

2021

FUELS & COMBUSTION

Full Marks: 60

Time: Two hours

The figures in the margin indicate full marks for the questions.

A. Multiple Choice Questions

1 x 20=20

1. Which of the following is not an example of secondary fuel
 - a. Petrol
 - b. Diesel
 - c. Coal
 - d. Charcoal
2. Ash content of coal is consists of
 - a. Combustible gases such as H₂, CO and hydrocarbons.
 - b. Silica, aluminum, iron oxide and moisture.
 - c. Silica, aluminum, iron oxide and magnesia.
 - d. Silica, aluminum, iron oxide and volatiles.
3. Which of the following is correct on the basis of decreasing order of vapour pressure for liquid fuel
 - a. Auto-ignition temperature > Fire point > Flash point
 - b. Auto-ignition temperature > Flash point > Fire point
 - c. Fire point > Flash point > Auto-ignition temperature
 - d. Flash point > Fire point > Auto-ignition temperature
4. Producer gas is a mixture of
 - a. CO and N₂
 - b. Co and N₂
 - c. CO and H₂
 - d. None of these

5. For transformation of Coal from:
Wood → Peat → Lignite → Bituminous coal → Anthracite, which of the following statement is false
- Moisture content decreases
 - Decrease in volatile contents
 - Decrease in calorific values
 - Increase in hardness
6. The carbon content in a type of coal is in the range 75-90%. The name of the coal is
- Anthracite
 - Bituminous coal
 - Lignite
 - Peat
7. Which of the following is true
- Proximate analysis is used to determine moisture content of coal.
 - Ultimate analysis is used to determine moisture content of coal.
 - Proximate analysis is used to determine elemental composition of coal.
 - None of these
8. Which of the following is false
- All coking coals are caking
 - All caking coals are coking
 - The coals which on heating undergo no fusing effect are called non-coking coals.
 - None of these
9. The name of cracking products obtained from decane are
- C_5H_{12} and C_5H_{10}
 - n-pentane and hexene
 - Pentene and pentyne
 - None of these
10. The thermal stability of petroleum fraction decreases as follows:
- Paraffin > naphthalene > aromatic
 - Aromatic > naphthalene > paraffin

- c. Paraffin > aromatic > naphthalene
 - d. None of these
11. Which of the following is correct for Water gas
- a. It is a mixture of both flammable and non-flammable gases.
 - b. It is a mixture of inflammable gases.
 - c. It contains carbon monoxide and hydrogen gases along with non-flammable gases.
 - d. None of these
12. In LTC
- a. The carbonization is carried out at 900-1200 °C.
 - b. The yield of coke is about 75-80%.
 - c. The yield of volatile matter is 1-3%.
 - d. None of these.
13. The moisture content is highest in which of the following briquettes:
- a. Maize straw
 - b. Coconut husk
 - c. Coal
 - d. Dried leaves
14. In coal gasification
- a. Sulphur compounds present in coal reacts with hydrogen and oxygen to form sulphuric acid.
 - b. High quantity of oxygen is used to facilitate smooth combustion.
 - c. The quantity of oxygen used is limited to prevent complete combustion of coal.
 - d. None of these.
15. For water gas shift reaction in coal gasification
- a. Both heterogeneous and homogeneous transition metal catalyst can be used.
 - b. Only homogeneous transition metal catalyst can be used.
 - c. Only heterogeneous transition metal catalyst can be used.
 - d. None of these.

16. Syngas is a
- Pure mixture of CO/N₂.
 - Pure mixture of CO/H₂.
 - Pure mixture of CO/H₂O.
 - None of these.
17. Catalytic cracking is believed to involve
- Free radical mechanism.
 - Hydrogenation.
 - Carbonium-ion intermediate.
 - None.
18. Octane rating of petrol obtained from vapour-pressure thermal cracking is
- Greater than 70.
 - Lower than 70.
 - Ranges from 65-70.
 - None of these.
19. In Fischer-Tropsch process for synthetic petrol production
- A catalyst mixture is used.
 - A single transition metal catalyst is used.
 - Catalyst is not used.
 - None of these.
20. In sweetening of gasoline
- Sulphur compounds are removed as hydrogen sulphides.
 - Unsaturated hydrocarbons are removed.
 - Sulphur compounds are removed as disulphides.
 - None of these.

B. Very Short Question

2*6=12

- What are the two main differences between liquid-phase and vapour-phase thermal cracking?
- What do you mean by ignition temperature of a fuel?
- What is extrinsic ash?
- What are significances of volatile matter in proximate analysis of coal?

5. Give the composition of crude petroleum.
6. Mention the main methods used for synthetic petrol production.

C Short Question

4*7=28

1. Give the Dulong's formula for calculating calorific value of solid fuel. Calculate the gross and net calorific value of a coal sample having the following composition:
 $C = 72\%$, $O_2 = 5.5\%$, $H_2 = 8.9\%$, $S = 1.5\%$, $N_2 = 1.4\%$, $Ash = 2.1\%$
2. Distinguish between LTC and HTC for carbonization of coal.
3. What do you mean by coal gasification? Write in brief about water-gas shift reaction in coal gasification process.
4. Distinguish between flash point and boiling point of fuel.
5. Explain the significances of ash content and fixed carbon of a solid fuel based on proximate analysis.
6. What do you mean by cracking of crude petroleum? What are two different classes of cracking? Define.
7. Calculate the weight and volume of air required for the combustion of 2.5 kg of carbon.
