Filtration:

1. Concentration polarization can be reduced by

   A) Pre filtering the solution

   B) Reducing the flow rate per surface area

   C) Back washing periodically

   D) all of the above

   Answer: All of the above

2. Cloth filter is generally made of

   A) canvas

   B) synthetic fabrics

   C) metal or glass fiber

   D) all of these

   Answer: Option D

3. Assuming the laminar flow across the filter, the rate of filtration \((dV_f/dt)\) can be expressed as a function of pressure drop \(Dp\) by the modified \(D'\)Arcy's equation as (where \(A\) is the area of filtering surface, \(K\) is the \(D'\)Arcy's filter cake permeability and \(L\) is the thickness of the filter cake)

   \[A. \frac{1}{A} \frac{dV_f}{dt} = \frac{\Delta p/\mu}{L/K}\]

   \[B. \frac{dV_f}{dt} = \frac{1}{A} \Delta p/\mu \frac{L}{L/K}\]

   \[C. \frac{1}{A} \frac{dV_f}{dt} = \Delta p/\mu LK\]

   \[D. \frac{dV_f}{dt} = \frac{1}{A} \Delta p/\mu LK\]

   Answer: Option A

4. Filtration leaf test results indicate that the filtration rate of a protein product is 100 dry lbs/(ft²hr). What size filter would be required to obtain 100 dry lbs of filter cake/hr?

   \[A. 1.54 \text{ ft}^2\]

   \[B. 3.08 \text{ ft}^2\]

   \[C. 65 \text{ ft}^2\]

   \[D. 65 \text{ lbs/ ft}^2 \cdot \text{hr}\]

   Answer: Option A
5. The filtration involves the separation of large particles generally

A) \( d_p > 5 \mu m \)  
B) \( d_p > 10 \mu m \)  
C) \( d_p > 15 \mu m \)  
D) \( d_p > 20 \mu m \)

**Answer:** Option B

6. The equation for the elution volume of a solute in an effluent is (where \( V \) is the elution volume of a substance, \( V_0 \) void volume, \( k_D \) distribution constant and \( V_i \) internal water volume)

A) \( V = V_0 + k_D V_i \)  
B) \( V = \frac{V_0}{V_i} \)  
C) \( V = V_0 - k_D V_i \)  
D) \( \frac{V}{V_0} = k_D V_i \)

**Answer:** Option A

7. Micro filtration is the separation of suspended material such as bacteria by using a membrane with pore sizes of

A) 0.02 to 10\( \mu m \)  
B) 1-10\( \mu m \)  
C) 20-30\( \mu m \)  
D) 10-200\( \mu m \)

**Answer:** Option A

8. Which of the following separation method is suited method for a protein sample with large differences in molecular mass

a) dialysis  
b) salting out process  
c) density gradient centrifugation  
d) rate zonal centrifugation

**Answer:** Option d.
9. **Primary steps in protein purification includes**

   a) Homogenization  
   b) Differential centrifugation  
   c) Solubilisation  
   d) All of these  

**Answer:** Option d.

10. Example of filter for continuous mode of filtration

   a) Plate and frame  
   b) Spiral wound  
   c) Rotary vacuum  
   d) Tubular  

**Answer:** Option c.
Chromatography

1. Chromatography is based on the

A) Different rate of movement of the solute in a column
B) Separation of one solute from other constituents by being captured on the adsorbent
C) Different rate of movement of the solvent in the column
D) None of the above

**Answer:** Option A

2. The purity of a solute collected between two times \( t_1 \) and \( t_2 \) during chromatographic separation is

A) Amount of solute eluted - amount of impurity eluted
B) Amount of solute eluted / amount of impurity eluted
C) Amount of solvent eluted + amount of impurity eluted
D) Amount of solvent eluted / amount of impurity eluted

**Answer:** Option B

3. In gas chromatography, the basis for separation of the components is the difference in

A) Partition coefficients
B) Conductivity
C) Molecular weight
D) Molarity

**Answer:** Option A

4. In reverse phase chromatography, the stationary phase is made

A) non-polar
B) polar
C) either non-polar or polar  
D) none of these  

**Answer:** Option A  

5. **Ion exchange chromatography is based on the**  
A) Electrostatic attraction  
B) Electrical mobility of ionic species  
C) Adsorption chromatography  
D) Partition chromatography  

