CSIR-UGC NET (2020-2021)
Mock Test No: 1
Subject: Surface Chemistry

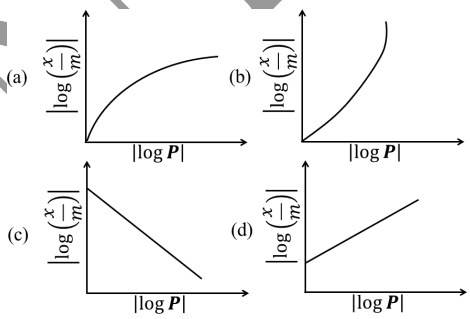
Date: 15/02/2020 **Time:** 1 hour 30 mins **Full Marks: 50**

Name: **Roll No.:**

No. of questions attempted	No. of correct answers	No. of wrong answers	Marks obtained	Total

- There is only one correct option.
- Tick (✓) to the correct option.
- There is a negative marking of 0.25 for each wrong attempt.

1. **For adsorption of a gas on a solid surface, the plot that represents Freundlich isotherm is (x = mass of gas, m is the mass of adsorbent, P is the pressure)**



2. **The adsorption of gas follows the Langmuir isotherm with $K = 1.25\ \mathrm{Pa}^{-1}$ at 25°C. The pressure (in Pa) at which surface coverage is 0.2 is .....**

   (a) 0.2 Pa (b) 0.5 Pa (c) 0.25 Pa (d) 0.35 Pa

3. **Charcoal (1 gram) of surface area 100 m^2 per gram, absorbs 60 mg of acetic acid from an aqueous solution at 25°C and 1 atmosphere**

pressure. The number of moles of acetic acid adsorbes per cm^2 of charcoal surface is

(a) 10^{-2} (b) 10^{-6} (c) 10^{-5} (d) 10^{-9}.

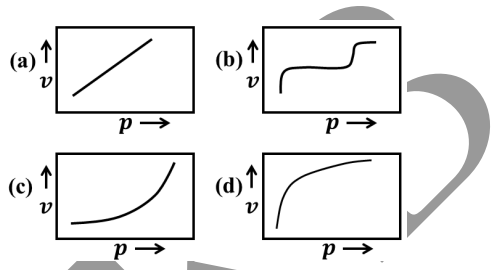
4. **The volume** (cm^3) **of** CO **absorbed on charcoal** (273 K) **at two different pressures is given below**

P (kPa)	40	80
V (cm^3)	25	40

Assuming Langmuir isotherm, the maximum possible volume (cm^3) CO **that can be adsorbed is**

(a) 50 (b) 100 (c) 150 (d) 200

5. **The graph that represents the Langmuir adsorption isotherm is**



6. **Consider aqueous solution of two compounds A and B of identical concentrations. The surface tension of the solution of A is smaller than that of pure water while for for B it is greater than that of pure water under identical conditions. From this one infers that**

(a) Surface concentration of A is smaller than its bulk concentration.
(b) Surface concentration of B is larger than its bulk concentration.
(c) Surface concentration of A is larger than that of B.
(d) Surface concentration of A is smaller than that of B.

7. **The correct form for a simple Langmuir isotherm is**

(a) $\theta = K_P$ (b) $\theta = (K_p)^{\frac{1}{2}}$ (c) $\theta = \frac{K_P}{(1+K_P)}$ (d) $\theta = \frac{(1+K_P)}{K_P}$

8. **The aggregation of surfactant molecules is known as**

(a) micelles (b) clusters
(c) get (d) colloid

9. **Michael Faraday observed that the colour of colloidal suspensions of gold nanoparticles changes with the size of the nanoparticles. This is because**

(a) Gold forms complex with the solvent.
(b) Band gap of gold changes with size of the nanoparticle.
(c) Gold in nanocrystalline form undergoes transmutation to other elements.
(d) Colloidal suspensions diffract light

10. **"Colloids are thermodynamically unstable with reference to bulk but kinetically stable". Identify the correct pair.**

Statements	Reasons
(a) thermodynamically stable	(c) interfacial surface tension
(b) kinetically stable	(d) electrical double layer

