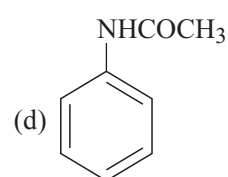
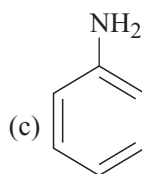
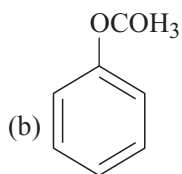
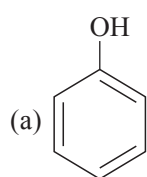


JEE (Main) Chemistry

Offline Solved Paper—2017

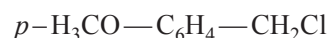
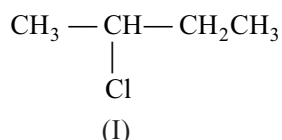
1. Which of the following compounds will form significant amount of *meta* product during mono-nitration reaction?



2. ΔU is equal to

(a) isochoric work (b) isobaric work (c) adiabatic work (d) isothermal work

3. The increasing order of the reactivity of the following halides for the S_N1 reaction is



(a) (III) < (II) < (I) (b) (II) < (I) < (III) (c) (I) < (III) < (II) (d) (II) < (III) < (I)

4. The radius of the second Bohr orbit for hydrogen atom is:

(Planck constant, $h = 6.6262 \times 10^{-34}$ J s; mass of electron, $m_e = 9.1091 \times 10^{-31}$ kg; charge of electron, $e = 1.60210 \times 10^{-19}$ C; and permittivity of vacuum, $\epsilon = 8.854185 \times 10^{-12}$ kg⁻¹ m⁻¹ A².)

(a) 1.65 Å (b) 4.76 Å (c) 0.529 Å (d) 2.12 Å

5. pK_a of a weak acid (HA) and pK_b of a weak base (BOH) are 3.2 and 3.4, respectively. The pH of their salt (AB) solution is

(a) 7.2 (b) 6.9 (c) 7.0 (d) 1.0

6. The formation of which of the following polymers involves hydrolysis reaction?

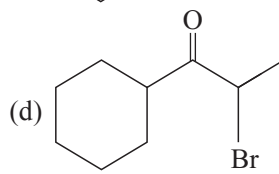
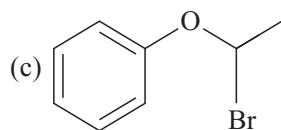
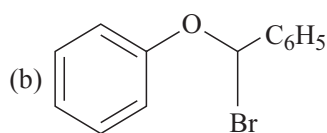
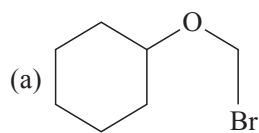
(a) Nylon 6 (b) Bakelite (c) Nylon 6, 6 (d) Terylene

7. The most abundant elements by mass in the body of a healthy human adults are:

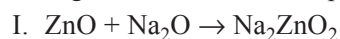
Oxygen (61.4%); Carbon (22.9%); Hydrogen (10.0%) and Nitrogen (2.6%). The mass which a 75 kg person would gain if all ¹H atoms are replaced by ²H atoms is

(a) 15 kg (b) 37.5 kg (c) 7.5 kg (d) 10 kg.

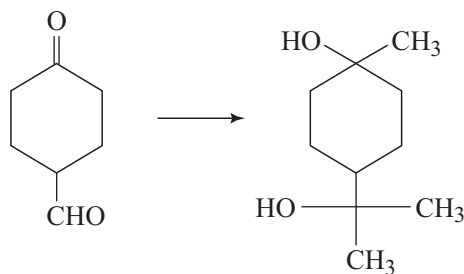
8. Which of the following, upon treatment with *tert*-BuONa followed by addition of bromine water, fails to decolourize the colour of bromine?



