

Chapter 23

MONOHYDROXY ALKANES OR ALCOHOLS

- i. Manufacture of Ethyl Alcohol ($\text{CH}_3\text{-CH}_2\text{-OH}$) iv. Role of Ethanol in Industries
ii. Combustion of Alcohols v. Impact of Alcohols on Daily Life
iii. Applications of Alcohols as Fuels

DESCRIPTIVE QUESTIONS

MANUFACTURE OF ETHYL ALCOHOL ($\text{CH}_3 - \text{CH}_2 - \text{OH}$)

Q.1 What are alcohols? Describe the preparation of ethanol by fermentation process. 10223001

Ans. Key points: Alcohols | Manufacture of Ethyl Alcohol ($\text{CH}_3\text{-CH}_2\text{-OH}$)

Alcohols

The class of organic compounds which have a hydroxyl functional group ($-\text{OH}$) attached to a hydrocarbon chain are called alcohols.

The alcohols which contains one ($-\text{OH}$) group attached to alkyls are called monohydroxy alkanes.

Monohydroxy alkanes or alcohols are an important class of organic compounds. Some of these alcohols can be obtained by the reactions in which living organisms are used as catalysts. They can also be synthesized in the laboratory.

Ethyl alcohol or ethanol is a very important member of this homologous series. It is manufactured on large scale by the following process:

Manufacture of ethyl alcohol ($\text{CH}_3 - \text{CH}_2 - \text{OH}$)**Fermentation of glucose by yeast**

Fermentation: Fermentation is a reaction in which a substance breaks down into simpler substances in the presence of enzymes present in yeast.

Examples: Preparation of yogurt, bread and ethyl alcohol are some examples of the fermentation reactions.

Conditions: Glucose can be converted to ethyl alcohol in the presence of yeast at around 35°C and in a neutral or acidic solution. This fermentation reaction must be carried out in the absence of air (anaerobic conditions) to obtain ethanol. Yeast contains an enzyme which acts as a catalyst in this reaction.

Chemical reaction: The balanced chemical equation for the fermentation of glucose is as follows:



Escape of CO_2 : Carbon dioxide gas comes out of the reaction mixture leaving behind a mixture of ethanol and water.

Optimum temperature range: The temperature of the process must be kept around 35°C to get the maximum yield of the product.

• A lower temperature decreases the rate of the reaction whereas the higher temperature makes the enzyme inactive in anaerobic conditions.

23.1 Quick Check

1. What is the role of yeast in fermentation reaction? 10223002

Ans. Yeast provides enzyme that acts as a catalyst and convert glucose into ethanol and carbon dioxide.

2. At which temperature enzymes present in yeast get inactive? 10223003

Ans. Fermentation required optimum temperature $30\text{-}35^\circ\text{C}$ to get maximum yield of the product. Temperature above $30\text{-}35^\circ\text{C}$ makes the enzyme inactive.

Absence of oxygen: Oxygen is excluded from the reaction because it converts the resulting ethanol into ethanoic acid.

Concentration: Since ethanol is toxic to yeast in high concentration, yeast is made inactive when the concentration of ethanol in the reaction mixture exceeds 15%.

Q.2 How ethanol is prepared from ethene or ethylene on large scale? 10223004

Ans. Key point: Hydration of Ethene or Ethylene

Hydration of ethene or ethylene

Hydration of ethene is an addition reaction. In this reaction water is added across the double bond of the ethene. The reaction is carried out by passing a mixture of ethene and steam over hot phosphoric acid (H_3PO_4), which acts as a catalyst.

Mechanism of reaction

Hydrogen atom of H_2O attaches itself to one carbon atom of ethene and the hydroxyl group to other atom. During this addition the double bond breaks down to give a saturated compound, ethanol.

Conditions of the reaction

- $300^\circ C$
- 60 atm
- Phosphoric acid H_3PO_4 (catalyst)

Chemical reaction



Importance of reaction

Gaseous ethanol obtained is then condensed into its liquid form. Hydration of ethene is an important industrial process because ethanol is a versatile compound. It has a wide range of applications from alcoholic drinks to fuels and as a solvent.