(a) (a) $\leftrightarrow$ (d) and (b) $\leftrightarrow$ (c)
(b) (a) $\leftrightarrow$ (c) and (b) $\leftrightarrow$ (d)
(c) (a)$\leftrightarrow$ (c) and (b) $\leftrightarrow$ (c)
(d) (a) $\leftrightarrow$ (d) and (b) $\leftrightarrow$ (d)

11. **Isothermal which has fractional coverage, linearly dependent on pressure at low pressures but almost indepenent at high pressure is called**

(a) BET isotherm
(b) Langmuir isotherm
(c) Freundlich isotherm
(d) Temkin isotherm

12. **With increase in temperature, the Gibbs free energy for the adsorption of a gas on to a solid surface**

(a) Becomes more positive from a positive value
(b) Becomes more negative from a positive value
(c) Becomes more positive from a negative value
(d) Becomes more negative from a negative value

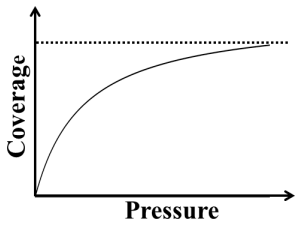
13. **The decomposition of** NH_3 **on** Mo **surface follows Langmuir-Hinshelwood mechanism. The decomposition was carried out at low pressure. The initial pressure of** NH_3 **was** 10^{-2} torr**. The pressure of** NH_3 **was reduced to** 10^{-4} torr **in** 10 **mins. The rate constant of decomposition of** NH_3 **is**

(a) 9.9×10^{-4} torr min^{-1}
(b) 0.4606 min^{-1}
(c) 9.9×10^{-3} torr min^{-1}
(d) 0.693 min^{-1}

14. **The Langmuir adsorption isotherm is given by** $\theta = \frac{K_P}{1+K_P}$**, where** P **is the pressure of the adsorbate gas. The Langmuir adsorption isotherm for a diatomic gas** A_2 **undergoes dissociative adsorption is**

(a) $\theta = \frac{K_P}{1+K_P}$
(b) $\theta = \frac{2K_P}{1+2K_P}$
(c) $\theta = \frac{(K_P)^2}{1+(K_P)^2}$
(d) $\theta = \frac{(K_P)^{\frac{1}{2}}}{1+(K_P)^{\frac{1}{2}}}$

15. **The adsorption of a gas on a solid surface exhibits the following isotherm. Which one of the following statement is true?**

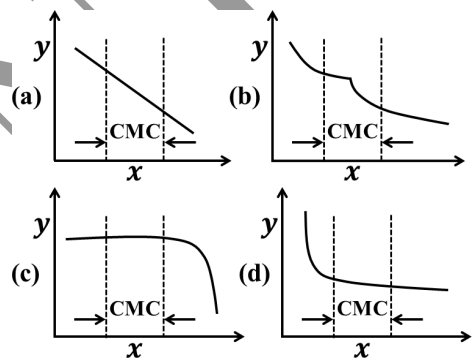


(a) Heat of adsorption is independent of coverage.
(b) Adsorption is multilayer.
(c) Heat of adsorption varies monotonically with coverage.
(d) Heat of adsorption varies exponentially with coverage.

16. **With increase in temperature, the Gibbs free energy for the adsorption of a gas on to a solid surface**

(a) Becomes more positive from a positive value
(b) Becomes more negative from a positive value
(c) Becomes more positive from a negative value
(d) Becomes more negative from a negative value

17. **The correct representation of the variation of molar conductivity (y-axis) with surfactant concentration (x-axis) is (CMC=critical micelle concentration)**



18. **The adsorption of a gas is described by the Langmuir isotherm with the equilibrium constant $K = 0.9\ \mathrm{kPa}^{-1}$ at $25°\mathrm{C}$. The pressure in (kPa) at which the fractional surface coverage is 0.95, is**

