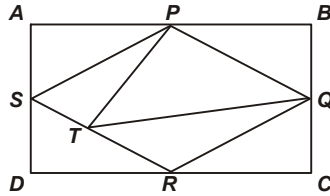


## MATHEMATICS

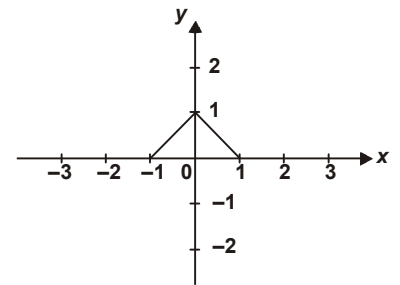
1. In a rectangle  $ABCD$ ,  $P$ ,  $Q$ ,  $R$  and  $S$  are the mid-points of the sides  $AB$ ,  $BC$ ,  $CD$  and  $DA$  respectively and  $T$  is the point on  $RS$  such that  $RT = 2TS$ . If the area of  $ABCD$  is  $k$  times the area of  $\Delta PQT$ , then  $k$  is \_\_\_\_.



- (A) 3                                      (B) 4                                      (C) 6                                      (D) None of these
- 
2.  $2^{73} - 2^{72} - 2^{71}$  is same as \_\_\_\_.
- (A)  $2^{72}$                                       (B)  $2^{71}$                                       (C)  $2^{70}$                                       (D)  $2^{73}$

3. In the following graph for  $x \in [-1, 1]$ ,  $f(x)$  is defined by

- (A)  $|x| - 1$   
 (B)  $-|x| + 1$   
 (C)  $-|x + 1|$   
 (D)  $|x|$



4. Roorkee express normally reaches its destination at 50 km/hr in 30 hours. Find the speed at which it travels to reduce the time by 10 hours?
- (A) 38 km/hr                                      (B) 76 km/hr                                      (C) 75 km/hr                                      (D) 60 km/hr
- 
5. What is the total number of ways of selecting atleast one object from 2 different sets, each set containing 6 identical objects ?
- (A) 24                                      (B) 48                                      (C) 76                                      (D) None of these

6. For every  $a, b \in N$

$$a @ b = a^2 \text{ when } (a + b) \text{ is even}$$

$$= a^2 - b^2 \text{ when } (a + b) \text{ is odd}$$

$$a \# b = b^2 \text{ when } a \times b \text{ is odd}$$

$$= a^2 - b^2 \text{ when } a \times b \text{ is even}$$

What is the value of  $20 \# (21 @ 22)$ ?

- (A) 0                                      (B) 2249                                      (C) -1849                                      (D) Can't be determined
- 
7. The set of values for which  $x^3 + 1 \geq x^2 + x$  is \_\_\_\_.
- (A)  $x \geq 0$                                       (B)  $x \leq 0$                                       (C)  $x \geq -1$                                       (D)  $-1 \leq x \leq 1$
- 
8. A spherical iron ball 10 cm in radius is coated with a layer of ice of uniform thickness that melts at a rate of  $50 \text{ cm}^3/\text{min}$ . When the thickness of ice is 5 cm, then the rate at which the thickness of ice decreases, is \_\_\_\_.

- (A)  $\frac{1}{54\pi} \text{ cm/min}$                                       (B)  $\frac{5}{6\pi} \text{ cm/min}$                                       (C)  $\frac{1}{36\pi} \text{ cm/min}$                                       (D)  $\frac{1}{18\pi} \text{ cm/min}$