Q.3 Give a comparison of fermentation reaction and catalytic hydration of ethene for the preparation of ethanol.

10223005

Ans. Key point: Comparison of Fermentation and Catalytic Hydration of Ethene

Table 23.1 Comparison of methods of production of ethanol

Hydration of Ethene	Fermentation
(i) Hydration of Ethene is an addition reaction. In this reaction water is added across the double bond of the ethene and ethyl alcohol is produced.	(i) Fermentation is a reaction in which a substance breaks down into simple substance in the presence of enzymes present in yeast. Ethyl alcohol is produced by fermentation of glucose.
(ii) Reaction is performed at high temperature and at high pressure.	(ii) It takes place at around $35^\circ C$ and at atmospheric pressure.
(iii) Starting material for the process is obtained from crude oil, which is a non-renewable source.	(iii) Starting material for this method is a renewable source, such as cane-sugar.
(iv) Rate of reaction is high.	(iv) Rate of reaction is low. It may take days to complete.
(v) The reaction produces relatively pure alcohol.	(v) The reaction produces 15% alcohol which needs further distillation to increase the concentration. Distillation requires energy.
(vi) Ethanol produced in this method is expensive.	(vi) Ethanol produced in this process is cheap.

23.2 Quick Check

1. Why oxygen is excluded when the fermentation reaction is carried out? 10223006

Ans. During fermentation oxygen is excluded from the reaction because it converts the resulting ethanol into ethanoic acid which is not required product. So fermentation of glucose is carried out in anaerobic condition.

2. Which method for the preparation of ethene involves renewable source? 10223007

Ans. Fermentation involves the preparation of ethanol from renewable source e.g. sugarcane.

COMBUSTION OF ALCOHOLS

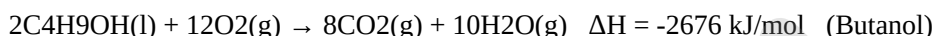
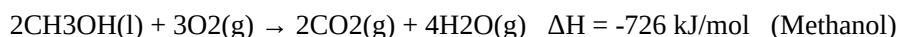
Q.4 Explain the combustion process of alcohols. 10223007

Ans. Key point: Combustion of Alcohols

Combustion of alcohols

- Alcohols are flammable, therefore, burn in air to produce CO₂ and H₂O evolving a large amount of heat.
- Methanol, ethanol and 1-propanol, all burn completely in excess of air because they contain a hydrocarbon chain.

Chemical reactions: The balanced equations for the combustion of alcohols are given below:



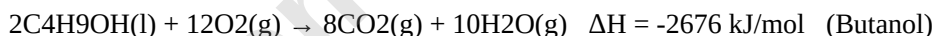
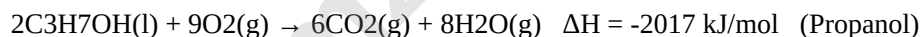
Mechanism of combustion

During combustion of alcohols the weaker C-H bonds in -CH₂ groups break and the stronger C=O and O-H bonds are formed in CO₂ and H₂O respectively. This explains why the amount of heat evolved increases with the addition of a -CH₂ group in the alcohol homologous series.

23.3 Quick Check

. Why does butanol evolve a higher amount of heat than propanol when burnt in oxygen? 10223008

Ans. Butanol evolve a higher amount of heat than propanol when burnt in oxygen because during combustion of alcohols the weaker C-H bonds in -CH₂ groups are broken and the stronger C=O and O-H are formed respectively. Formation of bonds release energy therefore as the number of carbon atoms increase more amount of heat is released. Butanol have more -CH₂ groups as compared to propanol so it releases more amount of heat.



APPLICATIONS OF ALCOHOLS AS FUELS

Q.5 Explain the application of alcohols as fuels. What are advantages and disadvantages of alcohols as fuels? 10223009

Ans. Key points: Applications of Alcohols as Fuels | Advantages of Alcohols as Fuels | Disadvantages of Alcohols as Fuels

Applications of alcohols as fuels

Alcohols are also used as fuels instead of petrol and diesel to run an automobile. The first four aliphatic alcohols namely methanol, ethanol, propanol and butanol have such properties which make them suitable to be used in internal combustion engines. They produce a large amount of heat when burnt. Therefore, alcohols are considered useful alternative fuels.

