

**Chemistry**  
**Standard level**  
**Paper 1A**

Practice paper

**Topic: Energy Content of Fuels (SL)**

1. Which unit is used for specific energy?
  - A.  $\text{kJ kg}^{-1}$
  - B.  $\text{kJ dm}^{-3}$
  - C.  $\text{kJ mol}^{-1}$
  - D.  $\text{kJ K}^{-1}$
  
2. Which fuel has the highest specific energy?
  - A. Coal
  - B. Wood
  - C. Hydrogen
  - D. Methane
  
3. What is the main byproduct of a hydrogen-oxygen fuel cell?
  - A. Carbon dioxide
  - B. Water
  - C. Nitrogen oxides
  - D. Carbon monoxide
  
4. Which molecule is used as a reactant in the transesterification of vegetable oils to form biodiesel?
  - A. Water
  - B. Methanol
  - C. Ethane
  - D. Acetic acid
  
5. Which describes the oxidation half-reaction at the anode of a hydrogen fuel cell (acidic)?
  - A.  $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$
  - B.  $\text{O}_2 + 4\text{H}^+ + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}$
  - C.  $2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$
  - D.  $\text{H}_2 + 2\text{OH}^- \rightarrow 2\text{H}_2\text{O} + 2\text{e}^-$
  
6. Energy density is defined as the energy released per unit:
  - A. Mass
  - B. Volume
  - C. Price
  - D. Temperature
  
7. Which of the following is considered a primary biofuel?
  - A. Petroleum

- B. Firewood
- C. Biodiesel
- D. Hydrogen

8. In a methanol fuel cell, what is the oxidation product at the anode?

- A.  $\text{H}_2\text{O}$
- B.  $\text{CO}$
- C.  $\text{CO}_2$
- D.  $\text{CH}_4$

9. Which factor would increase the energy density of a gas fuel?

- A. Increasing its temperature
- B. Increasing its pressure
- C. Increasing its container size
- D. Decreasing its molar mass

10. Which catalyst is commonly used in the production of biodiesel?

- A. Pt
- B.  $\text{V}_2\text{O}_5$
- C. NaOH
- D. Ni

11. Which is an advantage of a direct methanol fuel cell over a hydrogen fuel cell?

- A. Methanol is easier to store as a liquid
- B. Methanol produces less  $\text{CO}_2$
- C. Methanol has a higher specific energy
- D. Methanol reaches 100% efficiency

12. Which statement about biodiesel is correct?

- A. It is less biodegradable than petroleum diesel
- B. It contains a higher percentage of sulfur than coal
- C. It is produced from renewable biological sources
- D. It cannot be used in conventional diesel engines

13. In an alkaline hydrogen fuel cell, what is the reduced species at the cathode?

- A.  $\text{H}_2$
- B.  $\text{OH}^-$
- C.  $\text{O}_2$
- D.  $\text{H}_2\text{O}$

14. Calculate the specific energy of a fuel if 4.0 g of the fuel releases 200 kJ of energy.

- A. 50 kJ g<sup>-1</sup>
- B. 800 kJ g<sup>-1</sup>
- C. 0.02 kJ g<sup>-1</sup>
- D. 200 kJ g<sup>-1</sup>

15. Greenhouse gas emissions from biofuels are often considered 'neutral' because:

- A. They do not contain carbon
- B. The CO<sub>2</sub> released was recently absorbed by plants during growth
- C. They burn at low temperatures
- D. They produce oxygen as a byproduct

16. Which describes 'Ohmic Loss' in a fuel cell graph?

- A. Sudden drop at low current due to activation energy
- B. Linear drop due to internal resistance of the electrolyte
- C. Rapid drop at high current due to mass transport limits
- D. Increase in voltage over time

17. What is the role of the electrolyte in a fuel cell?

- A. To allow electrons to flow from anode to cathode
- B. To allow ions to flow while preventing electron flow
- C. To oxidize the fuel directly
- D. To act as a lubricant

18. Which has the highest energy density at standard conditions?

- A. Hydrogen gas
- B. Liquid Ethanol
- C. Methane gas
- D. Propane gas

19. Which reaction represents the complete combustion of methanol?

- A.  $\text{CH}_3\text{OH} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2$
- B.  $2\text{CH}_3\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$
- C.  $\text{CH}_3\text{OH} \rightarrow \text{C} + 2\text{H}_2\text{O}$
- D.  $\text{CH}_3\text{OH} + \text{O}_2 \rightarrow \text{HCHO} + \text{H}_2\text{O}$

20. Efficiency of a fuel cell is defined as:

- A. Energy output / Energy input
- B.  $\Delta G / \Delta H$
- C. Mass of fuel / Mass of byproduct

D. Voltage / Current

21. Which is a disadvantage of coal compared to natural gas?

- A. Higher specific energy
- B. Higher CO<sub>2</sub> emissions per MJ
- C. Easier to transport by pipeline
- D. Cleaner burning with no particulates

22. Which alternative energy source uses a non-renewable fuel?

- A. Solar
- B. Nuclear
- C. Wind
- D. Geothermal

23. Which gas is a major contributor to acid rain from coal combustion?

- A. CO<sub>2</sub>
- B. SO<sub>2</sub>
- C. CH<sub>4</sub>
- D. N<sub>2</sub>

24. What is 'Carbon Neutrality' in the context of biofuels?

- A. The fuel contains no carbon
- B. No CO<sub>2</sub> is released during combustion
- C. CO<sub>2</sub> released equals CO<sub>2</sub> absorbed during biomass growth
- D. The fuel is made from recycled plastics

25. Which has the highest carbon-to-hydrogen ratio?

- A. Methane (CH<sub>4</sub>)
- B. Ethane (C<sub>2</sub>H<sub>6</sub>)
- C. Octane (C<sub>8</sub>H<sub>18</sub>)
- D. Coal (primarily Carbon)

26. Which alternative energy source is dependent on direct sunlight?

- A. Hydroelectric
- B. Photovoltaic (Solar)
- C. Wind
- D. Nuclear Fusion

27. Advantage of secondary biofuels over primary ones:
- A. They are simpler to harvest
  - B. They are processed to higher energy density (e.g. biodiesel)
  - C. they are non-renewable
  - D. They produce more  $\text{SO}_2$
28. Comparison of specific energy: 1g Hydrogen vs 1g Methane:
- A. Hydrogen is higher
  - B. Methane is higher
  - C. They are equal
  - D. Hydrogen is zero
29. Which energy source has high initial cost but zero fuel cost?
- A. Natural Gas
  - B. Nuclear
  - C. Solar
  - D. Coal
30. Which describes the 'enhanced' greenhouse effect?
- A. Natural warming of the Earth
  - B. Increased heat trapping due to human-emitted  $\text{CO}_2$  and  $\text{CH}_4$
  - C. Cooling of the stratosphere
  - D. Reflection of UV light by the ozone layer