كلية العلوم – قسم الفيزياء

جامعة أسيوط

Summer course in "thermodynamics (P 223)"

الزمن :ثلاث ساعات

الفرقة : الثانية بكلية العلوم

Answer the following question:

A) Choose the right answer between brackets:

1) During the (isothermal – adiabatic – isochoric) process the internal energy of gas molecules changes.

2) Through the adiabatic compression the volume of the gas decreases and the temp. (increases – decreases –still const.).

3) The liquidation of the gas satisfies the condition of constant (enthalpy – internal energy - both of them).

4) Both the specific heat capacities C_P, and C_V are related to the change of (enthalpy – internal energy – entropy)

5) During the 1st half Carnot's cycle the thermal procedures are performed by (expansion – compression -both of them).

6) The radiant energy density depends on radiation (volume – temperature - both of them)

7) The change of Gibbes free energy is related to the change of (pressure - temperature – both of them).

B) Transfer the following sentences after putting a check mark right or wrong:

1) The net work done through the Carnot's cycle occurs at constant temperature of the working substance

2) The exchange of heat between two bodies represents a reversible process.

3) Through the inside area of the inflection curve a cooling of the compressed gas occurs and the gas is heated outside.

4) The specific heat capacity at constant pressure is related to the change of enthalpy.

5) The ratio of the volumetric adiabatic elastic coefficient to that for isothermal process equal C_V/C_P.

6) The heat engine converted the heat generated by the combustion of the working substance into work done.

7) Taking into consideration the surface pressure leads the dependence of internal energy of the real gas on its volume.

Answer only three questions:

2- a) Apply the 1st low of thermodynamic: $dQ = TdS = C_1\,dT + PdV$ to prove that:

(i) The change of entropy for one mole of ideal gas: $(\Delta S)_T = R\ln(V_2/V_1)$,

(ii) The work done (W) is related to entropy change: $(\Delta S/W)_T = 1/T$, explain the physical significance.

b) Consider a gas expands adiabatically, if the volume of the gas is doubled while its absolute temperature decreases by 1.32 times, calculate the ratio (C_P/C_V) of the gas.

c) Describe by the eqns. the applied thermal procedures through the first half of the thermal Carnot cycle, find the efficiency of the complete Carnot cycle.

للأسئلة بقية فى الورقة التالية

3- a) If the energy eqn. of state: $TdS = C_V dT + (\frac{\partial P}{\partial T})_V dT$,(i) Apply this eqn. on ideal gas, explain the physical Significance, (ii) Find the radiant energy eqn. of state then express the change of entropy under isothermal process. (Consider the total radiant energy: $E = \varepsilon V$, and the radiant energy density ε is related to temp.: $\varepsilon = P/3 = bT^4$)

b) Apply the condition of the constant pressure to prove that: $(\frac{dH}{dT})_P = (\frac{dS}{dT})_P$

c) Calculate the change of entropy in terms of gas constant when an ideal gas expands isothermally to four times its original volume.

4- a) Express the Maxwell's eqns. of thermodynamics. If the change of entropy: $TdS = C_P dT - T(\frac{\partial V}{\partial T})_P dP$,

(i) Rewrite this eqn. in terms of the volumetric thermal expansion coefficient (α_P).

(ii) Apply the resulting eqn. on the water to explain the anomalous state of the water with respect to other liquids.

b) 10 grams of oxygen at pressure of (10^5 N/m^2) and temp. (-10^{0}C), after heating at const. pressure the volume of the gas equal (10 L),(i) find the amount of heat gained by the gas, (ii) thermal energy before and after the heating. (consider $C_P = 29.08x10^3$ *J/kg mol-deg*)

c) Apply the condition ($dH = 0$) on the eqn.: $TdS = C_P dT - T(\frac{\partial V}{\partial T})_P dP$ to prove that the Joule-Kelvin factor:

$\mu = 1/C_P [T(\frac{\partial V}{\partial T})_P - V]$, describe the state of compressed gas around the inflection curve during liquidation.

5- a) Apply the Maxwell's eqns. to prove that: $C_P - C_V = T(\frac{\partial P}{\partial T})_V (\frac{\partial V}{\partial T})_P$, rewrite this eqn. for ideal gas

b) Prove that the change of entropy for one mole of ideal gas can expressed: $\Delta S = C_P \ln T - R \ln P + const.$

c) Prove that the volumetric thermal expansion coefficient is inversely proportional with temperature for ideal gas, find its value at absolute temperature.

انتهت الأسئلة

أ.د. عبد المنعم سلطان

Assiut University **Faculty of Science** **Physics Department**	**Final:** Summer 2023 **Date**: September 6th, 2023 **Allowed time:** 3 hours.

