R: \mathbb{N} \rightarrow \mathbb{N}$  such that  $aRb$  is  $\gcd(a, b) = 1 \& 2a \neq b$ , then relation R is.

- (1) Reflexive and transitive
- (2) Reflexive but not transitive
- (3) Symmetric but not transitive



(4) Symmetric and transitive

**Ans. (3)**

24. Consider the vectors  $\vec{u} = \frac{i+11j-9k}{2}$  and  $\vec{v} = \hat{i} + \hat{j} + \hat{k}$ . Consider a vector  $\vec{w}$  such that  $\vec{v} \times \vec{w} = \vec{u} + \lambda\vec{v}$ ;  $\vec{v} \cdot \vec{w} = 2$  then find  $\vec{u} \cdot \vec{w}$ . (Data may be different)

(1) 4

(2) 3

(3) 2

(4) 1

**Ans. (4)**

### **PHYSICS**

25. The kinetic energy of a particle is 1000 joule with the mass 2 kg. Find the momentum for the particle?

(1) 200 kg m/s

(2) 400 kg m/s

(3) 800 kg m/s

(4) 600 kg m/s

**Ans. (1)**

26. A Particle is projected vertically upward reaches 136 m height. What will be the maximum range for the particle projected with same speed ?

(1) 272 m

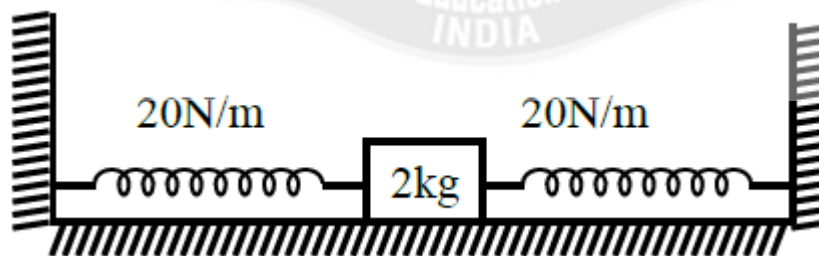
(2) 280 m

(3) 290 m

(4) 300 m

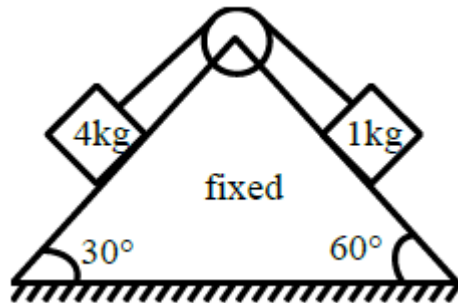
**Ans. (1)**

27. Given system is performing SHM with time period  $T = \frac{\pi}{\sqrt{x}}$ . Find x (all surfaces are smooth) ?



**Ans. (5)**

28. Find tension in string if all surfaces are smooth and string is massless.

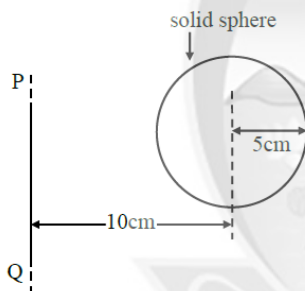


- (1)  $4(\sqrt{3} + 1)N$
- (2)  $4(\sqrt{3} - 1)N$
- (3)  $(4\sqrt{3} + 1)N$
- (4)  $(4\sqrt{3} - 1)N$

**Ans. (1)**

29. Radius of gyration of solid sphere about axis PQ is  $\sqrt{x} \frac{R}{5}$  where  $R$  is radius of sphere.

Find the value of  $x$  ?



**Ans. 110**

30. If equation of wave is given by  $y = 0.05 \sin(2x - 4t)$ . Find velocity of wave?

- (1) 1
- (2) 2
- (3) 4
- (4) 05

**Ans. (2)**

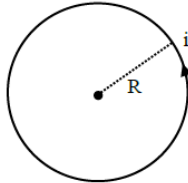
31. In a hydrogen atom first line wavelength of paschen series is  $\lambda = 720 \text{ nm}$ . Find out second line wavelength of same series?