Advantages of alcohols as fuels

- Alcohols are obtained from renewable sources.
- Burning of alcohols does not produce oxides of sulphur which makes them environmental friendly as compared to fossil fuels.
- Alcohols have higher fuel efficiency as compared to petrol or diesel fuels.

Disadvantages of alcohols as fuels

- Alcohols have less energy per volume than gasoline. It means more fuel is needed to travel the same distance.
- Alcohols can increase wear and tear on engine components.
- Land is utilized to grow crops which then yield alcohols. This fact affects the cultivation of food crops.

Interesting Information**S.Q. How does the use of alcohols as fuel keep the balance in concentration of CO₂ in our atmosphere? 10223010**

Ans. Alcohols are produced from plant materials which, in turn, are the result of the photosynthesis process using CO₂ of the atmosphere. The same CO₂ is generated when these bioalcohols are burnt in internal combustion engine. The overall process is considered to be carbon neutral because it does not increase the concentration of carbon dioxide gas in the atmosphere.

23.4 Quick Check**1. Why does the amount of heat evolved during burning of alcohols go on increasing from lower to higher alcohols? 10223011**

Ans. During combustion of alcohols the weaker C-H bonds in -CH₂ groups break and the stronger C=O and O-H bonds are formed in CO₂ and H₂O respectively. As we know energy is released when new bonds are formed. So as the number of carbon atoms increases more heat is evolved during combustion. This explains why the amount of heat evolved increases with the addition of -CH₂ group in the alcohol homologous series.

2. Why burning of alcohols does not produce oxides of sulphur unlike fossil fuels? 10223012

Ans. Alcohol is a biofuel that contains only carbon, hydrogen and oxygen atoms. When it burns it produces CO₂ and H₂O. Fossil fuels on the other hand, contain sulphur impurities which come from dead plants or animals. When fossil fuels burn oxides of sulphur SO_x are produced during combustion. Alcohol does not have sulphur, so, oxides of sulphur are not produced.

ROLE OF ETHANOL IN INDUSTRIES**Q.6 Describe the applications of ethanol in pharmaceutical and cosmetic industries. 10223013****Ans. Key points: Role of Ethanol in Industries | Uses of Ethanol in Cosmetic Industry*****Role of ethanol in industries*****(a) Pharmaceutical industry**

Ethyl alcohol serves as a very common ingredient in a variety of manufacturing processes in pharmaceutical industry.

- (i) It possesses bactericidal activity and it is often used as a disinfectant in hand sanitizer and methylated spirit.
- (ii) It is also commonly used as a solvent and preservative in many pharmaceutical preparations including vaccines.
- (iii) Ethanol and isopropanol are found as an active ingredient in certain oral and topical drug products. They help solubilize many drugs.

(b) Properties of Ethyl alcohol in cosmetics industries

Ethyl alcohol plays an important role in cosmetic industry because of its following properties:

- (i) Being highly volatile it evaporates in a very short time.
- (ii) Deodorizing and anti-inflammatory properties.
- (iii) Refreshing and antimicrobial properties.

Uses of ethanol in cosmetic industry

Ethanol is an important part of such cosmetic and hygiene products as.

- Hair styling products
- Foundation creams
- Perfumes
- Deodorants and after shave lotions

Interesting Information**S.Q. How ethanol as a fuel is eco-friendly? 10223014**

Ans. Ethanol as a fuel reduces greenhouse gas emissions by 44 to 52% as compared to petrol. Besides this, ethanol also cuts down on other harmful pollutants like CO_x, NO_x and particulate matter.

IMPACT OF ALCOHOLS ON DAILY LIFE

Q.7 What is the impact of alcohols on our daily life? 10223015

Ans. Key point: Impact of Alcohols on Daily Life

Impact of alcohols on daily life

Alcohols play an important role in daily life as.