**Answer:** Option A  

6. **Which of the following statements about chromatography is correct?**  
A) Paper chromatography and gas chromatography are both routinely used for qualitative analysis only.  
B) Paper chromatography is usually considered to be quantitative only, while gas chromatography can be qualitative or quantitative.  
C) Paper chromatography is usually considered to be qualitative only, while gas chromatography can be qualitative or quantitative.  
D) Paper chromatography and gas chromatography are both routinely used for quantitative analysis only.  

**Answers:** Option C  

7. **In gas chromatography, the concentration of a substance can be determined by ...**  
A) comparison of the area under the peak produced by the substance with the areas under the peaks produced by standard.  
B) from the R_t value of the substance.  
C) measurement of the height of the peak produced by the substance.  
D) comparison of the R_t of the substance with that of a standard
8. **High performance liquid chromatography (HPLC) cannot be used to ...**

A) identify the various pigments from a leaf extract.

B) separate organic pesticides.

C) determine the caffeine content in coffee samples.

D) determine the mercury content in a fish sample.

**Answer:** Option D

9. **Which of the following statements about paper Rf and gas chromatography Rt is correct?**

A) The Rf and Rt values of a substance are determined solely by the interaction of the substance with the stationary phase.

B) A substance with a long retention time in gas chromatography is likely to have a high Rf value in paper chromatography.

C) A high Rf value is indicative of a substance that adsorbs strongly onto the stationary phase.

D) A long retention time in gas chromatography is indicative of a substance with a strong adsorption on to the stationary phase.

**Answer:** Option D

10. **Thin layer chromatography can be used to distinguish between different amino acids. If a particular amino acid has low solubility in the mobile phase used, then the other amino acid ...**

A) will spend more time dissolved in the mobile phase than attached to the stationary phase.

B) will have a low Rf value.

C) must have a high molecular mass.

D) will move at a speed close to that of the solvent.

**Answer:** Option B
Liquid liquid extraction

1. Which type of solid phase extraction cartridge can be used for retaining ethanol in gasoline

A) normal phase (or hydrophilic interaction)
B) C18 type reversed phase
C) cation-exchange
D) Phenyl type reversed phase

Answer: Option A

2. A system which require less solvent and produces a more concentrated extract phase, is desired with a

A) large distribution coefficients
B) small distribution coefficients
C) very small distribution coefficients
D) constant distribution coefficients

Answer: Option A

3. The effectiveness of a solvent can be measured by the

A) Distribution coefficients
B) Selectivity
C) Both (a) and (b)
D) Diffusivity

Answer: Option c

4. For the extraction operation, the selectivity should be

A) > 1
B) < 1
C) 1
D) Zero

Answer: Option A

5. Which type of liquid liquid extraction is efficient.

a) Multistage counter current
b) Multistage cross current
c) Multistage co current
d) Single stage  

**Answer:** Option a.

6. When the feed and solvent are fully miscible, is extraction still possible?

A) Yes, since only the difference in solubility of the solute in the two solvent matters. The higher the difference in solubility, the better the separation.

B) No. In this case there will be only one phase after the settler instead of two. No extract or raffinate phases can be formed.

C) It depends on the density difference between the two liquids. If this difference is higher than 25%, extraction is possible.

D) No, extraction is not possible anymore, since if the two liquids are fully miscible, the solute has also the same solubility in both liquids.

**Answer:** Option B

7. What will change if a co-current extraction column has to be used instead of a cross-current column?

A) The concentrations of in- and outlet streams of the column will change...

B) Using a co-current column, the carrier solvent and the fresh solvent must have the same density.

C) Before and after the column, an additional mixer/settler is needed to fulfill the separation task.

D) A co-current extraction column does not exist.

**Answer:** Option D.

8. What may be the drawback of the extraction process

A) If the extraction process is well designed, there are no drawbacks.

B) The solute may be destroyed by the extracting solvent, so the use of this setup is very critical.