- (1) 70.31 nm
- (2) 90 nm
- (3) 150 nm
- (4) 200 nm

**Ans. (1)**



32. Figure shows current carrying coil of radius  $R$ . Find  $\frac{B_{\text{centre}}}{B_{\text{axis}}}$  at  $r = R$



- (1)  $4\sqrt{2}$
- (2)  $2\sqrt{2}$
- (3)  $3\sqrt{2}$
- (4)  $\sqrt{2}$

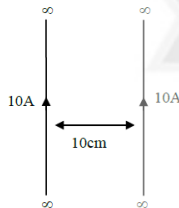
**Ans. (2)**

33. Two charges  $q_1$  &  $q_2$  are placed in a di-electric medium 'K' at a separation  $d$  and resultant force on any charge is  $F_0$ . If both are placed in air, then what should be the separation between them so that they experience same force?

- (1)  $r = Kd$
- (2)  $r = d$
- (3)  $r = d\sqrt{K}$
- (4)  $r = K^{3/2}d$

**Ans. (3)**

34. If a magnetic force on 10 cm portion of one wire is  $F_1$ . Now distance is halved and current gets doubled, then force on same portion is  $xF_1$ . Find  $x$ .



**Ans. 8**

35. A circular loop of radius  $\frac{10}{\sqrt{\pi}}$  cm is placed in a uniform time varying magnetic field with field being perpendicular to the plane of the loop. If the field decreases from 0.5 T to zero in 0.5sec, then induced emf in the loop at 0.25sec. is :

- (1) 1mV
- (2) 10mV
- (3) 5mV
- (4) 100mV

**Ans. (2)**

36. Statement-1 : When light is incident from air to water then Brewster's angle is  $\theta_B$  then if light is incident from water to air then Brewster's angle is  $\frac{\pi}{2} - \theta_B$ .





Statement-2 : When light goes from air to any medium of refractive index is then Brewster's angle ( $\theta_B$ ) is given by  $\theta_B = \tan^{-1}(\mu)$ .

- (1) both statement-1 and Statement- 2 is true
- (2) statement-1 is true and statement-2 is false
- (3) statement- 1 is false and statement-2 is true
- (4) both statement-1 and statement-2 are false

**Ans. (1)**

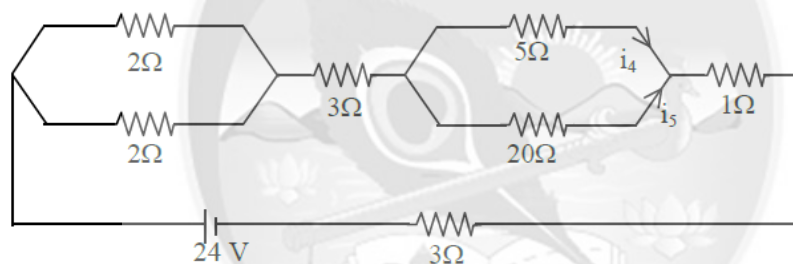
37. A cylinder has inner radius 2 mm and outer radius 4 mm. The resistivity of its material is  $2.4 \times 10^{-5} \Omega\text{m}$  and its length is 3.14 m given. Find out its resistance between two ends?

**Ans. 2**

38. Weight of an object on Earth is 18 N. Find out its weight (in N) at height 3200 km from the earth surface?

**Ans. 8**

39. Find the value of currents  $i_4$  and  $i_5$



- (1)  $\frac{2}{5}, \frac{8}{5}$
- (2)  $\frac{8}{5}, \frac{2}{5}$
- (3)  $\frac{3}{5}, \frac{6}{5}$
- (4)  $\frac{1}{5}, \frac{4}{5}$

**Ans. (2)**

40. Statement-1 : In photodiode, the intensity of light is measured while reverse biasing the photodiode.

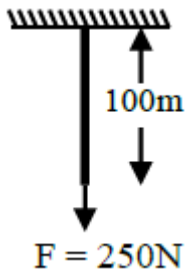
Statement-2 : Forward bias current is more than reverse bias current in PN junction.

- (1) TF
- (2) TT
- (3) FF
- (4) FT

**Ans. (2)**

41. A force of 250 N is applied on a wire as shown

[Young Modulus =  $10^{10} \text{ N/m}^2$ , Area =  $6.25 \times 10^{-4} \text{ m}^2$  ]. Find extension (in cm ) is spring ?