9. In the following reactions, ZnO is respectively acting as a/an

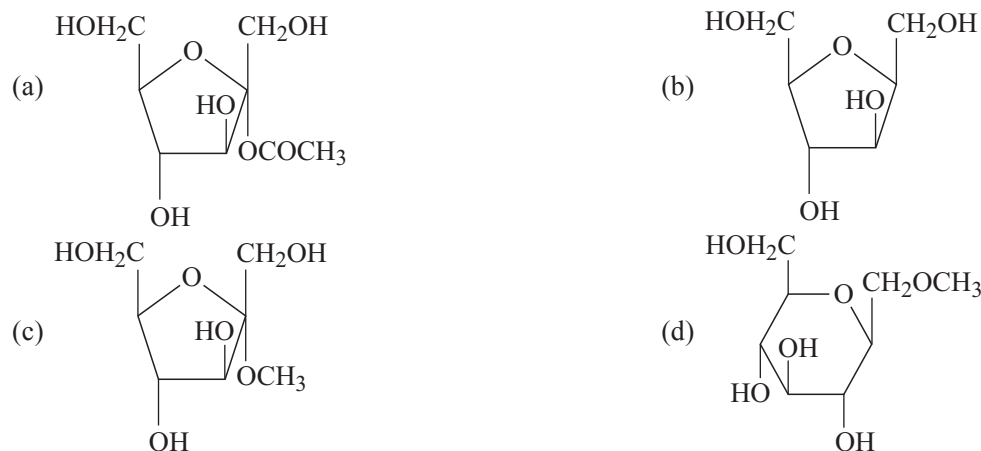


- (a) base and acid (b) base and base (c) acid and acid (d) acid and base
10. Both lithium and magnesium display several similar properties due to the diagonal relationship. However, the one which is incorrect is:
- (a) Both form basic carbonates
 (b) Both form soluble bicarbonates
 (c) Both form nitrides
 (d) Nitrates of both Li and Mg yield NO_2 and O_2 on heating.
11. 3-Methylpent-2-ene on reaction with HBr in presence of peroxide forms an addition product. The number of possible stereoisomers for the product is:
- (a) Six (b) Zero (c) Two (d) Four
12. A metal crystallises in a face-centred cubic structure. If the edge length of its unit cell is a , the closest approach between two atoms in the metallic crystal will be
- (a) $2a$ (b) $2\sqrt{2}a$ (c) $\sqrt{2}a$ (d) $a/\sqrt{2}$
13. Two reactions R_1 and R_2 have identical pre-exponential factors. Activation energy of R_1 exceeds that of R_2 by 10 kJ mol^{-1} . If k_1 and k_2 are rate constants for the reactions R_1 and R_2 , respectively at 300 K, then $\ln(k_2/k_1)$ is equal to: ($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)
- (a) 8 (b) 12 (c) 6 (d) 4
14. The correct sequence of reagents for the following conversion will be

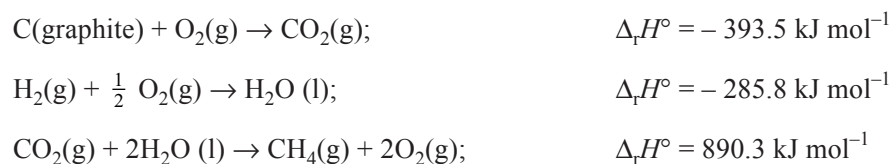


- (a) $[\text{Ag}(\text{NH}_3)_2]^+\text{OH}^-$, $\text{H}^+/\text{CH}_3\text{OH}$, CH_3MgBr (b) CH_3MgBr , $\text{H}^+/\text{CH}_3\text{OH}$, $[\text{Ag}(\text{NH}_3)_2]^+\text{OH}^-$
 (c) CH_3MgBr , $[\text{Ag}(\text{NH}_3)_2]^+\text{OH}^-$, $\text{H}^+/\text{CH}_3\text{OH}$ (d) $[\text{Ag}(\text{NH}_3)_2]^+\text{OH}^-$, CH_3MgBr , $\text{H}^+/\text{CH}_3\text{OH}$
15. The Tyndall effect is observed only when following conditions are observed:
- (I) The diameter of the dispersed particles is much smaller than the wavelength of the light used.
 (II) The diameter of the dispersed particles is not much smaller than the wavelength of the light used.
 (III) The refractive indices of the dispersed phase and dispersion medium are almost similar in magnitude
 (IV) The refractive indices of the dispersed phase and dispersion medium differ greatly in magnitude
- (a) (I) and (IV) (b) (II) and (IV) (c) (I) and (III) (d) (II) and (III)

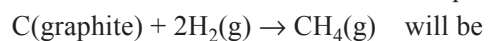
16. Which of the following compounds will behave as a reducing sugar in aqueous KOH solution?