Course Name: **Physics of semiconductors and thin solid and its applications** **Course Code**: P451

Coordinator: Dr. Alaa Abd-Elnaiem **Grade:** 50

Part I: Answer all the following questions:

Question I: Put (✓) for the correct sentences and (X) for the incorrect sentences in below Table for the following: **(10 Marks)**

1. The length of the unit cell is called the microstrain constant.
2. The periodic structure can be determined using X-ray diffraction and electron microscopy.
3. There are no free electrons to conduct electric current in pure Si at absolute zero temperature.
4. The most important semiconductor materials used in microelectronics are amorphous.
5. Silicon is a group V element in the periodic table and has eight valence electrons.
6. A crystalline solid consists of atoms arranged in a repetitive structure.
7. Every silicon atom has two other silicon atoms as its nearest neighbor atoms.
8. Semiconductors containing many mobile electrons and few holes are called N-type semiconductors.
9. A Si atom is connected to each neighbor with four dots representing the two shared electrons in the covalent bond.
10. The crystal structure for Silicon and Germanium crystals is known as the diamond structure because it is also the unit cell of the diamond crystal with each sphere representing a carbon atom.
11. The equilibrium condition is the greatest energy configuration in the presence of thermal agitation.
12. Doping of Si or Ge by group V elements is called donors for they donate electrons.
13. The gap between the conduction band and the valence band is called the band gap.
14. At any temperature greater than 0 °C, thermal energy will cause a small fraction of the covalent electrons to break loose and become conduction electrons.
15. In semiconductors, current conduction by holes is as important as electron conduction in general.
16. In the energy band model, the top nearly filled band is called the conduction band, and the lowest nearly empty band is called the valence band).
17. A much larger number of conduction electrons can be introduced in pure Si and Ge if desired by introducing suitable impurity atoms.
18. Doping of Si or Ge by group III elements are called acceptors for they accept electrons.
19. Semiconductors containing many holes and few electrons are called P-type semiconductors.
20. An insulator has a filled conduction band and an empty valence band that is separated by a larger band gap (> 4 eV).

Q no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Sign																				

Question II: Answer the following problems: **(10 Marks)**

1. If a semiconductor such as GaAs is transparent to light with a wavelength longer than 0.87 μm, what is its band-gap energy in the eV unit? h =6.63×10^{-34} J.s, c= 3×10^{8} m/s.

2. Where is EF located in the energy band of silicon, at 300K with n = $10^{17}cm^{-3}$? And for p = $10^{14}cm^{-3}$? Where the effective mass of electrons or holes are 0.26 and 0.39.

3. In a silicon sample at T = 300 K, the Fermi level is located at 0.26 eV (10 kT) above the intrinsic Fermi level. What are the hole and electron concentrations? N_c = 2.8×10^{19} cm^{-3}, k = 1.38×10^{-23} $J.K^{-1}$, q=1.6×10^{-19} C, n_i = 10^{10} cm^{-3}.

4. Boron atoms are added to a Si film resulting in an impurity density of 4×10^{16} cm^{-3}. (a) What is the conductivity type (N-type or P-type) of this film? (b) Why does the mobile carrier concentration increase at high temperatures?

Part II: Answer Three questions from the following questions (30 Marks)

1- **(a)** Discuss the linear and nonlinear optical properties of semiconductor materials. (6 Marks)

(b) What is the relationship between semiconductors' electric and optical band gaps? (4 Marks)

2- **(a)** Explain the different approaches utilized for the synthesis of solid thin films and explore one of them in more detail, highlighting the benefits and drawbacks of the chosen approach. (6 Marks)

(b) What are some of the most prevalent applications for semiconductor films? (4 Marks)

3- **(a)** In terms of basic research and technology application, the electrical properties of semiconductors are critical. Discuss the electrical characteristics of semiconductor materials and their relationship to temperature in detail. (6 Marks)

(b) Explain the band theory of conduction in semiconductors. (4 Marks)

4- **(a)** How can the Hall effect experiment be used to determine whether a semiconductor is n or p? (6 Marks)

(b) Explain the many types of semiconductor materials. (4 Marks)

Best wishes,

Level: II المستوي : الثاني	Summer Semester	Assiut University
26/ 8/ 2023 التاريخ:	2022-2023	Faculty of Science
3 hours " الزمن: ثلاث ساعات	"Waves & Vibrations" P212	Physics Dept.