**Ans. 0.4**

42. Match the column.

	Column-I		Column-II
(a)	$h$ (Planck's constant)	(P)	$[M^1 L^1 T^{-1}]$
(b)	$p$ (momentum)	(Q)	$[M^1 L^2 T^{-3}]$
(c)	$V$ (stopping potential)	(R)	$[M^1 L^2 T^{-2}]$
(d)	$\phi$ (work function)	(S)	$[M^1 L^2 T^{-3} A^{-1}]$

Choose the correct option

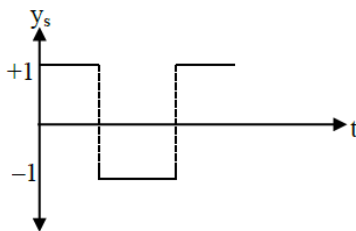
- (1) (a)  $\rightarrow$ Q, (b)  $\rightarrow$ P, (c)  $\rightarrow$ S, (d)  $\rightarrow$ R
- (2) (a)  $\rightarrow$ P, (b)  $\rightarrow$ Q, (c)  $\rightarrow$ R, (d)  $\rightarrow$ S
- (3) (a)  $\rightarrow$ R, (b)  $\rightarrow$ P, (c)  $\rightarrow$ S, (d)  $\rightarrow$ Q
- (4) (a)  $\rightarrow$ S, (b)  $\rightarrow$ P, (c)  $\rightarrow$ Q, (d)  $\rightarrow$ R

43. An Electromagnetic wave propagation vector  $\vec{K}$  and electric field  $\vec{E}$ . If  $\omega$  is the angular frequency then the value of the magnetic field is?

- (1)  $\omega(\vec{K} \times \vec{E})$
- (2)  $\frac{1}{\omega}(\vec{K} \times \vec{E})$
- (3)  $\vec{K} \times \vec{E}$
- (4)  $\vec{E} \times \vec{K}$

Ans. (3)

44. A signal of square shape is superimposed with a carrier wave  $y_c = 2\sin(\omega_c t - kx)$ , then modulation index of amplitude modulated wave is



- (1) 1:2
- (2) 1:4



(3) 4: 1

(4) 2: 1

**Ans. (1)**

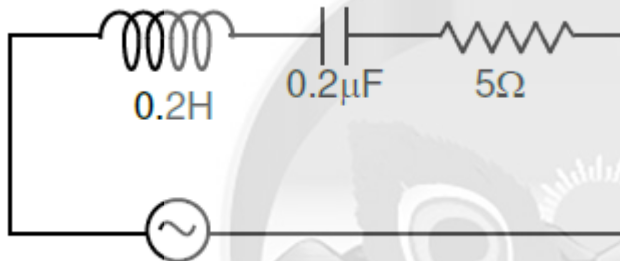
45. **Statement 1** : If temperature of a gas is increased from  $-73^{\circ}\text{C}$  to  $527^{\circ}\text{C}$  then its rms velocity becomes double.

**Statement 2** : Product of pressure and volume is equal to translational kinetic energy of an ideal gas.

- (1) Statement 1 is true, statement-II is true  
 (2) Statement 1 is false, statement-II is true  
 (3) Statement 1 is true, statement-II is false  
 (4) Statement 1 is false, statement-II is false

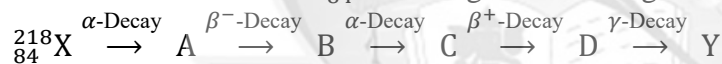
**Ans. (3)**

46. Calculate the ratio of quality factor and band width for the following circuit.



**Ans. 8**

47. A radioactive substance  ${}_{84}^{218}\text{X}$  undergoes following decay:



Then product y is :

- (1)  ${}_{84}^{210}\text{Y}$   
 (2)  ${}_{80}^{210}\text{Y}$   
 (3)  ${}_{84}^{208}\text{Y}$   
 (4)  ${}_{82}^{210}\text{Y}$

**Ans. (2)**

48. 1 gm liquid is converted into vapour under  $3 \times 10^5$  Pa. 10% of heat is used to expand volume by  $1600 \text{ cm}^3$ . What is the increase in internal energy:-

- (1) 4800  
 (2) 4320  
 (3) 4300  
 (4) 400

**Ans. (2)**

49. Choose the correct option based on the following statements

- (a) Photoelectric effect is explained by wave theory  
 (b) Stopping potential may depend on work function  
 (c) If intensity of light increases then photoelectric current also increases  
 (d) If intensity of light increases then maximum kinetic energy of photoelectrons increases.