(a) $\frac{1}{11.1}$ (b) 21.1 (c) 11.1 (d) 42.2

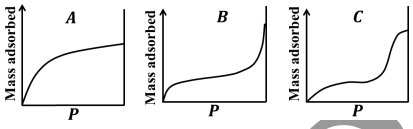
19. **The volume of a gas absorbed on a solid surface is** 10.0 ml, 11.0 ml, 11.2 ml, 14.5 ml **and** 22.5 ml **at** 1.0, 2.0, 3.0, 4.0 **and** 5.0 atm, **pressure, respectively. These data are best represented by**

(a) Gibb's isotherm (b) Langmuir isotherm.
(c) Freundlich isotherm (d) BET isotherm

20. **The aggregation of surfactant molecules is known as**

(a) micelles (b) clusters
(c) get (d) colloid

21. **Among the following figures, the variations of mass adsorbed with pressure for a monolayer and a multilayer are represented by**



(a) A and C respectively. (b) A and B respectively.
(c) C and A respectively. (d) B and A respectively.

22. **Hydrogen is adsorbed on many metal surfaces by dissociation (S represents a surface site):**

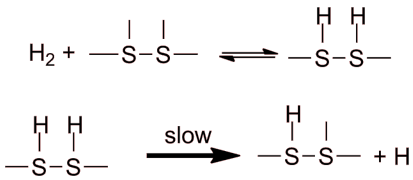
If the pressure of $H_2(p)$ **is small, the fraction of the surface covered by hydrogen is proportional to (NET-DEC-2014)**

(a) p (b) p^2 (c) $p^{\frac{1}{2}}$ (d) $p^{\frac{3}{2}}$.

23. **For the non-dissociative Langmuir type adsorption of a gas on a solid surface at a particular temperature, the fraction of surface coverage is** 0.6 **at** 30 bar**. The Langmuir isotherm constant (in** bar^{-1} **units) at this temperature is**

(a) 0.05 (b) 0.20 (c) 2.0 (d) 5.0

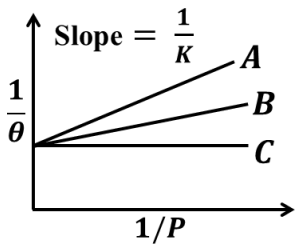
24. **For a reaction on a surface like**



At low pressure of H_2, the rate is proportional to

(a) $[H_2]$ (b) $\frac{1}{[H_2]}$ (c) $[H_2]^{\frac{1}{2}}$ (d) $\frac{1}{[H_2]^{\frac{1}{2}}}$

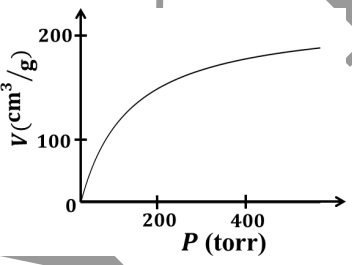
25. **Adsorption isotherm of three gases (A), (B) and (C) are shown in the following figure where θ is the % of surface coverage**



The correct order of the extent of adsorption of these gases

(a) $A > B > C$ (b) $B > A > C$ (c) $C > A > B$ (d) $C > B > A$

26. **The figure below depicts an adsorption isotherm of O_2 on charcoal at 90 K**



At a pressure 25 torr, only 10% of charcoal sites are occupied by O_2. Therefore, the ratio of adsorption to desorption rate constants (in torr^{-1}) is close to

(a) 0.003 (b) 0.004 (c) 0.006 (d) 0.015

27. **In Freundlich isotherm, a linear relationship is obtained in the plot of (θ = surface coverage and p = partial pressure of the gas)**

(a) θ vs p (b) $\ln\theta$ vs $\ln p$
(c) $\ln\theta$ vs p (d) θ vs $\ln p$

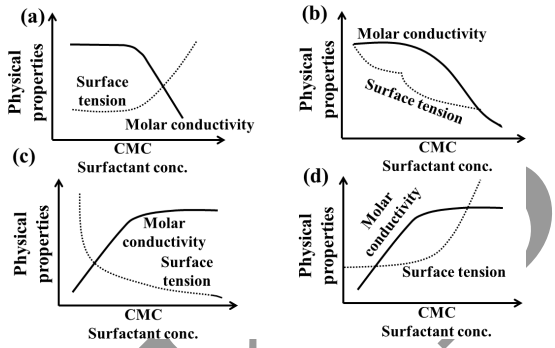
28. **Micelle formationis accompanied by the**

(a) decrease in overall entropy due to ordering.
(b) increase in overall entropy mostly due to increase in solvent entropy.