C) The extract has to be separated to obtain the pure solute or to reuse the solvent in the process. This needs a further separation step (e.g. distillation).
D) To run an extraction process, many equipments are needed (mixer, settler, pumps, ...). For a batch process with different operations (different solvents and solutes), a lot of time is needed to clean and prepare the system.

**Answer:** Option C

9. What are the important properties of a good solvent for extraction processes?

A) The chosen solvent should be highly selective for the solute to allow high solubility. Its density should be as different as possible from the one of the carrier solvent.

B) Since a lot of solvent is needed, it should be as cheap as possible.

C) Each solvent has its advantages and disadvantages. To choose the most suitable solvent, the advantages should be higher than the disadvantages.

D) The chosen solvent should have a lower selectivity for the solute to allow high separation. Its density should be as different as possible from the one of the carrier solvent.

**Answer:** Option A + B

10. What are the advantages of extraction processes compared with other separation processes?

A) Extraction is a separation process which involves no evaporation; carried out mostly at ambient temperatures and can be used as a separation process for high temperature sensitive products.

B) All streams are in liquid phase, therefore the system pressures are lower, resulting in thinner walls needed for the equipments.

C) There are no specific advantages.

D) The treatment of the process products is more easier, since all are in liquid phase. There is no cooling energy needed.

**Answer:** Option A.
Adsorption

1. The correlation to correlate adsorption data is (where $Y_{\text{max}}$ is the maximum amount of solute adsorbed per mass of adsorbent, $X$ is the mass fraction of solute in the diluent phase in solute-free basis, $K_L$ is a constant and $Y$ is the equilibrium value of the mass of solute adsorbed per mass of adsorbent)

   A) $Y = \frac{Y_{\text{max}}X}{(K_L+X)}$
   B) $Y = \frac{Y_{\text{max}}}{(K_L+X)}$
   C) $Y = \frac{Y_{\text{max}}X}{K_L}$
   D) $Y = \frac{Y_{\text{max}}-X}{(K_L+X)}$

   **Answer:** Option A

2. The phenomenon of concentrations of molecules of a gas or liquid at a solid surface is called
   a) absorption
   b) adsorption
   c) catalysis
   d) none of these

   **Answer:** Option b

3. The adsorption of gases on metal surfaces is called
   a) catalysis
   b) occlusion
   c) adsorption
   d) absorption

   **Answer:** Option b

4. The process of adsorption is
   a) exothermic
   b) endothermic
   c) sometimes exothermic or endothermic
   d) none of the above

   **Answer:** Option a.

5. Physical adsorption is a _________ process.
a) reversible  
b) irreversible  
c) exothermic  
d) none of these

**Answer:** Option a.

6. Multi-molecular layers are formed in
   
a) absorption  
b) physical adsorption  
c) chemisorption  
d) reversible adsorption

**Answer:** Option c.

7. The relationship between equilibrium pressure of gas and its amount adsorbed on the solid adsorbent at constant temperature is called
   
a) chemisorption  
b) adsorption isobar  
c) adsorption isotherm  
d) none of these

**Answer:** Option c.

8. Rusting of iron is
   
a) Oxidation  
b) Reduction  
c) Absorption  
d) Adsorption

**Answer:** Option a.

9. **Chemisorption**
   
a. Involves the weak attractive interactions between adsorbent and adsorbate  
b. Is irreversible in nature
c. Decreases with increase of temperature
d. Involves multilayer formation of adsorbent on adsorbate

**Answer:** Option b

10. Tubular adsorber follows which isotherm

   a) Langmuir
   b) freundlich
   c) Linear adsorption

**Answer:** Option c.
**Drying:**

1. Sterilization depends on
   a) nature of additive
   b) volume and feed rate
   c) both (a) and (b)
   d) none of these

   **Answer:** option c

2. The heat conduction in dry air is
   a) less rapid than in steam
   b) more rapid than in steam
   c) similar to steam
   d) none of these

   **Answer:** option a

3. The mechanical means of accomplishing sterilization of fermentation media/equipment is
   a) ultrasonic
   b) radiation
   c) chemical agents
   d) none of these

   **Answer:** option a

4. The destruction of microorganisms by steam may be a
a) first order chemical reaction
b) zero order chemical reaction
c) second order chemical reaction
d) none of these

**Answer:** option a

5. ---------takes a liquid stream and separates the solute or suspension as a solid and the solvent into a vapour.

a) spray dryer  
b) freeze dryer  
c) drum dryer  
d) pulse combustion dryer.