- **Methylated spirit:** Ethyl alcohol is an essential part of first aid kit in every home in the form of methylated spirit. Methylated spirit is used as an antiseptic, for dressing of wounds and as an antidote for snake bites.
- **Fuel:** In many parts of the world, ethanol is used as high efficiency fuel to drive vehicles.
- **Solvent:** Ethanol is widely used as a solvent in perfumes. It is relatively safe and can be used to dissolve many organic compounds which are insoluble in water.

Do you know?

S.Q. What are the disadvantages of use of alcohol as a drink? 10223016

Ans. Ethyl alcohol as a drink can cause hangover, alcohol poisoning, accidents and risky behaviour. Long-term use of alcohol is known to cause more than 200 different diseases.

MULTIPLE CHOICE QUESTIONS (EXERCISE)

A. Choose and tick the correct answer from the given choices.

1. Which conditions are considered best for the fermentation of glucose? 10223017

- (a) 35°C, fresh yeast, absence of oxygen (b) 45°C, yeast (c) 45°C, absence of oxygen (d) 35°C, fresh yeast

2. Which catalyst other than H_3PO_4 can also be used for hydration of alkenes? 10223018

- (a) NaOH (b) H_2SO_4 (c) CH_3COOH (d) Ni

3. Alcohol which has the maximum heat of combustion is: 10223019

- (a) $CH_3CH_2CH_2OH$ (b) CH_3CH_2OH (c) CH_3OH (d) $CH_3CH_2CH_2CH_2OH$

4. The most environment friendly fuel is: 10223020

- (a) coal (b) kerosene oil (c) ethanol (d) wood

5. Which property or properties of ethanol make it suitable to be used in cosmetic industry? 10223021

- (a) Easily Flammable (b) Highly volatile and deodorizing (c) Antipyretic (d) Sedative

6. Which is the correct name of the following alcohol: $CH_3-CH(OH)-CH_2-CH(CH_3)-CH_3$ 10223022

- (a) 2-Methylpentan-4-ol (b) 4-Methylpentan-2-ol (c) Hexan-2-ol (d) Hexan-4-ol

7. Which property of ethanol makes it suitable for cleaning wounds? 10223023

- (a) Good solvent (b) Volatility (c) Antiseptic (d) Deodorizing

8. Which alcohol is used to accomplish all the following tasks: It is added in petrol to improve combustion. It serves as a feed stock to prepare vinegar and many other organic compounds. 10223024

- (a) Propanol (b) Propan-2-ol (c) Ethanol (d) Methanol

SLO BASED MULTIPLE CHOICE QUESTIONS

Manufacture of Ethyl Alcohol

9. Ethyl alcohol is also called: 10223025

- (a) Methanol (b) Propanol (c) Ethanol (d) Butanol

10. The optimum temperature for fermentation is: 10223026

- (a) 15°C (b) 25°C (c) 35°C (d) 60°C

18. Starting material for hydration of ethene is obtained from: 10223034

- (a) Water (b) Crude oil (c) Sugar (d) Air

19. Which method gives relatively pure ethanol directly? 10223035

- (a) Fermentation (b) Hydration of ethene (c) Oxidation (d) Reduction

11. Fermentation takes place in: 10223027

- (a) Presence of oxygen (b) Absence of oxygen (c) High pressure (d) Sunlight

12. The gas produced during fermentation is: 10223028

- (a) Hydrogen (b) Oxygen (c) Carbon dioxide (d) Nitrogen

13. If the temperature becomes too high during fermentation, then: 10223029

- (a) Reaction becomes faster (b) Yeast enzyme becomes inactive (c) More ethanol forms (d) Oxygen increases

14. If oxygen is present during fermentation, ethanol converts into: 10223030

- (a) Methanol (b) Ethanoic acid (c) Glucose (d) Propanol

15. Yeast becomes inactive when ethanol concentration exceeds: 10223031

- (a) 5% (b) 10% (c) 15% (d) 25%

16. Hydration of ethene is a type of: 10223032

- (a) Substitution reaction (b) Addition reaction (c) Decomposition reaction (d) Neutralization reaction