17. Given:



Based on the above thermochemical equations, the value of $\Delta_r H^\circ$ at 298 K for the reaction



- (a) +74.8 kJ mol⁻¹ (b) +144.0 kJ mol⁻¹ (c) -74.8 kJ mol⁻¹ (d) -144.0 kJ mol⁻¹

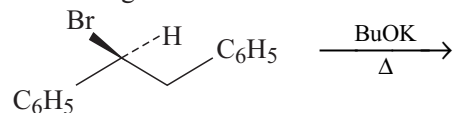
18. Which of the following reactions is an example of a redox reaction?

- (a) $\text{XeF}_4 + \text{O}_2\text{F}_2 \rightarrow \text{XeF}_6 + \text{O}_2$ (b) $\text{XeF}_2 + \text{PF}_5 \rightarrow [\text{XeF}]^+ \text{PF}_6^-$
 (c) $\text{XeF}_6 + \text{H}_2\text{O} \rightarrow \text{XeOF}_4 + 2\text{HF}$ (d) $\text{XeF}_6 + 2\text{H}_2\text{O} \rightarrow \text{XeO}_2\text{F}_2 + 4\text{HF}$

19. The product obtained when chlorine gas reacts with cold and dilute aqueous NaOH are:

- (a) ClO^- and ClO_3^- (b) ClO_2^- and ClO_3^- (c) Cl^- and ClO^- (d) Cl^- and ClO_3^-

20. The major product obtained in the following reaction is:



- (a) $(\pm) \text{C}_6\text{H}_5\text{CH}(\text{OBu})\text{CH}_2\text{C}_6\text{H}_5$ (b) $\text{C}_6\text{H}_5\text{CH}=\text{CHC}_6\text{H}_5$
 (c) $(+) \text{C}_6\text{H}_5\text{CH}(\text{OBu})\text{CH}_2\text{C}_6\text{H}_5$ (d) $(-) \text{C}_6\text{H}_5\text{CH}(\text{OBu})\text{CH}_2\text{C}_6\text{H}_5$

21. Sodium salt of an organic acid 'X' produces effervescence with conc. H_2SO_4 . X reacts with acidified aqueous CaCl_2 solution to give a white precipitate which decolourises acidic solution of KMnO_4 . The compound X is

- (a) $\text{C}_6\text{H}_5\text{COONa}$ (b) HCOONa (c) CH_3COONa (d) $\text{Na}_2\text{C}_2\text{O}_4$

22. Which of the following species is not paramagnetic?

- (a) NO (b) CO (c) O_2 (d) B_2

23. The freezing point of benzene decreases by 0.45°C when 0.2 g of acetic acid is added to 20 g of benzene. If acetic acid associates to form a dimer in benzene, percentage association of acetic acid in benzene will be (Given: $K_f(\text{benzene}) = 5.12 \text{ K kg mol}^{-1}$):

- (a) 64.6% (b) 80.4% (c) 74.6% (d) 94.6%

24. Which of the following molecule is least resonance stabilized.

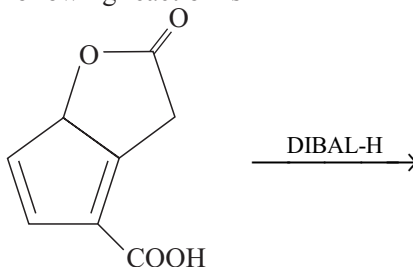


JEEC.4 Complete Chemistry—JEE Main

25. On treatment of 100 mL of 0.1 M solution of $\text{CoCl}_3 \cdot 6\text{H}_2\text{O}$ with excess AgNO_3 , 1.2×10^{22} ions are precipitated. The complex is

- (a) $[\text{Co}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$ (b) $[\text{Co}(\text{H}_2\text{O})_3\text{Cl}_3] \cdot 3\text{H}_2\text{O}$
 (c) $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$ (d) $\{\text{Co}(\text{H}_2\text{O})_5\text{Cl}\}\text{Cl}_2 \cdot \text{H}_2\text{O}$

26. The major product obtained in the following reaction is



- (a)
- (b)
- (c)
- (d)