**Answer:** option a.

6. Which drying process is often used as an encapsulation technique in food and other industries

a) Rotary vacuum  
b) drum  
c) freeze  
d) spray

**Answer:** option d.

7. Most of the biological products are---------

a) Hygroscopic  
b) Non hygroscopic  
c) Both a and b

**Answer:** Option a.

8. The--------- is the minimum moisture content to which a hygroscopic material can be dried.

a) Residual moisture content  
b) Equilibrium moisture content  
c) None of the above

**Answer:** Option b.
9. Heat transfer coefficient for air------
   a) 10 to 100 W/m$^2$ K  
   b) 20 to 60 W/m$^2$ K  
   c) 30 to 80 W/m$^2$ K  

**Answer:** Option a.

10. Important parameters in spray dryer

   Point 1: Evaporation rate  
   Point 2: Particle size distribution of the product  
   a) Point 1 alone  
   b) Point 2 alone  
   c) Both  
   d) None of the above  

**Answer:** Option c.
**Distillation**

1. The process for converting sugar into ethanol is
   a) distillation
   b) desalination
   c) combustion
   d) fermentation

   **Answer:** option d.

2. Ethanol is used as a fuel in some countries. It is produced from crops such as sugar cane. Which of the statements are true?

   1. using ethanol as a fuel helps reduce global warming because no carbon dioxide is produced when it is burnt.
   2. using ethanol as a fuel helps reduce global warming because the crops use carbon dioxide whilst growing

   a) 1 only b) 2 only c) both 1 and 2 d) neither

   **Answer:** option b.

3. Distillation can be used to separate --------

   a) a soluble solid from a solution
   b) a liquid from a solution
   c) a solid from a solid
   d) an insoluble solid from a solution

   **Answer:** option b

4. In fractional distillation, a mixture of liquids is separated based on their
   a) boiling point
   b) solubility
   c) density
   d) chemical composition

   **Answer:** option a.

5. Fractional distillation can not be used to --------
a) Separate the components of liquid air  
b) Refine crude oil  
c) Test purity of a substance  
d) Separate methanol and water  

**Answer:** option c.

6. Biscuit packet contains nitrogen not air. The nitrogen used is obtained from air by

a) fractional distillation  
b) fermentation  
c) desalination  
d) nanotechnology  

**Answer:** option a.

7. Which of the following statements about the fractions obtained from crude oil is true?

a) each fraction contains only one substance  
b) molecules in bitumen contain four carbon atoms  
c) molecules in petrol contain sixty carbon atom  
d) petrol burns more easily than diesel oil.  

**Answer:** option d.

8. Oil and water may be separated by using
   
a) A filter funnel  
b) Chromatography paper  
c) A separating funnel  
d) Condenser  

**Answer:** option c

9. Water and alcohol are easily separated by distillation because of their differences in
   
a) boiling points  
b) densities  
c) melting points  
d) colours  

**Answer:** option a

10. Which one of the following is a disadvantage of evaporation?
a) All of the solute is recovered
b) It cannot be used for insoluble solids
c) The solvent is not recovered
d) It always requires heat

**Answer:** option d.
Crystallisation

1. Various stage in crystallization

   a) Nucleation
   b) growth
   c) evaporation
   d) a and b
   **Answer:** option d.

2. The advantages of crystallization: low operating temperatures, low energy requirements, high purity in a single step.

   a) True
   b) False
   **Answer:** option a.

3. The crystal size distribution depends on

   a) number of nuclei formed
   b) relationship between nucleation and growth
   c) Nucleation alone
   d) a and b
   **Answer:** option d.

4. The crystal size distribution depends on the number of nuclei formed during the cooling process as well as the presence of impurities.

   a) True
   b) False
   **Answer:** option a.

