單選題(1–20)，每題 5 分，共 100 分。　※注意：單選題考生應作答於答案卡。

1. The pressure at the foot of a column of mercury of height 0.9 m and density 13.6 g cm^{-3} is (A) 1.20 ×10^2 kg m s^{-2}, (B) 1.20 ×10^2 kg m^{-1} s^{-2}, (C) 1.20 ×10^5 kg m s^{-2}, (D) 1.20 ×10^5 kg m^{-1} s^{-2}, (E) 1.48 ×10^5 Pa.
2. Consider a region of the atmosphere of volume 25 dm^3, which at 20°C contains about 1.0 mol of molecules. Take the average molar mass of the molecules as 29 g mol^{-1} and their average speed as about 400 m s^{-1}. The energy stored as molecular kinetic energy in this volume of air is (A) 2.3 J, (B) 2.3 kJ, (C) 2.3 kcal, (D) 58 kJ, (E) 0.1 kJ.
3. In an experiment to measure the molar mass of a perfect gas, 250 cm^3 of the gas was confined in a glass vessel. The pressure was 152 Torr at 298 K and the mass of the gas was 33.5 mg. The molar mass of the gas is (A) 16.4 g mol^{-1}, (B) 16.4 kg mol^{-1}, (C) 2.0 kg, (D) 2.0 g mol^{-1}, (E) none of the above.
4. Cooling a sample of air from 25°C to 0°C reduces the original root-mean-square speed of the molecules by a factor of approximately (A) 1.000, (B) 0.957, (C) 0.723, (D) 0.654, (E) 0.431.
5. In the isothermal reversible compression of 52.0 mmol of a perfect gas at 260 K, the volume of the gas is reduced from 300 cm^3 to 100 cm^3. The work done for this process is (A) −123 J, (B) −37 J, (C) 0 J, (D) +37 J, (E) +123 J.
6. When 229 J of energy is supplied as heat to 3.00 mol $Ar_{(g)}$, assumed be to a perfect gas, the temperature of the sample increases by 2.55 K. The molar heat capacity at constant pressure of the gas is (A) 30 J K^{-1} mol^{-1}, (B) 38 J K^{-1} mol^{-1}, (C) 90 J K^{-1} mol^{-1}, (D) 98 J K^{-1} mol^{-1}, (E) none of the above.
7. In an experiment to determine the enthalpy of vaporization of 2-propanol (molar mass = 60.04 g mol^{-1}), a sample was brought to the boil. When an electric current of 0.812 A from an 11.5 V supply was passed for 303 seconds, 4.27 g of the alcohol was vaporized. The molar enthalpy of vaporization of 2-propanol at its boiling point was found to be (A) 0.7 kJ mol^{-1}, (B) 2.8 kJ mol^{-1}, (C) 39.8 kJ mol^{-1}, (D) 131.3 kJ mol^{-1}, (E) 169.9 kJ mol^{-1}.
8. The difference between the standard enthalpy of ionization of $Ca_{(g)}$ to $Ca^{2+}_{(g)}$ and the accompanying change in internal energy at 25°C is estimated to be (A) 0 kJ mol^{-1}, (B) 0.42 kJ mol^{-1}, (C) 4.96 kJ mol^{-1}, (D) 416 kJ mol^{-1}, (E) 4958 kJ mol^{-1}.
9. The molar heat capacity of aluminum is 24.35 J K^{-1} mol^{-1} and the molar mass of aluminum is 26.98 g mol^{-1}. A 1.00 kg sample of aluminum is cooled at constant pressure from 300 K to 250 K. The change in entropy of the sample is calculated to be (A) −45 KJ, (B) −165 J K^{-1}, (C) +165 J, (D) +165 J K^{-1}, (E) +45 KJ.
10. The formation of glutamine from glutamate and ammonium ions requires an energy input of 14.2 kJ mol^{-1}. It is driven by the hydrolysis of ATP to ADP mediated by the enzyme glutamine synthetase. Given that the change in Gibbs energy for the hydrolysis of ATP corresponds to $\Delta G = -31$ kJ mol^{-1} under the conditions prevailing in a typical cell, the minimum amount of ATP required to produce 1 mol of glutamine is (A) 0.46 mol, (B) 1.00 mol, (C) 2.18 mol, (D) 4.58 mol, (E) 21.83 mol.
11. The molar absorption coefficient of P450 at 522 nm is 291 dm^3 mol^{-1} cm^{-1}. When light of this wavelength passes through a cell of length 6.5 mm containing a solution of P450, 39.8 percent of the light is absorbed. The molar concentration of P450 in the solution is (A) 0.0021 mmol dm^{-3}, (B) 2.1 mmol dm^{-3}, (C) 3.2 mmol dm^{-3}, (D) 1.2 mmol dm^{-3}, (E) none of the above.
12. The rate law for a reaction is given by rate = k_r[A][B][C] with the molar concentrations in moles per cubic decimeter and the time in seconds. The units of k_r are (A) mol^3 dm^{-3} s^{-1}, (B) mol^3 dm^{-9} s^{-3}, (C) mol dm^{-3} s^{-1}, (D) mol^{-2} dm^6 s^{-1}, (E) mol^{-2} dm^3 s^{-1}.
13. The following initial-rate data (v_0) were obtained for the rate of glucose ($C_6H_{12}O_6$) binding with the enzyme hexokinase, present at a concentration of 1.34 mmol dm^{-3}. The order of reaction with respect to glucose was (A) fourth, (B) second, (C) third, (D) first, (E) zero.