9. The ratio of the altitude of the cone of greatest volume that can be inscribed in a given sphere to the diameter of the sphere is \_\_\_\_.
- (A)  $\frac{2}{3}$                       (B)  $\frac{3}{4}$                       (C)  $\frac{1}{3}$                       (D)  $\frac{1}{4}$
- 
10. The sum of the ages of Anshuman and Armaan is 45 years. Five years ago the product of their ages was 4 times the Anshuman's age at that time. The present ages of Anshuman and Armaan respectively are
- (A) 25 and 20                      (B) 35 and 10                      (C) 36 and 9                      (D) 40 and 5
- 
11. A virus gives birth to two new viruses in each second and the life span of each virus is 5 seconds. The process of the reproduction is continuous until the death of the virus. Initially there is one newly born virus at time  $t = 0$ , then find the total number of live viruses just after 10 seconds.
- (A)  $\frac{3^{10}}{2}$                       (B)  $3^5 (3^5 - 1)$                       (C)  $3^{10} - 2^{10}$                       (D)  $3^{10} - 2^5$
- 
12. In a class 45% students read English, 30% read French and 20% read both English and French. One student is selected at random. Find the probability that he reads English, if it is known that he reads French.
- (A)  $\frac{1}{3}$                       (B)  $\frac{2}{3}$                       (C)  $\frac{5}{6}$                       (D)  $\frac{4}{9}$
- 
13. If  $x = -0.5$ , then which of the following has the smallest value ?
- (A)  $2^{1/x}$                       (B)  $\frac{1}{x}$                       (C)  $\frac{1}{x^2}$                       (D)  $2^x$
- 
14. In a code language if POSE is coded as OQNPRTDF, then the word TYPE will be coded as \_\_\_\_.
- (A) SUXZOQFD                      (B) SUXZQOFD                      (C) SUXZOQDF                      (D) SUXZQODE
- 
15. Priti scored more than Rahul. Yash scored as much as Divya. Anusha scored less than Manju. Rahul scored more than Yash. Manju scored less than Divya. Who scored the lowest ?
- (A) Manju                      (B) Yash                      (C) Rahul                      (D) Anusha
- 
16. A postman was returning to the post office which was in front of him to the north. When the post office, was 100 m away from him, he turned to the left and moved 50 m to deliver the last letter at the Shanti villa. He, then moved in the same direction for 40 m, turned to his right and moved 100 m. How many metres was he away from the post office ?
- (A) 0                      (B) 150                      (C) 90                      (D) 100
- 
17. The given below question has a few statements, followed by four conclusions numbered I, II, III and IV. You have to consider every given statements as true, even if it does not confirm to the well known facts. Read the conclusions and then decide which of the conclusions can be logically derived.
- Statements :
1. Some birds are mangoes.
  2. No duck is a parrot.
  3. All mangoes are ducks.
- Conclusions :
- I. Some birds are ducks.
  - II. Some ducks are mangoes.
  - III. No parrot is duck.
  - IV Some birds are not parrots.
- (A) Only I, II and III follow                      (B) Only I and III follow  
(C) Either II or IV follows                      (D) I, II, III & IV follows
-

18. If the following alphabets are arranged in the reverse order, which letter will be 8<sup>th</sup> letter to the left of 7<sup>th</sup> letter counting from the right end ?

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

- (A) P (B) O (C) N (D) Q

19. Four ladies A, B, C and D and four gentlemen E, F, G and H are sitting in a circle around a table facing each other.

- (i) No two ladies or two gentlemen are sitting side by side.
- (ii) C, who is sitting between G and E, is facing D.
- (iii) F is between D and A and is facing G.
- (iv) H is to the right of B.

Who is sitting to the left of A ?

- (A) E (B) F (C) G (D) H

20. In the given question, a statement followed by two assumptions numbered I and II. An assumption is something supposed or taken for granted. You have to consider the statement and the following assumptions and decide which of the assumptions is implicit in the statement.

Statement : Helping the poor is the real service to the humanity.

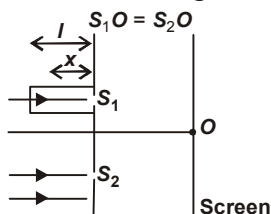
Assumptions : I. Poor people are in need of help from others.

