1. For a steady-state reactor, the general balance is:

$$\textbf{Input} - \textbf{Output} + \textbf{Generation} - \textbf{Consumption} = 0$$

A species enters at 120 mol/h and leaves at 80 mol/h. If 25 mol/h of that species is generated inside the reactor, the consumption rate must be:

A) 15 mol/h
B) 25 mol/h
C) 40 mol/h
D) 65 mol/h
E) None of the above

2. A material has mass = 10 g and volume = 2 cm^3. What is its density?

A) 5 g/cm^3
B) 2 g/cm^3
C) 20 g/cm^3
D) 0.2 g/cm^3
E) None of the above

3. If surface area doubles, adsorption capacity will most likely:

A) Decrease
B) Stay same
C) Increase
D) Become zero
E) None of the above

4. A solution concentration decreases from 10 to 0.5 mol/L. What is the percentage decrease?

A) 25%
B) 50%
C) 75%
D) 100%
E) None of the above

5. Heat conduction through a wall is given by:

$$Q = \frac{kA\Delta T}{L}$$

Wall X has $k = 2$, $A = 3$, $\Delta T = 40$, and $L = 4$.
Wall Y has $k = 4$, $A = 2$, $\Delta T = 20$, and $L = 2$.

Which statement is correct?

A) $Q_X > Q_F$
B) $Q_F > Q_X$
C) $Q_X = Q_F$
D) None of the above

6. A system has input = 120 kg and output = 100 kg. What is accumulation?

A) 20 kg
B) 100 kg
C) 120 kg
D) 0 kg
E) None of the above

7. Flow rate = Area × Velocity. If area is constant and velocity triples, flow rate will:

A) Stay same
B) Increase Double
C) Increase Triple
D) Decrease Half
E) None of the above

8. Heat transfer rate is proportional to temperature difference. If ΔT doubles, heat transfer will:

A) Stay same

B) Half
C) Double
D) Become zero
E) None of the above

9. A straight-line graph has a constant slope. What does this indicate?

A) Variable rate
B) Constant rate
C) Zero rate
D) Infinite rate
E) None of the above

10. The edge length of a cubic unit cell is 2 cm. What is its volume?

A) 4 cm^3
B) 6 cm^3
C) 8 cm^3
D) 12 cm^3
E) None of the above

11. Use Gibbs free energy interpretation to calculate ΔG if $\Delta H = -20$, $T = 5$, and $\Delta S = -2$, then is:

A) -10
B) -20
C) -30
D) $+10$
E) None of the above

12. A material sample has mass 48 g and dimensions 2 cm $\times$ 3 cm $\times$ 4 cm. Its density is:

A) 2 g/cm^3
B) 4 g/cm^3
C) 6 g/cm^3
D) 8 g/cm^3

E) None of the above

13. Theoretical density is 8.0 g/cm^3, while experimental density is 7.2 g/cm^3. The percentage error is:

A) 5%
B) 8%
C) 10%
D) 12.5%
E) None of the above

14. If particle size decreases for the same mass of material, surface area generally:

A) Decreases
B) remains constant
C) increases
D) becomes zero
E) None of the above

15. If the calculated E^{o}_{cell} is negative, this usually means the reaction is:

A) spontaneous
B) nonspontaneous
C) at equilibrium
D) impossible to analyze
E) None of the above

16. For a cell reaction, increasing product concentration while keeping reactants constant will generally make the cell voltage:

A) Increase
B) Decrease
C) stay unchanged
D) become exactly zero
E) None of the above

17. At steady state, accumulation is zero. If a nonreactive system has input = 60 kg/h, the output must be:

A) 0 kg/h

B) 30 kg/h
C) 60 kg/h
D) 120 kg/h
E) None of the above

18. If an incompressible fluid moves from a wider pipe section to a narrower one, the fluid velocity will:

A) Decrease
B) remain constant
C) increase
D) become negative
E) None of the above

19. A reaction follows the rate law:

$$\textbf{Rate} = k[A]^2[B]$$

If the concentration of $A$is doubled and the concentration of $B$is halved, the new reaction rate compared with the original rate will be:

A) Half the original rate
B) The same as the original rate
C) Twice the original rate
D) Four times the original rate
E) None of the above

20. If ln(x) = 2, what is the value of x?

A) 2
B) e^2
C) ln(2)
D) 4
E) None of the above