5. In crystallisation, solubility diagrams are useful in determining

   a) equilibrium condition
   b) saturation condition
6. Nucleation may occur around an impurity in the mother liquor.
   
a) True
   b) False
   
**Answer:** option a.

7. Translational velocity (crystal growth) depends on
   
a) size of atom
   b) size of face
   c) size of crystal
   d) none of the above

**Answer:** option a.

8. The resistance to integration into the crystal experienced by impurity atoms accounts for the high purity in crystalline products.
   
a) True
   b) False
   
**Answer:** option a.

9. The phenomenon involved in crystallization technique is
   
a) parallel displacement of faces
   b) antiparallel displacement of faces
   c) none of the above

**Answer:** option a.

10. Nucleation and growth is expected in a saturated solution.
   
a) True
   b) False
   
**Answer:** option a.
Cell Disruption:

1. During successful purification scheme, this may be expected that the
   a) specific activity increases
   b) specific activity decreases
   c) number of proteins in the sample decreases
   d) both (a) and (c)

   **Answer:** option d.

2. Which of the following may be added to stabilize the protein after yeast cells disruption?
   a) NaCl
   b) Protease inhibitor
   c) AMP
   d) All of these

   **Answer:** option d

3. Disadvantage of enzymatic cell lysis
   a) Not always reproducible
   b) Not usually applicable to large scale
   c) the enzyme must be removed to allow cell growth
   d) all the above

   **Answer:** option d.

4. In sonication method the range applied to the sample is--------
   a) 20-50KHz
   b) 60-80KHz
   c) 10-20KHz
   d) None of the above

   **Answer:** option a.

5. Disadvantages of sonication method

   a) heat generated must be dissipated
b) yield variability  
c) free radicals are generated  
d) all the above

**Answer:** option d.

6. which is the physical method of cell disruption

a) sonication  
b) french press  
c) Homogenizer  
d) decompression method

**Answer:** option d.

7. which organic solvent is used for yeast cell lysis

a) Acetonitrile  
b) carbinol  
c) Dichloromethane  
d) Toluene

**Answer:** option d

8. which enzymes are used in enzymatic cell lysis method

a) proteases  
b) lysozymes  
c) a and b  
d) none of the above

**Answer:** option c.

9. In beadmill correct bead size (diameter) is

a) 0.1 to 6 mm  
b) 2 to 7 mm  
c) 0.5 to 9mm  
d) 1 mm

**Answer:** Option a.
10. Important considerations for optimal cell lysis other than choice of detergent is

   a) pH 
   b) buffer 
   c) a and b 
   d) buffer, temperature and pH 

   **Answer:** Option d.
**Lyophilization:**

1. Lyophilization gives the opportunity to avoid denaturation caused by heating the product, by maintaining it frozen throughout drying.
   
   a) True  
   b) False  

   **Answer:** Option a.

2. In the primary drying (sublimation) phase during lyophilization process, which statements are incorrect?

   1. The partial pressure of the vapor surrounding the product must be lower than the pressure of the vapor from the ice, at the same temperature.  
   2. The energy supplied in the form of heat must remain lower than the product's eutectic temperature (the highest allowable product temperature during the conditions of sublimation.)

   a) Point 1  
   b) Point 2  
   c) None of the above  

   **Answer:** Option c.

3. A secondary drying aimed at eliminating the final traces of water which remain due to absorption, and where, what is happening exactly,

   1. The partial pressure of the vapor rising from the product will be at its lowest level.  
   2. The partial pressure of the vapor decreasing from the product will be at its highest level.

   a) Point 1 alone  
   b) Point 2 alone  
   c) None of the above  

   **Answer:** Option a.

4. The initial freezing process is carried out in such a way that:

   1. The product exhibits the desired crystalline structure.  
   2. The product is frozen below its eutectic temperature.

   a) Point 1 alone  
   b) Both point 1 and 2  
   c) Point 2 alone
5. Number of phases that are involved in freeze drying process
   a) Three
   b) One
   c) Two
   Answer: Option a.

6. Which statement is correct about freeze drying
   1. Heat transfer is increased by a pressure decrease.
   2. Water vapor flux is decreased as pressure is increased.
   a) Statement 1
   b) Statement 2
   c) Both a and b
   Answer: Option b.