II. If we don't help poor, we will not be called human beings.

- (A) Only assumption I is implicit. (B) Only assumption II is implicit.  
 (C) Either I or II is implicit. (D) Neither I nor II is implicit.

## PHYSICS

21. In the figure shown, a parallel beam of light is incident on the plane of the slits of a Young's double slit experiment. Light incident on the slit,  $S_1$  passes through a medium of variable refractive index  $\mu = 1 + ax$  (where  $x$  is the distance from the plane of slits as shown), upto a distance  $l$  before falling on  $S_1$ . Rest of the space is filled with air. If at  $O$  a minima is formed, then the minimum value of the positive constant  $a$  (in terms of  $l$  and wavelength  $\lambda$  in air) is

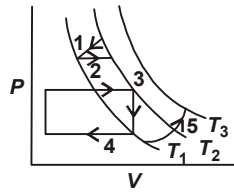


- (A)  $\frac{\lambda}{l}$  (B)  $\frac{\lambda}{l^2}$  (C)  $\frac{l^2}{\lambda}$  (D) None of these

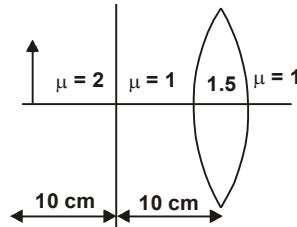
22. The strings of a violin are tuned to the tones G, D, A and E, which are separated by a fifth from one another, that is  $F(D) = 1.5 F(G)$ ,  $F(A) = 1.5 F(D) = 400$  Hz and  $F(E) = 1.5 F(A)$ . The distance between the two fixed points, the bridge at the scroll and over the body of the instrument is, 0.25 m, the tension on the string E is 90 N. The mass per unit length of string E is nearly

- (A) 1 gm/m (B) 2 gm/m (C) 3 gm/m (D) 4 gm/m

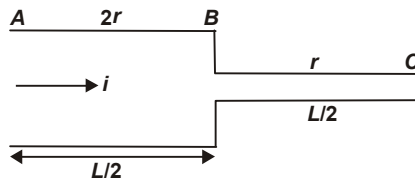
23. The figure here shows five paths traversed by a gas on a  $P$ - $V$  diagram.  $\Delta U_1, \Delta U_2, \Delta U_3, \Delta U_4$  and  $\Delta U_5$  are the change in internal energy of the gas in paths 1, 2, 3, 4 and 5 respectively, then



- (A)  $\Delta U_5 > \Delta U_3$                       (B)  $\Delta U_3 > \Delta U_5$                       (C)  $\Delta U_3 > \Delta U_2$                       (D)  $\Delta U_2 > \Delta U_5$
- 
24. A closed compartment containing gas is moving with some acceleration in horizontal direction. Neglect effect of gravity. Then the pressure in the compartment is
- (A) Same every where                      (B) Lower in the front side  
(C) Lower in the rear side                      (D) Lower in the upper side
- 
25. A body of weight  $w$  is kept on a rough inclined plane having an angle of inclination with horizontal,  $\theta$  and friction coefficient  $\mu$ . Force required to pull the body downwards is
- (A)  $w(\mu \cos \theta + \sin \theta)$                       (B)  $w(\mu \cos \theta - \sin \theta)$                       (C)  $w(\sin \theta - \mu \cos \theta)$                       (D)  $w(\mu \cos \theta + 2 \sin \theta)$
- 
26. An object of length 1 cm is placed on the principle axis of an equiconvex lens of radius 5 cm. Distance between the lens and object is 20 cm. Space between the lens and object is filled with two media of different refractive indices 2 and 1 as shown in the figure. Refractive index is 1 on the left and 2 on the right side of the lens. Boundary of both media is mid-way between the object and lens.