17. The temperature and pressure required for hydration of ethene is about: 10223033

- (a) 100°C, 1atm (b) 200°C, 6atm (c) 300°C, 60 atm (d) 500°C, 60 atm

27. Alcohols fuels have: 10223043

- (a) Higher efficiency than petrol (b) Lower efficiency than petrol (c) Same efficiency (d) No efficiency

28. A disadvantage of alcohol fuel is: 10223044

- (a) More energy per volume (b) Less energy per volume (c) No combustion (d) Minimum heat production

29. Ethanol in pharmaceutical industry is used as: 10223045 (Role of Ethanol in Industries)

- (a) Fuel only (b) Disinfectant (c) Catalyst (d) Fertilizer

30. Ethanol is commonly used in: 10223046

- (a) Hand sanitizers (b) Fertilizers (c) Cement (d) Plastic

31. Ethanol evaporates quickly because it is: 10223047

- (a) Non-volatile (b) Highly volatile (c) Solid (d) Heavy

37. Methylated spirit is used for: 10223053

- (a) Dressing wounds (b) Growing crops (c) Cooking food (d) Making plastics

20. When alcohols burn in air, they produce? 10223036 (Combustion of alcohols)

- (a) CO and H₂ (b) CO₂ and H₂O (c) CH₄ and CO₂ (d) H₂ and O₂

21. Combustion of alcohols release: 10223037

- (a) Light only (b) Electricity (c) Large amount of heat (d) Nitrogen gas

22. Which alcohol produces the highest heat on combustion? 10223038

- (a) Methanol (b) Ethanol (c) Propanol (d) Butanol

23. Which alcohol is commonly used as a fuel in engines? 10223039

- (a) Methanol (b) Ethanol (c) Propanol (d) All of these

24. Alcohol fuels can replace: 10223040

- (a) oxygen (b) Petrol and diesel (c) Water (d) Nitrogen

25. Alcohols used as fuels are obtained from: 10223041

- (a) Fossil fuels (b) Renewable sources (c) Rocks (d) Metals

26. Burning of alcohols does not produce: 10223042

- (a) CO₂ (b) H₂O (c) Oxides of sulphur (d) Heat

32. Ethanol is used in cosmetic products like: 10223048 (Perfumes / Deodorants / After shave lotions / All of these)

- (a) Perfumes (b) Deodorants (c) After shave lotions (d) All of these

33. Ethanol as a fuel reduce greenhouse gas emission by: 10223049

- (a) 44-52% (b) 34-52% (c) 41-52% (d) 50-52%

34. Ethanol is used as solvent and _____ in pharmaceutical preparations: 10223050

- (a) Catalyst (b) Preservative (c) Reactant (d) Lubricant

35. Methylated spirit is used in first aid as: 10223051 (Impact of Alcohols on Daily Life)

- (a) Fertilizer (b) Antiseptic (c) Fuel (d) Lubricant

36. Ethanol is used as a solvent in: 10223052

- (a) Perfumes (b) Cement (c) Fertilizers (d) Dairy products

38. Long-term use of alcohol may cause: 10223054

- (a) Better health (b) Diseases (c) Strong bones (d) Faster growth

ANSWER KEY

1. a	2. b	3. d	4. c	5. b	6. b	7. c
8. c	9. c	10. c	11. b	12. c	13. b	14. b
15. c	16. b	17. c	18. b	19. b	20. b	21. c
22. d	23. d	24. b	25. b	26. c	27. a	28. b
29. b	30. a	31. b	32. d	33. a	34. b	35. b
36. a	37. a	38. b				

SHORT ANSWER QUESTIONS (EXERCISE)

B. Write Short Answers.

1. Give two advantages of burning of alcohols over the burning of fossil fuel? 10223055

Ans. (i) Alcohols are obtained from renewable sources.

Ans. (ii) Burning of alcohols does not produce oxides of sulphur which makes them environmental friendly as compared to fossil fuels.