(c) increase in overall entropy mostly due to increase in solute entropy.
(d) increasein overall entropyand decrease in enthalpy

29. **For low partial pressure of ozone (O_3), the adsorption of ozone on graphite surface is fully dissociative in nature, and follows Langmuir isotherm. Under these conditions, if the dependence of the surface coverage of graphite (θ) on partial pressure of ozone (P_{O_3}) is given by $\theta \propto (P_{O_3})^x$, the value of x is ..... (up to two decimal places).**
(a) $\frac{1}{3}$ (b) 2 (c) 3 (d) $\frac{1}{2}$.

30. **For an ionic micelle forming surfactant near its CMC the dependence of molar conductivity and surface tension on surfactant concentration is best represented by**



31. **The dissociative chemisorption of X_2 (g) on a metal surface follows Langmuir adsorotion isotherm. The ratio of the rate constants of the adsorption and desorption processes is $4.0\ \mathrm{atm}^{-1}$. The fraction of surface coverage of X (absorbed) at $1.0\ \mathrm{atm}$ pressure is ..... (up to two decimal places).**
(a) 0.5 (b) 0.67 (c) 0.20 (d) 0.45

32. **Absorption of CO on charcoal at 273 K follows Langmuir isotherm. A plot of $\frac{P\ (\mathrm{kPa})}{V\ (\mathrm{cm}^3)}$ vs P (kPa) is linear with a slope 0.01 and y-intercept of 0.5. The equilibrium constant k (kPa), for the absorption is**
(a) 0.02 (b) 0.5 (c) 0.04 (d) 0.7

33. **At 273 K, N_2 is adsorbed on a mica surface. A plot of $\frac{1}{V}$ vs $\frac{1}{P}$ (V in m^3 and P in torr) gives a straight line with a slope equal to $2\times10^{-5}\ \mathrm{torr\ m}^{-3}$ and an intercept equivalent to v_m equal to $4\times10^{-8}\ \mathrm{m}^3$. The adsorption coefficient and the number of molecules of N_2 forming the monolayer respectively are**
(a) $1.25\times10^{12}\ \mathrm{torr}^{-1}$ and 1.075×10^{18}
(b) $2.5\times10^{12}\ \mathrm{torr}^{-1}$ and 1.075×10^{18}

(c) 2.5×10^{12} torr^{-1} and 1.75×10^{18}
(d) 4.25×10^{12} torr^{-1} and 1.075×10^{18}

34. **Hydrogen adsorption on a platinum surface is**

(a) Endothermic with positive ΔS and positive ΔG.
(b) Endothermic with positive ΔS and negative ΔG.
(c) Exothermic with negative ΔS and negative ΔG.
(d) Exothermic with positive ΔS and negative ΔG.

35. **Physisorbed particles undergo desorption at** $27°$C **with an activation energy of** 16.628 kJ mol^{-1}**. Assuming first order process and a frequency faster of** 10^{12} Hz**, the average residence time (in second) of the particles on the surface is**

(a) 8×10^{-10} (b) 8×10^{-11}
(c) 2×10^{-9} (d) 1×10^{-12}

36. **At** 273 K **and** 10 bar**, the Langmuir adsorption of a gas on a solid surface gave the fraction of surface coverage of** 0.01**. The Langmuir adsorption isotherm constant is .....** bar^{-1}**. (Give the answer to the third decimal place).**

37. **A monoatomic gas,** X **adsorbed on a surface, follows Langmuir adsorption isotherm. A plot of the fraction of surface coverage,** θ**, against the concentration of the gas** $[X]$**, for very low concentration of the gas is described by the equation**

(a) $\theta = K[X]$ (b) $1 - \theta = \frac{1}{K[X]}$
(c) $\theta = K^{\frac{1}{2}}[X]^{\frac{1}{2}}$ (d) $\theta = \frac{K[X]}{1+K[X]}$