- (1) (a, d)  
 (2) (a, c)



(3) c

(4) (b, c, d)

**Ans (3)**

50. If  $\hat{A} = 3\hat{i} - 2\hat{j} + b\hat{k}$  and  $B = a\hat{i} + \frac{7}{2}\hat{j} + 2\hat{k}$  and  $\hat{A}$  &  $B$  are perpendicular to each other, also  $2a - 3b = -4$ . If  $\frac{a}{b} = \frac{x}{2}$ . The value of  $x$  is ?

**Ans. (1)**

**Chemistry**

1.  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$  primary and secondary valency will be :'

**Sol.** 3, 6

2.  $\text{CoCl}_4^{2-}$  electronic configuration  $\rightarrow e^m t_2^n$ .

Calculate  $m + n$ .  $n$  = number of unpaired electrons

**Ans : 7**

3. Graph of X-ray frequency  $(\nu)^n \nu/s$  atomic number  $(Z)$  is linear. Find the value of  $n$ .

(1)  $\frac{1}{2}$

(2) 1

(3)  $-\frac{1}{2}$

(4) -1

**Ans : (1)**

4. The wavelength of first line of paschen series is 720 nm, then calculate wavelength of second line of paschen series?

**Ans : 492. 1875 nm**

5. Find correct order of covalent character :

(A)  $\text{KF} < \text{KI}$

(B)  $\text{CuCl} > \text{NaCl}$

(C)  $\text{LiF} > \text{KF}$

(1) A & B only      (2) A & C only      (3) A, B & C      (4) B & C only

**Ans : (3)**

6. Freezing point of solution is less than that of pure solvent, which of the following statements are correct ?

(A) Vapour pressure of solution is less than that of pure solvent

(B) Vapour pressure of solution is greater than that of pure solvent

(C) Only solvent molecules will freeze

(D) Only solute molecules will freeze

(1) A & B only

(2) A & C only

(3) C & D only

(D) A, B & D only

**Ans : (2)**



7. For which of the following aqueous ion, spin only magnetic moment is 3.87BM ?

- (1)  $Ti^{2+}$
- (2)  $V^{2+}$
- (3)  $Cr^{2+}$
- (4)  $Mn^{2+}$

Ans : (2)

8. Correct order of strength of H-bond in the following:

- (A) Liquid water
- (B) Ice
- (C) Impure water

- (1)  $A > B > C$
- (2)  $A < B < C$
- (3)  $B > A > C$
- (4)  $A = B > C$

Ans : (3)

9. How many reactions are nonspontaneous at 300 K. For independent reaction  $\Delta H$  &  $\Delta S$  values are given

- (1)  $\Delta H = -25$  kJ/ mole,  $\Delta S = -80$  J/mole
- (2)  $\Delta H = +25$  kJ/mole,  $\Delta S = -50$  J/mole
- (3)  $\Delta H = 22$  kJ/mole,  $\Delta S = +50$  J/ mole
- (4)  $\Delta H = -22$  kJ/ mole,  $\Delta S = 80$  J/ mole

Ans : (2)

10. Buffer solution of pH = 5 prepared by mixing 25ml, 0.2M  $CH_3COONa$  and 25ml, 0.02M  $CH_3COOH$ , if  $K_a$  of  $CH_3COOH = x \times 10^{-5}$  find x.

Ans : (10)

**11. Column-I Column-II**

- |                           |              |
|---------------------------|--------------|
| (A) Zone refining         | (P) pig iron |
| (B) Electrolysis          | (Q) Al       |
| (C) Reverberatory furnace | (R) Si       |
| (D) Blast furnace         | (S) Cu       |

A B C D

- (1) R Q S P
- (2) Q P S R
- (3) P S Q R
- (4) S P R Q

Ans. (1)

12. How many statements are correct regarding Arrhenius equation ? ( $K = Ae^{-E_a/RT}$ )

- (I) Slope of graph between  $\ln K_v/s \frac{1}{T}$  is  $-\frac{E_a}{R}$
- (II) On increasing  $E_a$ , rate constant decreases