3. How is ethyl alcohol important for pharmaceutical industry? 10223057

Ans. Ethyl alcohol is used in pharmaceutical industry as: (i) It possesses bactericidal activity and it is often used as a disinfectant in hand sanitizer and methylated spirit. (ii) It is also commonly used as a solvent and preservative in many pharmaceutical preparations. (iii) Ethyl alcohol is used as a solvent in medicines and syrups. (iv) It is used as an antiseptic to kill germs and disinfect wounds.

5. Write the conditions involved in the hydration of ethene. 10223059

Ans. Conditions of hydration of ethene — Temperature about 300°C, Pressure about 60 atm, Catalyst: Phosphoric acid (H₃PO₄). $\text{CH}_2=\text{CH}_2 + \text{H}_2\text{O} \xrightarrow{\text{H}_3\text{PO}_4, 300^\circ\text{C}, 60\text{atm}} \text{CH}_3\text{CH}_2\text{OH}$

2. Which properties of ethyl alcohol make it useful for cosmetic industry? 10223056

Ans. Ethyl alcohol plays an important role in cosmetic industry because of its following properties: (i) Being highly volatile it evaporates in a very short time. (ii) Deodorizing and anti-inflammatory properties. (iii) Refreshing and antimicrobial properties.

4. Give any two disadvantages of fermentation reactions. 10223058

Ans. Fermentation is a slow process. It may take days to complete.

Ans. It produces impure alcohol (only 15%) which requires purification by distillation. Distillation requires energy.

SLO BASED SHORT ANSWER QUESTIONS

Introduction

6. What do you know about alcohols? 10223060

Ans. Alcohols: The class of organic compounds which have a hydroxyl functional group (-OH) attached to an alkyl group are called monohydroxy alkanes or alcohols. Their general formula is $\text{C}_n\text{H}_{2n+1}\text{OH}$. Examples: Methanol, Ethanol propanol etc.

7. What is fermentation? 10223061

Ans. Fermentation: It is a reaction in which a substance breaks down into simpler substances in the presence of enzymes secreted by a living organism yeast. Examples: Preparation of yogurt, bread and ethyl alcohol are some examples of fermentation reactions.

9. Write balanced chemical reaction for fermentation? 10223063

Ans. The chemical equation for fermentation reaction is given. $\text{C}_6\text{H}_{12}\text{O}_6 \xrightarrow{\text{Yeast}, 35^\circ\text{C}} 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$ (Glucose → Ethanol)

10. Why is high temperature not suitable for fermentation? 10223064

Ans. Fermentation occur at about 25-35°C to get maximum yield of the product. A lower temperature decreases the rate of reaction while higher temperature makes the enzyme inactive. So that is why higher temperature is not suitable for fermentation.

8. What is the role of yeast in fermentation? 10223062

Ans. Yeast is a living organism. It provides enzymes which act as a catalyst and convert glucose into ethanol and carbon dioxide.

13. What is hydration of ethene? 10223067

Ans. Hydration of ethene is an addition reaction in which water is added across the double bond of ethene to form ethanol.
 $\text{CH}_2=\text{CH}_2 + \text{H}_2\text{O} \xrightarrow[\text{60 atm}]{\text{H}_3\text{PO}_4, 300^\circ\text{C}} \text{CH}_3\text{-CH}_2\text{-OH}$

14. Why is fermentation slow reaction? 10223068

Ans. Fermentation is a slow process. It occurs at low temperature and depends on enzymes. So its rate of reaction is low. It may take days to complete.

Combustion of Alcohols

15. Why does fermentation require distillation? 10223069

Ans. Alcohol produced by fermentation is only about 15% pure. So distillation is needed to increase concentration. After distillation, ethanol is upto 95% pure and it is called rectified spirit.

16. Write combustion reactions of methanol and ethanol. 10223070

Ans. $2\text{CH}_3\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$ $\Delta H = -726 \text{ kJ/mol}$ (Methanol);
 $\text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$ $\Delta H = -1367 \text{ kJ/mol}$ (Ethanol)

17. Why do alcohols produce heat during combustion? 10223071

Ans. During combustion of alcohols the weaker C-H bonds in -CH₂ groups breaks and the stronger C=O and O-H bonds are formed in CO₂ and H₂O respectively. So energy is released.