38. **The process given below follows the Langmuir adsorption isotherm** $A_2\ (g) \rightleftharpoons 2A_{ads}$ **with** k_1 **and** k_{-1}**. If** θ **denotes the surface coverage and** P **denotes the pressure, the slope of the plot of** $\frac{1}{\theta}$ **vs** $\frac{1}{\sqrt{P}}$ **is**

(a) $\frac{1}{K^2}$ (b) $\frac{1}{K}$ (c) $-\frac{1}{K}$ (d) $\frac{1}{K^{\frac{1}{2}}}$

39. **If** γ **is surface tension of soap solution, the amount of work done in blowing a soap bubble from diameter** D **to a diameter** $2D$ **is**

(a) $2\pi D^2\gamma$ (b) $4\pi D^2\gamma$
(c) $6\pi D^2\gamma$ (d) $8\pi D^2\gamma$

40. **Choose the wrong statement from the following.**

(a) Small droplets of a liquid are spherical due to surface tension
(b) Oil rises through the wick due to capillarity
(c) In drinking the cold drinks through a straw, we use the phenomenon of capillarity

(d) Gum is used to stick two surfaces. In this process we use the property of Adhesion

41. **If the surface of a liquid is plane, then the angle of contact of the liquid with the walls of container is**

(a) Acute angle (b) Obtuse angle
(c) $90°$ (d) $0°$

42. **A capillary tube when immersed vertically in a liquid records a rise of 3 cm. If the tube is immersed in the liquid at an angle of 60 with the vertical, then length of the liquid column along the tube will be**

(a) 2 cm (b) 3 cm
(c) 6 cm (d) 9 cm

43. **If soap bubbles of different radii are in communication with each other**

(a) Air flow from the larger bubble into the smaller one until the two bubbles are of equal size.
(b) The sizes of the bubbles remain unchanged.
(c) Air flows from the smaller into the larger one and lager bubble grows at the expense of the smaller one.
(d) Air flows from the larger into the smaller one becomes equal to that of the larger one and the large one equal to that of the smaller one.

44. **A capillary tube of radius r can support a liquid of weight 6.28×10^{-4} N. if the surface tension of the liquid is 5×10^{-2} N m^{-1}. The radius of capillary must be**

(a) 2.5×10^{-3} m (b) 2.0×10^{-4} m
(c) 1.5×10^{-3} m (d) 2.0×10^{-3} m

45. **The work done in blowing a soap bubble of radius R is W_1 and that to a radius $3R$ is W_2. the ratio of work done $(W_1 : W_2)$ is**

(a) 1 : 3 (b) 3 : 1
(c) 1 : 9 (d) 9 : 1

46. **When the angle of contact between a solid and a liquid is $90°$, then**

(a) Cohesive force > Adhesive force.
(b) Cohesive force < Adhesive force.
(c) Cohesive force = Adhesive force.
(d) Cohesive force $\gg$ Adhesive force

47. **Rain drops are spherical in shape because of**

(a) Surface tension
(b) Capillary
(c) Downward motion
(d) Acceleration due to gravity

48. **A sheet can be made water proof by coating it with a substance that changes the angle of contact**

(a) to $\frac{\pi}{2}$
(b) to zero
(c) from acute to obtuse
(d) from obtuse to acute

49. **Water rises in a capillary tube to a certain height such that the upward force due to surface tension is balanced by 75×10^{-4} N, forces due to the weight of the liquid. If the surface tension of water is 6×10^{-2} N m^{-1}, the inner-circumference of the capillary must be**

(a) 1.25×10^{-2} m (b) 0.50×10^{-2} m
(c) 6.50×10^{-2} m (d) 12.5×10^{-2} m

50. **An intense purple color (plasma band) is exhibited by a colloid consisting of spherical**

(a) Silver particles of 10 mm diameter.
(b) Silver particles of 5 mm diameter.
(c) Gold particles of 5 mm diameter.
(d) Iron particles of 5 mm diameter.