**Physical Chemistry (II) Examination Paper**

**3. Interfacial Phenomena**

**I Choice (1 point for each, totally 30 points)**

1. Which of the following statements about the surface tension is NOT correct?

A：the contracted tension per unit length in the interface；

B：the reversible interfacial work gained with the increase of a unit interfacial area；

C：the Gibbs function per unit interface area at constant temperature and volume.

1. Which of the following parameters equals zero for a plane interface ?

A：surface tension； B：pressure difference； C：interfacial Gibbs function

1. When water with a constant volume aggregates into a spherical ball or disperses into large amount of droplets at the same temperature, which of the following parameters keeps unchanged ?

A：surface tension； B：surface energy； C：specific surface area

1. The statement that “the surface tension of solution always increases with increasing the concentration of the solution” is ?

A：true； B：faulse； C：uncertain

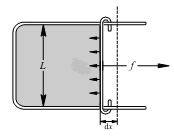
1. At the same temperature, comparing the surface tension of pure water with that of inorganic salt solutions or aqueous solutions of soap, it goes that

A：inorganic salt solutions> pure water> aqueous solutions of soap；

B：pure water> inorganic salt solutions > aqueous solutions of soap；

C：aqueous solutions of soap> pure water> inorganic salt solutions.

1. A layer of liquid film lies in in a platinum frame, each side of the film has a gas-liquid interface. If the force *f* applied on the movable platinum wire in the direction as shown in the figure does not exist, the liquid film will shrink. Given that the length of movable wire is L=0.2m, the surface tension of liquid film is 0.04N/m. Only in the case of *f* = can the liquid film stably stay in the frame.



A：0.008； B：0.016； C：0.032

1. The spreading coefficient is defined as , the spreading pressure

A：can cause the gas-liquid interface of the solution to spread;

B：can cause the gas-liquid interface of the solution to contract;

C: has no relation with the concentration of solutions.

1. At 25 oC, the interfacial tension of water is . If the work done on water is 144 J, the interfacial area of water will increase by

A：500； B：1000； C：2000

1. Which of the following statements is NOT correct?

A: In practical, the total amount of component *i* in the interfacial layer is always positive

B: In Gibbs isotherm model, the total amount of component *i* in the interfacial layer can be negative

C: In Gibbs isotherm model, the total amount of component *i* in the interfacial layer cannot be zero

1. According to the definition of , which of the following statements is NOT correct?

A: (*i*≠1) is irrelevant to the selection of the interface position.

B: (*i*≠1) can’t be less than zero

C: 

1. Which of the following substance can be a negative absorption at the interface of the aqueous solution?

A: Inorganic salts； B：Ethanol； C：Sodium dodecyl sulfate

1. Which of the following substance can be a positive absorption at the interface of the aqueous solution?

A: Inorganic salts； B：Sucrose； C：Sodium dodecyl sulfate

1. Which of the following substance can make the interfacial tension decreased significantly?

A: Inorganic salts； B：Sucrose； C：Sodium dodecyl sulfate

1. Theoretical basis of the maximum bubble pressure method for measuring the interfacial tension is\_\_\_\_\_\_\_\_

A: Kelvin Equation B: Laplace Equation C: Gibbs Isotherm

1. The pressure difference of a soap droplet with a radius of 1×10-5m is 8 kPa. Then the pressure inside of a soap bubble with the same radius is \_\_\_\_\_\_\_\_\_\_kPa (Assuming the pressure of air is 100 kPa)

A: 108 B: 116 C: 100

1. To maintain the radius of small droplets, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_is an effective method for reducing the pressure difference.

A: Adding surfactants; B: lowering the temperature; C: Adding inorganic salts

1. There is a bubble with the diameter of D in the air. The pressure difference between inside and outside of the bubble is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

A: ； B：； C：

1. The pressure difference of a soap bubble with a radius of 1×10-5m is \_\_\_\_\_\_\_\_\_\_\_kpa. Given that the surface tension of this soap solution at 25 oC is .

A: 0.8; B: 1.0 C: 1.6

1. The height of a liquid can rise in a capillary is \_\_\_\_\_\_\_\_\_\_\_\_\_. Suppose the capillary can be wetted by the liquid completely, and the density of the gas can be ignored

A: ； B: ； C: 

1. Three capillaries denoted as a, b, and c were dipped into water, respectively. If the radius of capillaries is in the sequence of ，the lowest vapor pressure of the liquid above the concave meniscus is in the capillary of . Suppose water can wet the capillary completely.

A: a ； B: b； C: c

1. The height of a liquid can rise in a capillary is independent of .

A: gravity, *g* ; B: density of liquid; C: atmosphere pressure

1. The height of water can rise in a capillary is inversely proportional to .

A: surface tension of liquid; B: radius of capillary; C: vapour pressure

1. To prevent the rise of liquids in a capillary, the pressure above the concave meniscus in the capillary is .

A: ； B: ； C: 

1. The normal melting temperature of Au is 1336 K, when it is dispersed into 4 nm nanoparticles, its melting point is .

A: unchanged； B: increased； C: decreased

1. When the surfactant is added into a solution, it will be .

A: d*σ*/d*c*<0，negative absorption；

B: d*σ*/d*c*<0，positive absorption；

C: d*σ*/d*c*>0，positive absorption

1. The surface tension of liquid A and solid B are *a* and *b*, respectively, and the interface tension between them is *c*. If the solid B can be wetted by the liquid A. when we dipped the ball of solid B with the surface area of *S* into the liquid A,  .