18. Why does heat of combustion increase in the homologous series? 10223072

Ans. Heat of combustion increase in homologous series because the number of -CH₂ groups increases producing more energy.

25. Why ethanol is used in cosmetic products? 10223079

Ans. Ethanol is used in cosmetic products because it is highly volatile, deodorizing, refreshing and antimicrobial.

26. Name some cosmetic products containing ethanol. 10223080

11. Why must oxygen be excluded from fermentation? 10223065

Ans. Oxygen is excluded from the reaction because it converts the resulting ethanol into ethanoic acid (further oxidation).

12. What happens when ethanol concentration exceeds 15%? 10223066

Ans. Ethanol is toxic to yeast in high concentration, yeast become inactive when the concentration of ethanol in the reaction mixture exceeds 15%.

Application of Alcohols as Fuels

19. Why are alcohols considered good fuels? 10223073

Ans. Alcohols are considered good fuels when burnt in internal combustion engines to produce a large amount of heat. They are obtained from renewable sources. They also have higher fuel efficiency as compared to petrol or diesel.

20. Why are alcohols considered renewable fuels? 10223074

Ans. Alcohols are produced from plant materials such as sugarcane and crops. Therefore, they are considered renewable fuels.

21. Why are alcohols considered environmental friendly fuels? 10223075

Ans. Burning of alcohols does not produce oxides of sulphur which makes them environmental friendly as compared to fossil fuels.

22. Give two disadvantages of alcohol fuels. 10223076

Ans. (i) Alcohols have less energy per volume than gasoline. It means more fuel is needed to travel the same distance. (ii) Alcohols can increase wear and tear on engine components.

Role of Ethanol in Industries

23. Why is ethanol used in hand sanitizers? 10223077

Ans. Ethanol is used in hand sanitizers because it has bactericidal (germ-killing) properties.

24. How is ethanol used in pharmaceutical preparations? 10223078

Ans. It is used as a solvent and preservative in many pharmaceutical preparations including vaccines. Ethanol is found as an active ingredient in certain oral or topical drug products.

Impact of Alcohols on Daily Life

27. Mention two harmful effects of drinking alcohol. 10223081

Ans. • Alcohol poisoning
 • Accidents and risky behaviour

28. Why ethanol is essential part of first aid kit? 10223082

Ans. Ethanol is essential part of first aid kit in every home in

Ans. Names of cosmetic products are: Perfumes, Deodorants, Hair styling products, After shave lotions, Foundation creams

the form of methylated spirit. Methylated spirit is used as an antiseptic, for dressing of wounds.

CONSTRUCTED RESPONSE QUESTIONS

1. How ethanol is obtained as a by-product in sugar industry? 10223083

Ans. During the sugar manufacturing process molasses (a by-product) is produced. Molasses contains sugar which is fermented by yeast to produce ethanol and carbon dioxide. $C_6H_{12}O_6 \xrightarrow{\text{Yeast, } 35^\circ C} 2C_2H_5OH + 2CO_2$. So the ethanol obtained is not pure. Ethanol is also toxic to yeast in high concentration, yeast is made inactive when the concentration of ethanol in the reaction mixture exceeds 15%. So distillation is required to remove impurities as well as to get the high concentration of alcohol after fermentation.

2. Why do we get relatively impure alcohol in the fermentation process? 10223084

Ans. Fermentation produces alcohol mixed with water, yeast cells and other impurities.

3. How do properties of ethyl alcohol help us to utilize it as fuel? 10223085

Ans. Properties of ethyl alcohol that help us to utilize it as fuel:
 • Ethanol burns easily and cleanly. • It produces high heat energy. • It forms less harmful gases making it a good alternative fuel.

DESCRIPTIVE QUESTIONS (EXERCISE)

1. Give a comparison of fermentation reaction and catalytic hydration of ethene for the preparation of ethanol. 10223086

Ans. See Q.3 from theory.

2. Describe the preparation of ethanol by fermentation process. 10223087

Ans. See Q.1 from theory.

3. Describe the applications of ethanol in pharmaceutical and cosmetic industries? 10223088

Ans. See Q.6 from theory.