MHT CET 2025 Apr 15 Shift 2 Question Paper

General Instructions

Read the following instructions very carefully and strictly follow them:

- 1. The test is of 3 hours duration.
- 2. The question paper consists of 200 questions. The maximum marks are 200.
- There are three parts in the question paper consisting of Physics, Chemistry and Biology (Botany and Zoology) having 50 questions in each part of equal weightage.

1. A sound wave travels through air with a frequency of 500 Hz and a wavelength of 0.68 m. Calculate the speed of sound in air.

- (1) 340 m/s
- (2) 500 m/s
- (3) 200 m/s
- (4) 680 m/s

2. In a silicon semiconductor at room temperature, the intrinsic carrier concentration is $1.5 \times 10^{16} \text{ m}^{-3}$. Calculate the energy band gap of the silicon if the intrinsic carrier concentration is given by:

$$n_i = \sqrt{N_c N_v} e^{-E_g/2kT}$$

Where: $-N_c = 2.8 \times 10^{25} \text{ m}^{-3}$ is the effective density of states in the conduction band, $-N_v = 1.04 \times 10^{25} \text{ m}^{-3}$ is the effective density of states in the valence band, $-k = 1.38 \times 10^{-23}$ J/K is the Boltzmann constant, -T = 300 K is the temperature. (1) 1.1 eV (2) 0.9 eV

- $(3) 2.0 \,\mathrm{eV}$

3. An ideal gas is contained in a cylinder with a movable piston. The gas undergoes an isothermal expansion from a volume of 2 liters to 8 liters at a temperature of 300 K. If the initial pressure of the gas is 2×10^5 Pa, calculate the work done by the gas during this expansion. (Use R = 8.31 J/mol·K)

(1) 7200 J

- (2) 3600 J
- (3) 1800 J
- (4) 14400 J

4. A concave mirror has a focal length of 20 cm. An object is placed 60 cm in front of the mirror. Find the image distance.

 $(1) 30 \, \text{cm}$

- $(2) 40 \,\mathrm{cm}$
- $(3) 60 \,\mathrm{cm}$
- (4) 80 cm

5. A projectile is fired with an initial speed of 20 m/s at an angle of 30° above the horizontal. Find the maximum height reached by the projectile.

- $(1) 10 \,\mathrm{m}$
- (2) 20 m
- (3) 5 m
- (4) 15 m

6. The gravitational potential energy of an object of mass 5 kg at a height of 10 m above the surface of the Earth is:

- (1) 490 J
- (2) 500 J
- (3) 450 J
- (4) 550 J

7. A car of mass 1000 kg is moving in a circular path of radius 50 m with a speed of 20 m/s. Calculate the centripetal force acting on the car.

(1) 4000 N

- (2) 2000 N
- (3) 5000 N
- (4) 10000 N

8. Two charges, $q_1 = +3 \mu C$ and $q_2 = -4 \mu C$, are placed 20 cm apart. Calculate the force between the charges. (Use Coulomb's constant $k = 9 \times 10^9 \,\text{N} \cdot \text{m}^2/\text{C}^2$) (1) 1.35 N (2) 2.45 N (3) 3.5 N (4) 4.2 N

9. A fluid of density 800 kg/m^3 is flowing through a pipe of varying cross-sectional area. The velocity of the fluid at point A is 2 m/s, and the velocity at point B is 4 m/s. If the cross-sectional area at point A is 1 m^2 , find the cross-sectional area at point B.

- $(1) 0.5 \,\mathrm{m}^2$
- (2) $1.5 \,\mathrm{m}^2$
- $(3) 2.0 \,\mathrm{m}^2$
- (4) $4.0 \,\mathrm{m}^2$

10. For the reaction:

 $2A+B\to 3C$

The rate law is given as:

$$Rate = k[A]^2[B]$$

If the concentration of A is doubled and the concentration of B is halved, how does the rate of the reaction change?

(1) It remains the same.

(2) It doubles.

(3) It increases by a factor of 4.