(III) On increasing temperature, temperature coefficient decreases

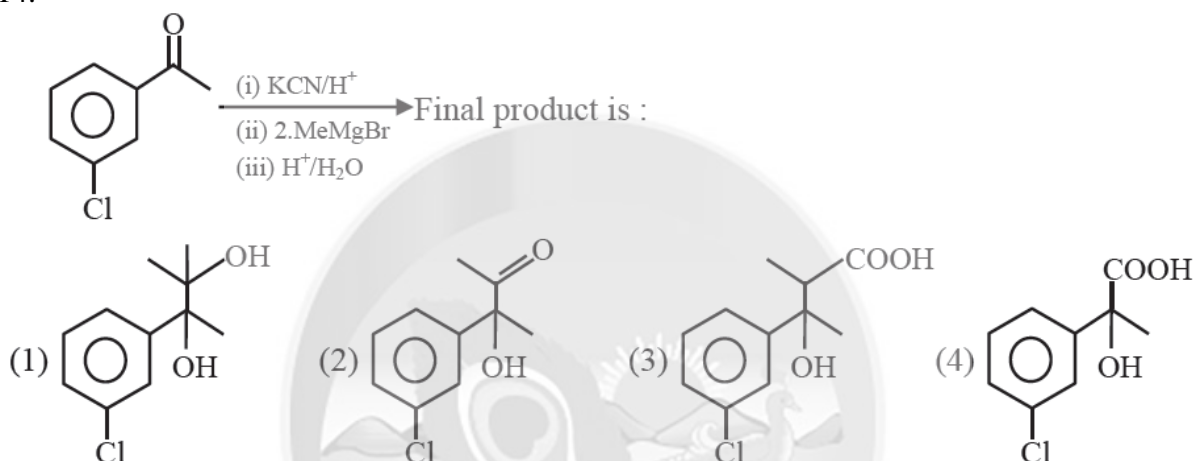
(IV) On increasing activation energy fraction of molecules crossing energy barrier increases

Ans : (3)

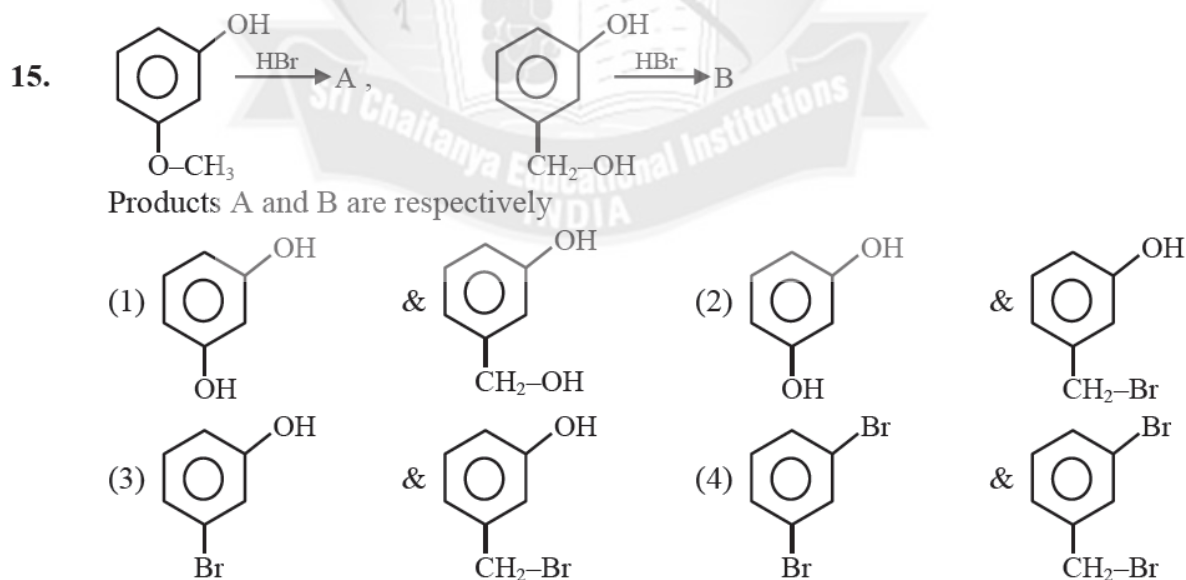
13. 5 g of NaOH is mixed with 450ml of de-ionized water to form stock solution. What volume of this stock solution is used to prepare 500ml, 0.1M solution.

Ans : 180ml

14.