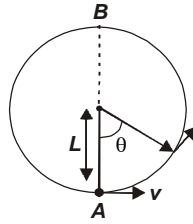


- (A) The image will be formed at distance of 7.5 cm from the optical centre of lens.  
(B) The image will be formed at distance of 10 cm from the optical centre of lens.  
(C) The image will be formed at distance of 15.0 cm from the optical centre of lens.  
(D) The image will be formed at distance of 12.5 cm from the optical centre of lens.
- 
27. A steady current  $i$  is flowing through a cylindrical element  $ABC$  as shown in the given figure. Select the correct relationship regarding this.



- (A)  $V_{AB} = 2V_{BC}$   
(B) Power across  $BC$  is 4 times the power across  $AB$   
(C) Current densities in  $AB$  and  $BC$  are equal  
(D) Electric fields due to current inside  $AB$  and  $BC$  are equal

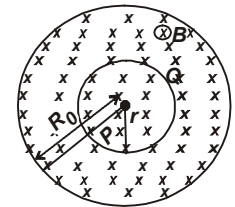
28. A bob of mass  $M$  is suspended by a massless string of length  $L$ . The horizontal velocity  $v$  at position  $A$  is just sufficient to make it reach the point  $B$ . The angle  $\theta$  at which the speed of the bob is half of that at  $A$ , satisfies



- (A)  $\theta = \frac{\pi}{4}$                       (B)  $\frac{\pi}{4} < \theta < \frac{\pi}{2}$                       (C)  $\frac{\pi}{2} < \theta < \frac{3\pi}{4}$                       (D)  $\frac{3\pi}{4} < \theta < \pi$

**DIRECTION :** Refer the following passage to answer Q. Nos. 29, 30 and 31.

Magnetic field in a cylindrical region is increasing at the rate of  $\frac{dB}{dt} = 0.05 \text{ T/s}$  as shown in figure. The radius of the cylindrical region is  $R_0 = 3 \text{ cm}$ . A concentric non-conducting ring of radius  $r = \frac{R_0}{2}$  is placed in this region.



29. The magnitude of induced electric field as a function of distance ' $R$ ' from the centre is best represented by



30. The emf induced in the ring between the points  $P$  and  $Q$ , where  $PQ = R_0$ , is

- (A) Zero                      (B)  $7.08 \times 10^{-5} \text{ V}$                       (C)  $3.54 \times 10^{-5} \text{ V}$                       (D)  $1.76 \times 10^{-5} \text{ V}$

31. If a conducting rod of length  $R_0$  is placed symmetrically about the centre along a diameter of the cylindrical region, their emf induced across the ends of the rod is

- (A) Zero                      (B)  $7.08 \times 10^{-5} \text{ V}$                       (C)  $3.54 \times 10^{-5} \text{ V}$                       (D)  $1.76 \times 10^{-5} \text{ V}$

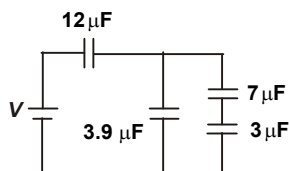
32. **Statement I :** In ammeter, current in shunt is always greater than current in galvanometer.  
**Statement II :** Value of shunt resistance is negative if current in shunt is less than current in galvanometer.

- (A) Both statements I and II are true and statement II is the correct explanation of statement I.  
 (B) Both statements I and II are true but statement II is not the correct explanation of statement I.  
 (C) Statement I is true but statement II is false.  
 (D) Statement I is false but statement II is true.

33. **Statement I :** Specific heat of a substance during change of state is infinite.  
**Statement II :** During change of state,  $\Delta Q = mL$ , specific heat does not come into play.

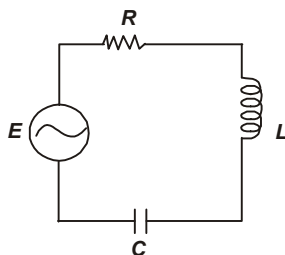
- (A) Both statements I and II are true and statement II is the correct explanation of statement I.  
 (B) Both statements I and II are true but statement II is not the correct explanation of statement I.  
 (C) Statement I is true but statement II is false.  
 (D) Statement I is false but statement II is true.