11. The enthalpy of formation of hydrogen chloride (HCl) is -92.3 kJ/mol. If 2 moles of HCl are formed from hydrogen and chlorine gas, calculate the total heat released.

 $(1) - 184.6 \,\text{kJ}$

- $(2) 92.3 \,\mathrm{kJ}$
- (**3**) 92.3 kJ
- (4) 184.6 kJ
- 12. For the equilibrium reaction:

 $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

At a certain temperature, the equilibrium constant K_c is 4.0. If the concentrations of N_2 , H_2 , and NH_3 are 0.2 M, 0.6 M, and 0.4 M, respectively, calculate the reaction quotient Q_c and determine whether the reaction is at equilibrium.

- (1) $Q_c = 1.2$, the reaction will shift to the left.
- (2) $Q_c = 4.0$, the reaction is at equilibrium.
- (3) $Q_c = 2.0$, the reaction will shift to the right.
- (4) $Q_c = 0.5$, the reaction will shift to the left.

13. The freezing point depression constant (K_f) for water is $1.86 \degree C \cdot kg/mol$. If 0.5 moles of a non-volatile solute is dissolved in 1 kg of water, calculate the freezing point depression.

- (1) 0.93 °C
- (2) 1.86 °C
- (3) 3.72 °C
- (4) 2.79 °C

14. The energy of the nth orbit of the hydrogen atom is given by:

$$E_n = -\frac{13.6}{n^2} \,\mathrm{eV}$$

What is the energy of the second orbit (n = 2) of the hydrogen atom?

(1) -3.4 eV
(2) -13.6 eV
(3) -6.8 eV
(4) -1.36 eV

15. In the reaction:

 $Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$

Which of the following is the correct oxidation half-reaction?

(1) $\operatorname{Zn} \to \operatorname{Zn}^{2+} + 2e^{-}$ (2) $\operatorname{Cu}^{2+} + 2e^{-} \to \operatorname{Cu}$ (3) $\operatorname{Zn}^{2+} + 2e^{-} \to \operatorname{Zn}$ (4) $\operatorname{Cu} \to \operatorname{Cu}^{2+} + 2e^{-}$

16. Which of the following is the primary function of the human respiratory system?

- (1) To transport oxygen to tissues and carbon dioxide to the lungs.
- (2) To remove waste products from the body.
- (3) To facilitate digestion and absorption of nutrients.
- (4) To maintain homeostasis by regulating blood pH.

17. In a monohybrid cross between two heterozygous pea plants (Pp x Pp), what is the expected phenotypic ratio of the offspring?

(1) 3:1

- (2) 1:2:1
- (3) 1:1
- (4) 4:0

18. Which of the following is an example of a primary consumer in an ecosystem?

- (1) Grasshopper
- (2) Snake
- (3) Fox
- (4) Deer

19. Which part of the human brain is primarily responsible for regulating basic life functions, such as heart rate and breathing?

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla Oblongata
- (4) Hypothalamus

20. Which of the following is the correct equation for photosynthesis?

(1) $6CO_2 + 6H_2O +$ light energy $\rightarrow C_6H_{12}O_6 + 6O_2$

(2) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{energy}$

(3) $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2 +$ light energy

(4) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O +$ light energy

21. Which organelle is primarily responsible for producing ATP in a cell?

- (1) Nucleus
- (2) Mitochondria
- (3) Endoplasmic Reticulum
- (4) Golgi Apparatus

22. In a DNA molecule, which of the following base-pairings is correct?

- (1) Adenine pairs with Cytosine.
- (2) Thymine pairs with Guanine.
- (3) Adenine pairs with Thymine.
- (4) Cytosine pairs with Uracil.

23. Which of the following processes occurs during the second meiotic division (Meiosis II)?

- (1) Homologous chromosomes are separated.
- (2) Sister chromatids are separated.
- (3) DNA replication occurs.
- (4) Crossing over occurs.

24. Which of the following factors does NOT affect the rate of an enzyme-catalyzed

reaction?

- (1) Temperature
- (2) pH
- (3) Substrate concentration
- (4) Color of the enzyme