7. In the process of freeze drying, a dense cell suspension is placed in a small vial and is frozen at
   a) -60 to -78°C
   b) -20 to -30°C
   c) -30 to -48°C
   d) -48 to -58°C
   Answer: Option a.

8. Freeze-dried coffee was first produced in -------- and this lead to the development of powdered food products.
   a) 1938
   b) 1965
   c) 1967
   d) 1980
   Answer: Option a.

9. Freeze-drying is a method for preserving materials, which are -----
   a) unstable in solution.
   b) stable in solution
   c) unstable in air
   d) stable in air
Answer: option a.

10. ---------is applied to the frozen product to accelerate sublimation.

   a) heat
   b) air
   c) water
   d) solvent

   Answer: option a.
Pre-Treatment:

1. Methods for pre-treatment included---
   a) Heating
   b) Use of filter aid
   c) Flocculation
   d) All of the above

   **Answer:** Option d.

2. Flocculation method will improve the
   a) Centrifugation
   b) Filtration
   c) Lyophilization
   d) Drying

   **Answer:** Option a.

3. Example of flocculating agents
   a) MnSO₄
   b) MgSO₄
   c) CaCl₂
   d) Polyelectrolytes

   **Answer:** Option c and d.

4. Disadvantage of filter Aids
   a) decreases the specific cake resistance
   b) Inert
   c) Reduces the compressibility of biomass
   d) certain antibiotics bind irreversibly to filter aids.

   **Answer:** Option d.

5. Ineffective flocculant for glucose broth is
   a) Bentonite
   b) Polystyrene sulphate
   c) Polyacrylamide

   **Answer:** Option c.
6. Particle size of filter aid is –
   a) 2 - 20\(\mu\)m
   b) 10 – 30 \(\mu\)m
   c) 15 - 45\(\mu\)m

**Answer:** Option a.

7. Which material has lower filterability
   a) Cellulose
   b) Diatomaceous earth
   c) Perlite

**Answer:** Option a.

8. Which is a physical method of pretreatment
   a) By using Gas
   b) Irradiation
   c) Milling

**Answer:** Option b and c.

9. Which type of radiation is useful in pretreatment
   a) Gamma
   b) Electron
   c) Both a and b

**Answer:** Option c.

10. Which type of pretreatment involves Fluorescent in situ Hybridisation (FISH)
    a) Enzymatic
    b) Chemical
    c) Physical

**Answer:** Option a.
Membrane Separation

1. Pervaporation method involves
   a) removal of ions  
b) Production of potable water  
c) Purification of aqueous streams  
d) separation and concentration of liquid mixture.

**Answer:** Option d

2. The problem associated with concentration polarization and fouling is overcome by
   a) cross flow filtration  
b) dead end filtration  
c) Ultrafiltration  
d) Microfiltration

**Answer:** Option a.

3. Microfiltration membrane is not made of
   a) polysulfone  
b) Cellose acetate  
c) Ceramic  
d) Poly propylene

**Answer:** Option b.

4 Factors affecting membrane separation process is
   a) Fouling  
b) Membrane surface  
c) Flux  
d) Concentration Polarization

**Answer:** Option a and d.

5. Reverse osmosis membrane can be used to separate molecules
   a) upto 50 Da  
b) upto 500 Da  
c) upto 5000 Da  
d) upto 100 Da.

**Answer:** Option b.
6. The membrane configuration which is not used in Microfiltration is
   a) Plate and frame
   b) Hollow fiber
   c) Spiral wound
   d) Tubular

   **Answer:** Option d.

7. Incorrect statement about pervaporation is
   a) low cost
   b) independent of vapour/liquid equilibrium
   c) suitable for heat sensible product
   d) require high temperature and high pressure.

   **Answer:** Option d.

8. Membrane Bioreactor is used for the production of
   a) amino acid
   b) antibiotics
   c) vitamins
   d) All of the above

   **Answer:** Option d.

9. How many membrane configurations are commercially available
   a) 2
   b) 4
   c) 3
   d) 1

   **Answer:** Option b.

10. Property of the polymer which is not affecting diffusion process
    a) porosity
    b) degree of cross-linking
    c) backbone material
    d) Thermal conductivity

   **Answer:** Option d.