34. Four capacitors and a battery are connected as shown in the figure. If the potential difference across the  $7\mu\text{F}$  capacitor is 6 V, then match the following columns and select the correct option from the codes given below.



- | Column I   | Column II  |
|--|--|
| (i) The potential difference across the $12\mu\text{F}$ capacitor (in volt)  | (p) 30   |
| (ii) The charge on the $3\mu\text{F}$ capacitor (in $\mu\text{C}$ )          | (q) 42   |
| (iii) The potential difference across the $3\mu\text{F}$ capacitor (in volt) | (r) 10   |
| (iv) The emf of the battery (in volt)  | (s) 14   |
| (A) (i) - (p), (ii) - (q), (iii) - (r), (iv) - (s)                           | (B) (i) - (q), (ii) - (s), (iii) - (p), (iv) - (r) |
| (C) (i) - (r), (ii) - (q), (iii) - (s), (iv) - (p)                           | (D) (i) - (s), (ii) - (r), (iii) - (q), (iv) - (p) |

35. In the given *LCR* circuit,  $R = 160\ \Omega$ ,  $C = \frac{40}{\pi}\ \mu\text{F}$ ,  $L = \frac{750}{\pi}\ \text{mH}$ ,  $f = 60\ \text{Hz}$ ,  $E_m = 36\ \text{V}$ . Match the following columns regarding this and select the correct option from the codes given below.



- | Column I   | Column II  |
|--|--|
| (i) Current amplitude in A                         | (p) 0.8  |
| (ii) rms current in A                              | (q) 2.7  |
| (iii) Power factor                                 | (r) 0.18   |
| (iv) Average power dissipated in the resistor in W | (s) 0.13   |
| (A) (i) - (r), (ii) - (s), (iii) - (p), (iv) - (q) | (B) (i) - (s), (ii) - (p), (iii) - (q), (iv) - (r) |
| (C) (i) - (p), (ii) - (q), (iii) - (r), (iv) - (s) | (D) (i) - (q), (ii) - (r), (iii) - (s), (iv) - (p) |

## CHEMISTRY

36. An  $\alpha$ -particle is accelerated through a potential difference of  $V$  volts. The de-Broglie's wavelength associated with it is

- (A)  $\sqrt{\frac{150}{V}}\ \text{\AA}$       (B)  $\frac{0.286}{\sqrt{V}}\ \text{\AA}$       (C)  $\frac{0.101}{\sqrt{V}}\ \text{\AA}$       (D)  $\frac{0.983}{\sqrt{V}}\ \text{\AA}$

37. Statement I :  $\text{Fe}_2\text{O}_3$  is more acidic than  $\text{FeO}$ .

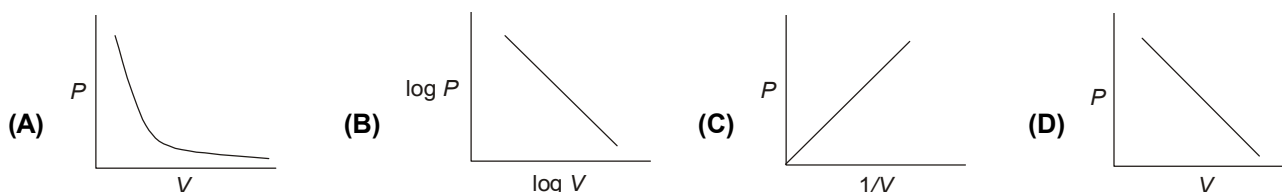
Statement II : Higher the oxidation state, higher the electronegativity, thus non-metallic characteristic is higher.

- (A) Both statements I and II are true and statement II is the correct explanation of statement I.  
 (B) Both statements I and II are true and statement II is not the correct explanation of statement I.  
 (C) Statement I is true but statement II is false.      (D) Statement I is false but statement II is true.