27. A water sample has ppm level concentrations of following anions

$$\text{F}^- = 10; \quad \text{SO}_4^{2-} = 100; \quad \text{NO}_3^- = 50$$

The anion/anions that make/makes the water sample unstable for drinking is/are

- (a) only NO_3^- (b) both SO_4^{2-} and NO_3^- (c) only F^- (d) only SO_4^{2-}
28. One gram of a carbonate (M_2CO_3) on treatment with excess HCl produces 0.01186 mol of CO_2 , the molar mass of M_2CO_3 in g mol^{-1} is
- (a) 1186 (b) 84.3 (c) 118.6 (d) 11.86
29. Given:

$$E_{\text{Cl}_2|\text{Cl}^-}^\circ = 1.36 \text{ V}$$

$$E_{\text{Cr}^{3+}|\text{Cr}}^\circ = -0.74 \text{ V}$$

$$E_{\text{Cr}_2\text{O}_7^{2-}|\text{Cr}^{3+}}^\circ = 1.33 \text{ V}$$

$$E_{\text{MnO}_4^-|\text{Mn}^{2+}}^\circ = 1.51 \text{ V}$$

Among the following, the strongest reducing agent is

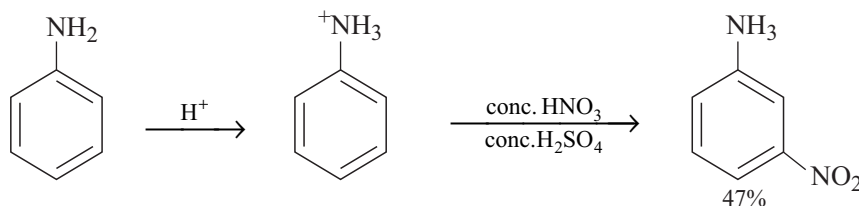
- (a) Cr (b) Mn^{2+} (c) Cr^{3+} (d) Cl^-
30. The group having isoelectronic species is
- (a) O^{2-} , F^- , Na^+ , Mg^{2+} (b) O^- , F^- , Na , Mg^+ (c) O^{2-} , F^- , Na , Mg^{2+} (d) O^- , F^- , Na^+ , Mg^{2+}

ANSWERS

1. (c) 2. (a) 3. (b) 4. (d) 5. (b) 6. (a)
 7. (c) 8. (a) 9. (d) 10. (a) 11. (d) 12. (d)
 13. (d) 14. (a) 15. (b) 16. (a) 17. (c) 18. (a)
 19. (c) 20. (b) 21. (d) 22. (b) 23. (d) 24. (d)
 25. (d) 26. (b) 27. (c) 28. (b) 29. (a) 30. (a)

HINTS AND SOLUTIONS

1. Nitration is carried out in the presence of conc. H_2SO_4 and conc. HNO_3 . Aniline being a base forms anilinium ion with acid. The $-\text{NH}_3^+$ ion being a deactivating group results in the formation of *meta* mono-nitration product.

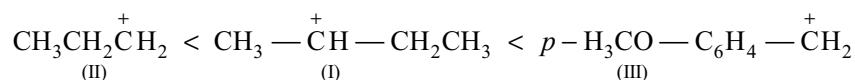


2. Adiabatic condition implies $q = 0$. Thus, from the first law of thermodynamics, we have

$$\Delta U = q + w = 0 + w = w$$

3. The $\text{S}_{\text{N}}1$ reaction proceeds through ionic mechanism. The larger the stability of the resultant carbocation, larger the reactivity of the halide.

The stability of the carbocations formed from the given compounds is



The carbocation from the compound (II) is most stable due to conjugation with phenyl group. The primary carbocation (I) is lesser stable than the secondary carbocation (III).

4. Recall that the Bohr radius (i.e. radius of $n = 1$ orbit of hydrogen atom) is 52.9 pm ($= 52.9 \times 10^{-12} \text{ m} = 0.529 \text{ \AA}$). Also,

$$r_n = n^2 r_1$$

$$\text{Hence } r_2 = (2)^2 (0.529 \text{ \AA}) = 2.116 \text{ \AA} \approx 2.12 \text{ \AA}$$

