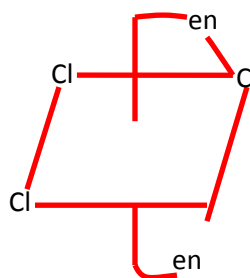
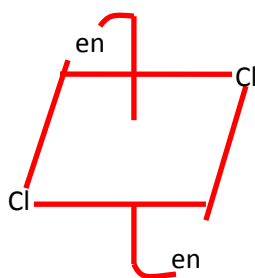
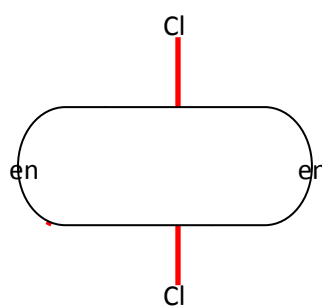
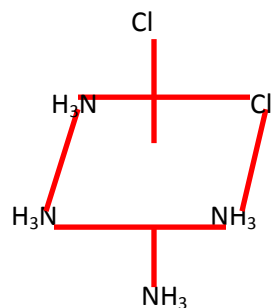
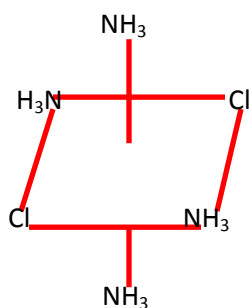
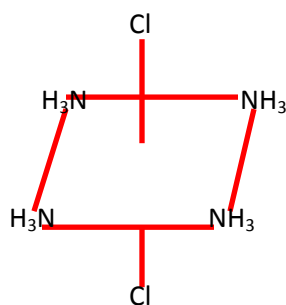
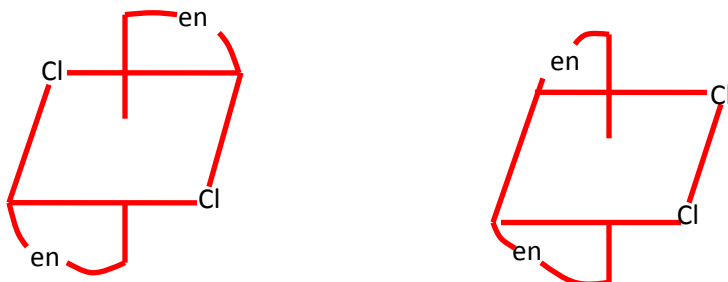


One or more correct answer type (Time: 20 min)

CHEMISTRY

1. Consider the following molecular structures





Choose the correct statement (s).

- (a) I and III are geometrical isomers.
- (b) VI and VIII are identical structures.
- (c) IV and VIII are geometrical isomers.
- (d) VI and VIII are optical isomers.

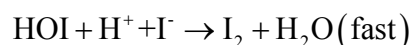
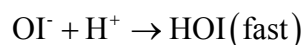
Answer: a,c,d.

Hint: Use the definition of various isomers.

2. The reaction of acidified, aqueous potassium iodide with aqueous H_2O_2 .



Is thought to involve the following steps



- a) The iodide ion is oxidized by H_2O_2
- b) The acid acts as catalyst
- c) The rate determining step is $\text{H}_2\text{O}_2 + \text{I}^- \rightarrow \text{H}_2\text{O} + \text{OI}^-$ (slow)
- d) The rate equation for the reaction is

$$\text{Rate} = k [\text{H}_2\text{O}_2][\text{I}^-]$$

Answer: a, c, d

Solution

H^+ is consumed during the reaction (step 2 and 3) and is not regenerated at the end. Hence, it cannot be a catalyst.

MATHEMATICS

3. Let A be a square matrix of order 3 satisfying $A^3 = 0$. Then which of the following statement(s) is/are true?
- $\frac{1}{2}A^2 + A + I$ is invertible
 - $\frac{1}{2}A^2 - A + I$ is invertible
 - $\frac{1}{2}A^2 + A + I$ is not invertible
 - $\frac{1}{2}A^2 - A + I$ is not invertible

Answer: a, b

Solution:

$$\begin{aligned} \frac{1}{4}A^4 + I &= \left(\frac{1}{4}A^4 + A + I\right)\left(\frac{1}{4}A^4 - A + I\right) \\ &= \left(\frac{1}{4}A^4 + A + I\right)\left(\frac{1}{4}A^4 - A + I\right) = I (\because A^3 = 0) \end{aligned}$$

Thus both $\frac{1}{2}A^2 + A + I$ and $\frac{1}{2}A^2 - A + I$ are invertible.

4. Let A be a set of 26 elements. The number of all possible pairings of A (a set of pair of 2 elements) is/are
- $\frac{|26|}{2^{13} \cdot |13|}$
 - $\frac{|26|}{2^{13}}$
 - $|13|$
 - $25 \cdot 23 \cdot 21 \cdot \dots \cdot 3 \cdot 1$

Answer: a, d

Solution:

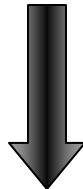
The number of ways is the same as dividing 26 elements in 13 groups of 2 elements each =

$$\frac{26!}{2^{13} \cdot 13!}$$

Now =

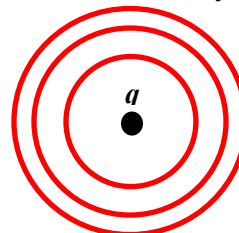
$$\begin{aligned} \frac{26!}{2^{13} \cdot 13!} &= \frac{26 \cdot 25 \cdot 24 \cdot 23 \cdot 22 \cdot 21 \dots 3 \cdot 2 \cdot 1}{2^{13} \cdot 13!} \\ &= \frac{(26 \cdot 24 \cdot 22 \dots 2) \cdot (25 \cdot 23 \cdot 21 \dots 3 \cdot 1)}{2^{13} \cdot 13!} \\ &= \frac{2^{13} (13 \cdot 12 \cdot 11 \dots 3 \cdot 1) \cdot (25 \cdot 23 \cdot 21 \dots 3 \cdot 1)}{2^{13} \cdot 13!} \\ &= 25 \cdot 23 \cdot 21 \dots 3 \cdot 1 \end{aligned}$$

PHYSICS SOLUTION ON NEXT PAGE



PHYSICS

5. The circular lines shown on the diagram are centered at the stationary charged particle. They could represent
- Electric field lines
 - Magnetic field lines
 - Gravitational field line
 - Electric equipotential lines



Answer: d

Solution:

They could represent electric potential lines as electric potential is same at every point of any such circular line.

6. When a monochromatic point source of light is at a distance of 0.2 m from a photoelectric cell, the cut-off voltage and the saturation current are respectively 0.6 volt and 18.0 mA. If the same source is placed 06 m away from the photoelectric cell, then
- The stopping potential will be 0.2 volt
 - The stopping potential will be 0.6 volt
 - The saturation current will be 6.0 mA
 - The saturation current will be 2.0 mA

Answer: b, d

Hint:

When the distance of source from the cell is made three times, then the intensity of light falling on the cell is reduced to $1/9$ of its original value but energy of each photon still remain the same.

Now, photoelectric current \propto intensity of incident light and stopping voltage is dependent only on the energy of the incident photon.