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MHT CET 2025 Apr 15 Shift 2 Question Paper

Time Allowed :3 Hour	Maximum Marks :200	Total Questions :200

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.
3. 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

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2. In a silicon semiconductor at room temperature, the intrinsic carrier concentration is 1.5×10^{16} 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: - $N_c = 2.8 \times 10^{25}$ m^{-3} is the effective density of states in the conduction band, - $N_v = 1.04 \times 10^{25}$ 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 eV

(4) $0.7\,\text{eV}$

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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) $7200\,\text{J}$

(2) $3600\,\text{J}$

(3) $1800\,\text{J}$

(4) $14400\,\text{J}$

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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) $40\,\text{cm}$

(3) $60\,\text{cm}$

(4) $80\,\text{cm}$

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

(1) $10\,\text{m}$

(2) $20\,\text{m}$

(3) $5\,\text{m}$

(4) $15\,\text{m}$

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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) $490\,\text{J}$

(2) $500\,\text{J}$

(3) $450\,\text{J}$

(4) $550\,\text{J}$

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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) $4000\,\text{N}$

(2) $2000\,\text{N}$

(3) $5000\,\text{N}$

(4) $10000\,\text{N}$

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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 $k = 9 \times 10^9\,\text{N·m}^2/\text{C}^2$)

(1) $1.35\,\text{N}$

(2) $2.45\,\text{N}$

(3) $3.5\,\text{N}$

(4) $4.2\,\text{N}$

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

(1) $0.5\,\text{m}^2$

(2) $1.5\,\text{m}^2$

(3) $2.0\,\text{m}^2$

(4) $4.0\,\text{m}^2$

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10. For the reaction:

$$2A + B \rightarrow 3C$$

The rate law is given as:

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

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.

(4) It decreases by a factor of 2.

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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 kJ

(2) -92.3 kJ

(3) 92.3 kJ

(4) 184.6 kJ

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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.

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

(1) $0.93\,^\circ$C

(2) $1.86\,^\circ$C

(3) $3.72\,^\circ$C

(4) $2.79\,^\circ$C

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

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

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

(1) $-3.4\,\text{eV}$

(2) $-13.6\,\text{eV}$

(3) $-6.8\,\text{eV}$

(4) $-1.36\,\text{eV}$

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15. In the reaction:

$$\text{Zn(s)} + \text{CuSO}_4(aq) \rightarrow \text{ZnSO}_4(aq) + \text{Cu(s)}$$

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

(1) $\text{Zn} \rightarrow \text{Zn}^{2+} + 2e^-$

(2) $\text{Cu}^{2+} + 2e^- \rightarrow \text{Cu}$

(3) $\text{Zn}^{2+} + 2e^- \rightarrow \text{Zn}$

(4) $\text{Cu} \rightarrow \text{Cu}^{2+} + 2e^-$

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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.

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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

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

(1) Grasshopper

(2) Snake

(3) Fox

(4) Deer

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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

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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) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O +$ 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

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

(1) Nucleus

(2) Mitochondria

(3) Endoplasmic Reticulum

(4) Golgi Apparatus

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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.

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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.

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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

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