38. The  $I_3^-$  ion has

- (A) Three equatorial lone pairs on the central iodine atom and two axial bond pairs in a pentagonal bipyramidal arrangement.
- (B) Five equatorial lone pairs on the central iodine atom and two axial bond pairs in a pentagonal bipyramidal arrangement.
- (C) Three equatorial lone pairs on the central iodine atom and two axial bond pairs in a trigonal bipyramidal arrangement.
- (D) Two equatorial lone pairs on the central iodine atom and three axial bond pairs in a trigonal bipyramidal arrangement.

39. Which of the following curves does not represent Boyle's law?



40. Match column I with column II and select the correct option from the codes gives below.

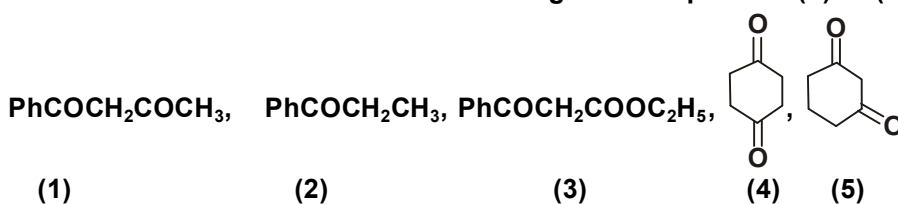
Column I (Reaction)	Column II (Relation between $K_p$ and $K_c$ )
A. $2NO \rightleftharpoons N_2 + O_2$	(P) $K_p = K_c/RT$
B. $N_2 + 3H_2 \rightleftharpoons 2NH_3$	(Q) $K_p = K_cRT$
C. $PCl_3 + Cl_2 \rightleftharpoons PCl_5$	(R) $K_p = K_c$
D. $2O_3 \rightleftharpoons 3O_2$	(S) $K_p = K_c(RT)^{1/2}$
E. $SO_3 \rightleftharpoons SO_2 + 1/2O_2$	(T) $K_p = K_c(RT)^{-2}$
(A) A-R; B-T; C-S; D-P; E-Q	(B) A-S; B-R; C-T; D-Q; E-P
(C) A-R; B-T; C-P; D-Q; E-S	(D) A-P; B-Q; C-R; D-S; E-T

41. Statement I : Diborane reacts with ammonia to form an adduct, which on heating at 473 K decomposes to give a volatile compound called borazine.

Statement II : Borazine is isoelectronic with benzene.

- (A) Both statements I and II are true and statement II is the correct explanation of statement I.
- (B) Both statements I and II are true and statement II is not the correct explanation of statement I.
- (C) Statement I is true but statement II is false.
- (D) Statement I is false but statement II is true.

42. Given below are the structures of five organic compounds (1) to (5) which can undergo enolization.



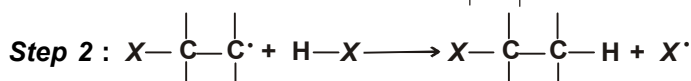
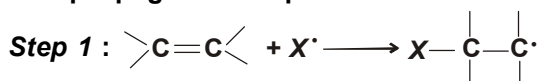
Select from the following the incorrect statement regarding the enolization of the above mentioned.

- (A) (3) is extensively enolized as compared to (4)
- (B) (4) is extensively enolized as compared to (5)
- (C) (1) is extensively enolized as compared to (4)
- (D) enol content of (3) is more than of (2)

43. Simple distillation can be used to separate

- (A) A mixture of benzene (boiling point 80°C) and toluene (boiling point 110°C)  
 (B) A mixture of ether (boiling point 35°C) and toluene (boiling point 110°C)  
 (C) A mixture of ethanol (boiling point 78°C) and water (boiling point 100°C)  
 (D) None of these

44. The propagation steps involved in the free radical addition of HX across a double bond are:



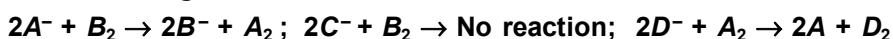
HCl does not follow free radical addition because

- (A) Both steps are exothermic. (B) Both steps are endothermic.  
 (C) Step-1 is exothermic and step-2 is endothermic. (D) Step-2 is exothermic and step-1 is endothermic.