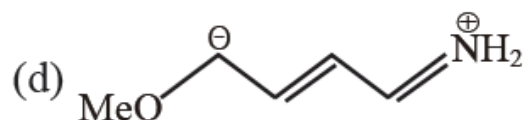
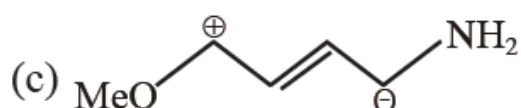
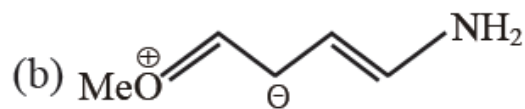
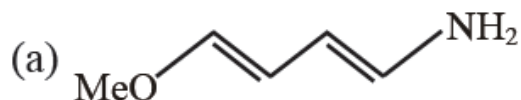
Ans : (2)



Ans. (2)



16 Which of the following is correct stability order of the given resonance structures?



(1)  $a > b > c > d$

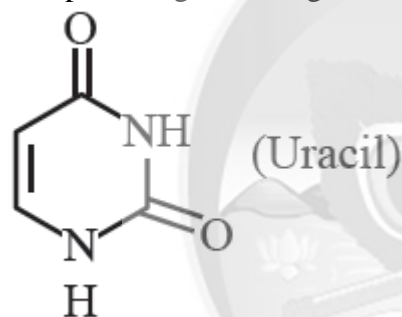
(2)  $b > a > d > c$

(3)  $a > b > d > c$

(4)  $a > d > b > c$

Ans. (3)

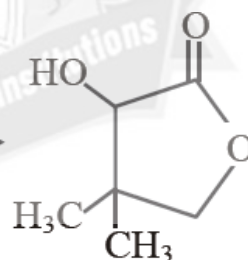
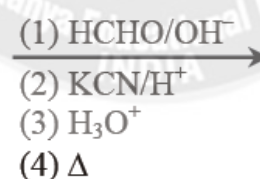
17 Mass percentage of nitrogen in uracil is



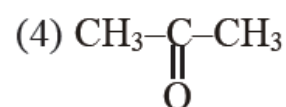
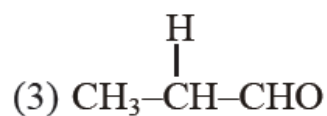
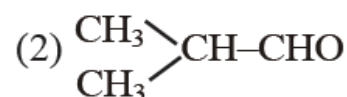
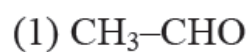
Ans. 25

18.

Compound (X)



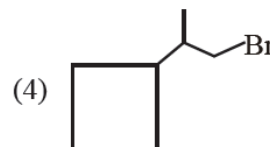
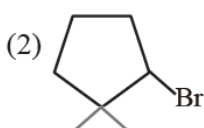
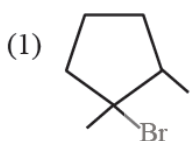
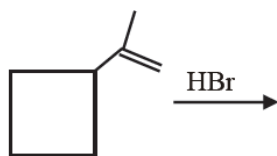
X will be :



Ans. (2)



19. Major product of the given reaction will be :



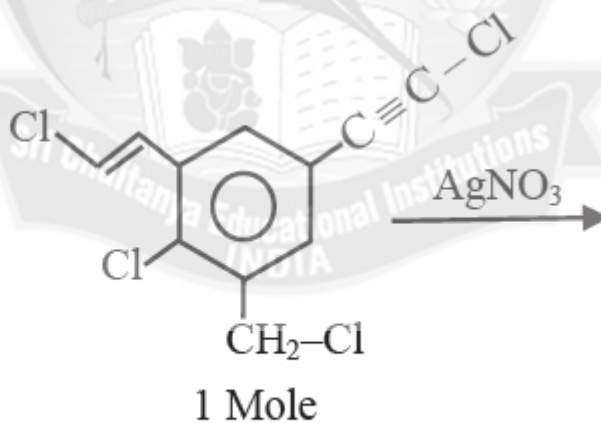
Ans. (1)

20. Which of the following statements is correct?

- (1) All radicals are known as freons.
- (2) Freons cause skin cancer.
- (3) Freons are chlorofluoro carbon.
- (4) Freons are used in sunscreen lotion.

Ans : (3)

21. How many moles of AgCl are formed in the given reaction?



Ans. (1)

22. Statement-I : Noradrenaline is one of the neurotransmitter.

Statement-II : Low level of noradrenaline is not cause of depression in humans.

- (1) Both Statement-I and Statement-II are correct.
- (2) Both Statement-I and Statement-II are incorrect.
- (3) Statement-I is correct but Statement-II is incorrect.
- (4) Statement-I is incorrect but Statement-II is correct.

Ans : (3)