A: *S*(*c*-*b*)； B：*S*(*c*-*a*)； C：*S*(*c*+*b*-*a*)

1. At 25℃, the contact angle between water and a solid is *θ*=45o , the difference between *σ*g,l and *σ*l,s is Nm-1. Given that the surface tension of water*σ*g,l is 0.072 Nm-1

A: 0.144； B：0.0720； C：0.0509

1. When the physical adsorption of gas molecules are taken place at the surface of a solid, then .

A: ；

B: ；

C: 

1. For a monolayer adsorption, if the suface coverage calculated in surface area ratio is 0.455, then = .

A: 0.455； B: 0.545； C：0.655

1. At 25℃, the adsorption of benzen on graphit can be described by the Langmuir isotherm, when the vapour pressure of benzen is 40Pa, the surface coverage *θ*=0.05，when *θ*=0.5, the vapour pressure of benzen is .

A: 400Pa； B: 760Pa； C: 1000Pa

**II（10 points, 5 points for each）**

1. At 500 ℃, the normal decomposition pressure of CaCO3 is 101.325 kPa. If CaCO3 was dispersed into nanoparticles with the radius of 30 nm, calculate the decomposition pressure. Given that the density of CaCO3 is 3.9×103 kg/m3, the surface tension is 1210×10-3 N/m, and molar mass is 100.1g.
2. At 298K and 101.325kPa, when the capillary with a radius of 1×10-4m is inserted into water, what is the pressure should be added above the concave meniscus to avoid the capillary rising? Without this pressure, the water will rise in the capillary, and what is the height? Given that the surface tension of water is 0.072N·m-1, the density is 1000kg·m-3 at 298K, and the capillary can be wetted completely.

**III（10 points）**

Given that, at 298K, *σ*水＝72.8×10-3 N/m，*σ*苯＝28.9×10-3 N/m，*σ*汞＝471.6×10-3 N/m，*σ*汞－水＝375×10-3 N/m，*σ*汞－苯＝362×10-3 N/m，*σ*水－苯＝32.6×10-3 N/m.

1. Insert a drop of water into the interface between benzene and mercury, what is the contact angle?
2. Can benzene spread on the surface of water or mercury?
3. If it can spread on both surfaces, what are the pros and cons of their properties?

**IV（10 points）**

At 25℃, the relation between the surface tension *σ* of ethanol aqueous solution and its concentration *c* is , in which the unit of *c* is mol·dm-3. When 

1. what is the surface tension?
2. calculate the unit interfacial excess of ethanol on the surface of solution.
3. insert a capillary with a radius of 1.00 mm into this solution, calculate the rising height of the solution.

Given that the density of the solution is 986kg/m3. Assume that the contact angle is zero, and the solution is ideal dilute solution.

**V（10 points）**

The adsorption of CHCl3(g) on activated carbon fits the Langmuir isotherm quite well. At 293 K, when the pressure of CHCl3(g) is 5.2 kPa and 13.5 kPa, the amount of adsorption at equilibrium is 0.0692 m3·kg-1 and 0.0826 m3·kg-1, respectively (the data have been corrected to that at standard state). Calculate

1. the adsorption coefficient *b* of CHCl3(g) on activated carbon;
2. the amount of saturated adsorption of CHCl3(g) on activated carbon *V*∞;
3. the specific area of activated carbon, given that the sectional area of a single CHCl3(g) molecule is 0.32 nm2.

**VI（10 points）**

Suppose that the soil could be completely wetted by water. At 25°C, the interfacial tension of water *σ* = 7.197×10-2 N·m-1, the density *ρ* = 0.9970 g·cm-3 and the saturated vapor pressure *p*\* = 3.167×103 Pa.

1. What is the vapor pressure of water above the concave meniscus in the soil capillary with the diameter of 0.1×10-6 m?
2. Given that the relative humidity of air is 56% (The relative humidity is the ratio of the vapor pressure of water to its saturated vapor pressure). If the vapor will condense into water in this soil capillary?

**VII（10 points）**

Given that, at 27°C, the saturated vapor pressure of water is 4.185 kPa, the density is 0.9965 kg·m-3, the interfacial tension is 7.166×10-2 N·m-1, and its molar mass is 18.02 g·mol-1. At this temperature, calculate

1. the saturated vapor pressure of the water drop with the radius of 10-6 m.
2. the lowest condensation pressure of water in the capillary with the concave radius of 10-6 m.
3. Why do the above two calculations give different results?

**VIII（10 points）**

Given that, at 293K, 4.185 kPa, is 0.9965 kg·m-3, the surface tension of water , its molar mass is 18.02 g·mol-1, the density , and the saturated vapor pressure of water is 610.5Pa. The molar enthalpy of vaporization is and keeps unchanged in the temperature range of 273~293K. When the spherical water droplet with a radius of 1 cm is dispersed into small droplets with an average radius of at 293K,

1. What is the necessary minimum work? What is the increase of Gibbs Function of the interface?
2. What is the pressure difference of the small droplet with a radius of ?
3. What is the vapour pressure of the small droplet with a radius of ?