45. The rate expression for the reaction  $\text{A}_{(g)} + \text{B}_{(g)} \rightarrow \text{C}_{(g)}$  is rate =  $k[\text{A}]^2[\text{B}]^{1/2}$ . What changes in the initial concentrations of A and B will cause the rate of reaction to increase by a factor of eight ?

- (A)  $[\text{A}'] = [\text{A}] : [\text{B}'] = 2[\text{B}]$  (B)  $[\text{A}'] = 2[\text{A}] : [\text{B}'] = 4[\text{B}]$   
 (C)  $[\text{A}'] = [\text{A}] : [\text{B}'] = 4[\text{B}]$  (D)  $[\text{A}'] = 4[\text{A}] : [\text{B}'] = [\text{B}]$

46. The following facts are available



Which of the following statements is correct?

- (A)  $E_{\text{C}^-/\text{C}_2} > E_{\text{B}^-/\text{B}_2} > E_{\text{A}^-/\text{A}_2} > E_{\text{D}^-/\text{D}_2}$  (B)  $E_{\text{C}^-/\text{C}_2} < E_{\text{B}^-/\text{B}_2} < E_{\text{A}^-/\text{A}_2} < E_{\text{D}^-/\text{D}_2}$   
 (C)  $E_{\text{C}^-/\text{C}_2} < E_{\text{B}^-/\text{B}_2} > E_{\text{A}^-/\text{A}_2} > E_{\text{D}^-/\text{D}_2}$  (D)  $E_{\text{C}^-/\text{C}_2} > E_{\text{B}^-/\text{B}_2} < E_{\text{A}^-/\text{A}_2} < E_{\text{D}^-/\text{D}_2}$

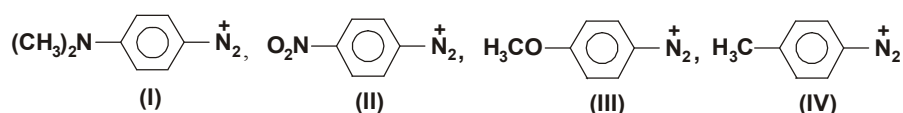
47. Which of the following statements is incorrect ?

- (A)  $\text{La}(\text{OH})_3$  is less basic than  $\text{Lu}(\text{OH})_3$ .  
 (B) In lanthanoid series ionic radius of  $\text{Ln}^{3+}$  ions decreases.  
 (C) La is actually an element of transition series rather than lanthanoid series.  
 (D) Atomic radii of Zr and Hf are same because of lanthanoid contraction.

48. When a vapour at atmospheric pressure was gradually heated from 25°C its colour was found to deepen at first and then fade as the temperature was raised above 160°C. At 600°C, the vapour was almost colourless, but its colour deepened when the pressure was raised at this temperature. The vapour was

- (A) The bromine (B) A mixture of nitrogen dioxide and dinitrogen tetroxide  
 (C) Pure nitrogen dioxide (D) Pure dinitrogen tetroxide

49. The reactivities of the ions (I, II, III & IV) in azo-coupling reactions (under similar conditions) will be



- (A) I < IV < II < III (B) I < III < IV < II (C) III < I < II < IV (D) III < I < IV < II



50. A ketone reacted with ethyl magnesium bromide (Grignard reagent) followed by hydrolysis gave a product which on dehydration gave an alkene. The alkene on ozonolysis gave diethyl ketone and acetaldehyde. The ketone is
- (A) Dimethyl ketone      (B) Ethyl methyl ketone      (C) Diethyl ketone      (D) Ethyl propyl ketone
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SPACE FOR ROUGH WORK