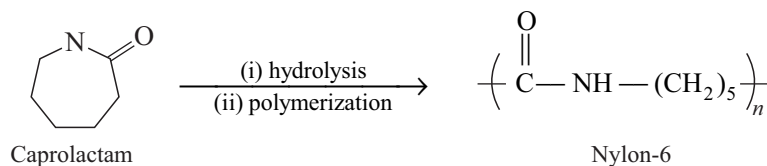
5. The pH of a solution containing a salt of weak acid and weak base is given by the expression

$$\text{pH} = \frac{1}{2} (\text{p}K_w + \text{p}K_a - \text{p}K_b)$$

Hence, at 25 °C, we have

$$\text{pH} = \frac{1}{2} (14 + 3.2 - 3.4) = 6.9$$

6. Nylon 6 is obtained by hydrolysis of caprolactam:



7. Mass of ^1H in 75 kg of the person $= \frac{10}{100} \times 75 \text{ kg} = 7.5 \text{ kg}$. Since the replacement of ^1H by ^2H causes doubling the mass, the gain in mass of the person would be 7.5 kg.

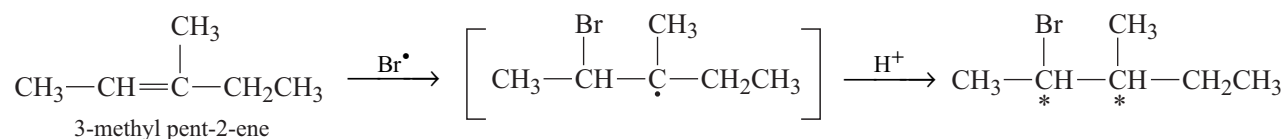
8. Treatment with *tert*-BuONa will cause elimination reaction resulting into the formation of alkene. The compound of choice (a) does not undergo elimination reaction and thus will not decolourize bromine water.

JEEC.6 Complete Chemistry—JEE Main

9. Oxygen acceptor is an acid and oxygen gainer is a base.

In the reaction I, ZnO gains O while in reaction II, ZnO loses O.

10. Magnesium forms basic carbonate ($4\text{MgCO}_3 \cdot \text{Mg}(\text{OH})_2 \cdot 5\text{H}_2\text{O}$) whereas Li does not. All the other choices (namely, b, c and d) are correct.
11. HBr in the presence of peroxide follows anti-Markovnikov addition which states that the hydrogen of acid attaches to the carbon containing lesser number of hydrogen. The addition follows free-radical mechanism. Tertiary radical is formed by the addition of Br^\bullet followed by the addition of H.



There are two asymmetric carbon leading to 2^2 (i.e. four) optical isomers.

12. In a face-centred cubic unit cell, atoms touch each other along the face diagonal of the cube. There are atoms at the corners and one at the face of the cube. Thus, the face-diagonal $\sqrt{2} a$ will be equal to $4r$. The closest approach between two atoms is $2r$ and thus will be equal to $a/\sqrt{2}$.
13. $k_2 = A e^{-E_2/RT}$ and $k_1 = A e^{-(E_2 + 10 \text{ kJ mol}^{-1})/RT}$

Hence
$$\frac{k_2}{k_1} = \frac{e^{-E_2/RT}}{e^{-(E_2 + 10 \text{ kJ mol}^{-1})/RT}}$$

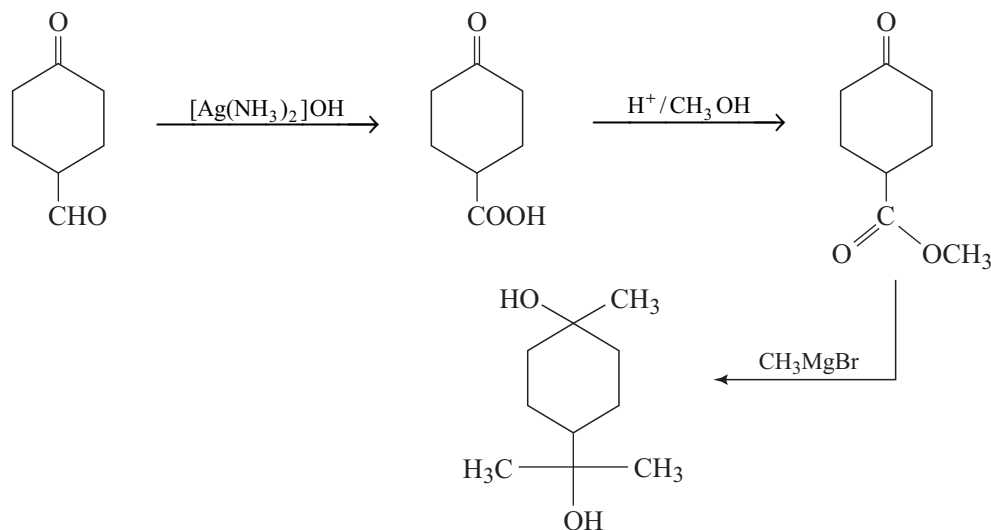
$$\ln\left(\frac{k_2}{k_1}\right) = -\frac{E_2}{RT} + \frac{(E_2 + 10 \text{ kJ mol}^{-1})}{RT} = \frac{10 \times 10^3 \text{ J mol}^{-1}}{(8.314 \text{ J K}^{-1} \text{ mol}^{-1})(300 \text{ K})} = 4$$