[$C_6H_{12}O_6$]/(mmol dm^{-3})	1.00	1.54	3.12	4.02
v_0 /(mol dm^{-3} s^{-1})	5.0	7.6	15.5	20.0

14. The rate of the second-order decomposition of acetaldehyde (CH_3CHO) was measured over the range of 700–1000 K, and the rate constants (k_r) that were found are reported below. Based on the Arrhenius equation, the activation energy was determined to be (A) 0 kJ mol^{-1}, (B) 0.23 kJ mol^{-1}, (C) 8.3145 kJ mol^{-1}, (D) 22.65 kJ mol^{-1}, (E) 188 kJ mol^{-1}.

見背面

Temperature (K)	700	730	760	790	810	840	910	1000
k_r (mol^{-1} dm^3 s^{-1})	0.011	0.035	0.105	0.343	0.789	2.17	20.0	145

15. Following the above question, the pre-exponential factor was (A) 9.810 mol^{-1} dm^3 s^{-1}, (B) 62.364 mol^{-1} dm^3 s^{-1}, (C) 1.1×10^{12} mol^{-1} dm^3 s^{-1}, (D) 3.2×10^{20} mol^{-1} dm^3 s^{-1}, (E) 6.02×10^{23} mol^{-1} dm^3 s^{-1}.
16. The equilibrium constant for the attachment of a substrate to the active site of an enzyme was measured as 200. In a separate experiment, the rate constant for the second-order attachment was found to be 1.5×10^8 dm^3 mol^{-1} s^{-1}. The rate constant for the loss of the unreacted substrate from the active site was estimated to be (A) 7.5×10^5 s^{-1}, (B) 7.5×10^5 dm^3 mol^{-1} s^{-1}, (C) 3.0×10^{10} s^{-1}, (D) 3.0×10^{10} dm^3 mol^{-1} s^{-1}, (E) 14 dm^3 mol^{-1} s^{-1}.
17. For the reaction $Pyruvate^-_{(aq)} + NADH_{(aq)} + H^+_{(aq)} \rightarrow lactate^-_{(aq)} + NAD^+_{(aq)}$, the standard Gibbs energy of reaction (ΔG_r^0) is −66.6 kJ mol^{-1}. The standard biological (pH = 7) Gibbs energy for the reaction at 310 K is calculated to be (A) 4.15×10^4 kJ mol^{-1}, (B) 0 kJ mol^{-1}, (C) −25.1 kJ mol^{-1}, (D) −66.6 kJ mol^{-1}, (E) −108.1 kJ mol^{-1}.
18. A solution of equal concentrations of lactic acid and sodium lactate was found to have pH = 3.08. Based on this, the pK_a value of lactic acid was calculated to be (A) 8.32×10^{-4}, (B) 14, (C) 10.92, (D) 3.92, (E) 3.08.
19. Following the above question, if the acid had twice the concentration of the salt, the pH would be (A) 10.92, (B) 7.84, (C) 6.16, (D) 3.08, (E) 2.78.
20. Based on the reactions below, and under the steady-state approximation with O treated as an intermediate, the rate of decomposition of O_3 is expressed by (A) $\frac{k_1k_2[O_3]^2}{k_1'[O_2]+k_2[O_3]}$, (B) $\frac{-k_1k_2[O_3]^2}{k_1'[O_2]+k_2[O_3]}$, (C) $\frac{-2k_1k_2[O_3]^2}{k_1'[O_2]+k_2[O_3]}$, (D) $\frac{2k_1k_2[O_3]^2}{k_1'[O_2]}$, (E) $\frac{k_1k_2[O_3]^2}{k_1'[O_2]}$.

$O_3 \rightarrow O_2 + O$ (the reaction constant = k_1; the reverse reaction constant = k_1')
$O + O_3 \rightarrow O_2 + O_2$ (the reaction constant = k_2; the reverse reaction is negligibly slow)

Boltzmann's constant	1.38065×10^{-23} J K^{-1}
Avogadro's constant	6.02214×10^{23} mol^{-1}
Gas constant	8.31447 J K^{-1} mol^{-1}
Standard acceleration of free fall	9.80665 m s^{-2}
1 atm = 760 Torr = 101.325 kPa	