14. $[\text{Ag}(\text{NH}_3)_2]^+\text{OH}^-$ is Tollens reagent. This causes oxidation of $-\text{CHO}$ to $-\text{COOH}$.

$\text{H}^+/\text{CH}_3\text{OH}$ causes esterification of $-\text{COOH}$ group.

CH_3MgBr adds to $>\text{C}=\text{O}$ and ester groups.

The reactions proceed as follows.

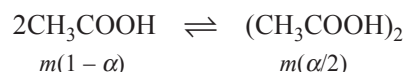


15. The choice (b) is correct.

16. The compound of choice (a) contains an ester group which is hydrolysed by KOH resulting into $-\text{OH}$ group. Due to hemiacetal group, the resulting compound acts as a reducing sugar.

JEEC.8 Complete Chemistry—JEE Main

In the solution, we have



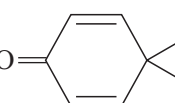
Total molality of solution, $m_{\text{total}} = m(1 - \alpha) + m(\alpha/2) = m(1 - \alpha/2)$

Since $-\Delta T_f = K_f m$, we have

$$(0.45 \text{ K}) = (5.12 \text{ K kg mol}^{-1}) \left\{ (1 \text{ mol kg}^{-1})/6 \right\} (1 - \alpha/2)$$

This gives $\alpha = 2 \left(1 - \frac{6 \times 0.45}{5.12} \right) = 0.9453$

The percentage association of acetic acid is $\frac{0.9453}{1} \times 100 = 94.53\%$

24. The molecule  is least-resonance stabilized as it does not involve $4n + 2$ electrons (aromatic requirement).

25. Amount of complex, $n_1 = MV = (0.1 \text{ mol L}^{-1})(0.1 \text{ L}) = 0.01 \text{ mol}$

Amount of chloride precipitated, $n_2 = \frac{N}{N_A} = \frac{1.2 \times 10^{22}}{(6.022 \times 10^{23} \text{ mol}^{-1})} = 0.02 \text{ mol}$

The complex of choice (d) will produce twice the precipitable chloride ions.

26. DIBAL-H is diisobutylaluminium hydride. It is an electrophilic reducing agent as it reacts more quickly with electron-rich compound. It reduces carboxylic acids, their derivatives and nitriles to aldehyde. By contrast, the use of LiAlH_4 reduces esters and acyl chloride to primary alcohol and nitriles to primary amines.

In the given reaction, the product is given by the choice (b).

27. The maximum concentrations of the given ions in the drinkable water are

$$\text{NO}_3^- = 50 \text{ ppm}; \quad \text{SO}_4^{2-} = 500 \text{ ppm}; \quad \text{F}^- = 2 \text{ ppm}$$

28. The reaction is $\text{M}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{MCl} + \text{CO}_2 + \text{H}_2\text{O}$

The stoichiometric numbers of M_2CO_3 and CO_2 are identical, the amount of M_2CO_3 will also be equal to 0.01186 mol. If M is the molar mass of M_2CO_3 , then

$$\frac{1 \text{ g}}{M} = 0.01186 \text{ mol} \quad \text{i.e.} \quad M = \frac{1 \text{ g}}{0.01186 \text{ mol}} = 84.32 \text{ g mol}^{-1}$$

29. Lesser the E° of the couple, lesser the reduction tendency of the species being reduced and larger the oxidation tendency of the species being oxidized. Larger oxidation tendency implies the strongest reducing agent.

$E_{\text{Cr}^{3+}|\text{Cr}}^\circ$ has the least value and thus Cr is the strongest reducing agent.

30. The species in the choice (a) have the same number of valence electrons, namely, 10 electrons.