Question No.1: (15 degrees) Total(50 degrees)

Write in the attached table the symbol (T) *for true answer* or (F) *for false answer*

1. *Nature is a science that studies the created universe*
2. *Matter and energy interact to give natural phenomena*
3. *Matter annihilates, energy appears. Energy disappears, matter appears*
4. *The human used his mind, so he was able to harness and adapt the universe to serve him*
5. *Our mission- only -is to follow the behaviors and actions of the universe to produce what we need*
6. *With his knowledge, man was able to destroy matter into nothingness*
7. *A mass of one kilogram contains energy equivalent to* C^2
8. *Any amount of mass, no matter how small, contains a small amount of energy*
9. *Energy has no priority over mass nor mass over energy*
10. *The origins of the universe, in order, are: Noor –light - radiation - energy – matter*
11. *Vision requires- only - the presence of: light Source, vision instrument*
12. *When light is reflected or scattered by bodies, we see the bodies*
13. *Spectra emitted from some materials help us to see light*
14. *Spectra are emitted When a substance absorbs light*
15. *Superposition of two waves have the same amplitude, frequency is: interference*
16. *Path difference for constructive interference equals:* $2n\pi$
17. *Angular difference for destructive interference equals:* $(2n + 1)\pi$
18. *when natural light falls on thin film separating two different media, we get a polarization by refraction and reflection*
19. *Through the Doppler effect, the viewer can determine whether an object is approaching or moving away*
20. *Calcite has two indices of refraction*

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20

Question No.2: (25 degrees)

Write in the attached table the symbol indicating the correct answer

1. Nature - from the human point of view – is.....:

(A) Material and Energy *(B) Waves & vibrations* *(C) All of the above*

2. Physics is a science that studies....

(A) Material and energy *(B) heat & electricity* *(C) All of the above*

3. The stars are not eternal because its transformations from:

(A) Mass to energy *(B) Energy to mass* *(C)All of the above*

4. Atoms are not eternal because of...

(A) its death *(B) its exchanged and transformation* *(C) All of the above*

5. Heat transfer in the universe occurs from.....:

(A) Hot to cold *(B) Cold to hot* *(C) All of the above*

6. The absolute beginning of the universe was.....

(A) Material *(B) energy* *(C) Noor*

7. The method of vision, hearing and smell according to the latest theories.....

(A) Vibrations & oscillations *(B) particles* *(C) all of the above*

8. F = -K x is the expression for:

A. Acceleration *B. Velocity* *C.Displacement* *D. Hook's Law*

9. When objects absorb light and then emit, we get:

(A) Spectrum *(B) bodies* *(C) light*

10. Spectra emitted from some materials give us an idea about:

(A) Light components *(B) Nature of light* *(C) material structure*

11. Different colors are: *(A) waves & vibrations* *(B)particles* *(C) photons*

12. light *can be considered as.....and is treated in a physical way*

(A) energy *(B) waves* *(C) Particles*

13. Light moves in straight lines unless it faces obstacles which forces us to deal with it as...:

(A) energy *(B) waves* *(C) Particles*

14. Light diffracts when it passes through very narrow slit which forces us to treat it as :

(A) energy *(B) waves* *(C) Particles*

1	2	3	4	5	6	7
8	9	10	11	12	13	14

15. The period is: the amount of time for a repeated event to happen
(A) once (B)twice (C)thrice

16. In SHM of a simple pendulum, the component of weight which is directed towards mean position is: (A)$mg\cos\theta$ (B)$mg\sin\theta$ (C)$mg\tan\theta$

17. *Which would have the longest period?*
Pendulum A: A 200-g mass attached to a 1.0m length string
Pendulum B: A 200-g mass attached to a 0.5-m length string
(A)Pendulum A (B)Pendulum B (C)A & B are the same

18. *An oscillator completes 30 cycles in 15 seconds, what is its period?*
(A)30 seconds (B)2 seconds (C)0.5 seconds (D)2 hertz

19. *A wave in Lake arrives on the shore every 5 seconds. It's period is .. and its frequency is…*
(A) 5 seconds; 0.2 hertz (B)0.2 seconds; 2 hertz (C)5 seconds; 50 hertz

20. *A mass-spring system can oscillate with simple harmonic motion because a compressed or stretched spring has which kind of energy?*
(A)Kinetic (B)mechanical (C)gravitational potential (D)elastic potential

21. *What is the only thing that increases the period of a pendulum?*
(A) increase the length of the pendulum (B) decrease the length of the pendulum
(C)increase the weight of the pendulum bulb

22. *what is the equation for frequency* (A)$f = t/n$ (B)$f = 1/T$ (C)$f = 2\ T$

23. *A simple harmonic oscillator takes 4.8 s to undergo five complete vibrations. What is the period (T) of 1 cycle?* (A) 4.8 s (B)0.96 s (C)9.

24. *Define amplitude.?* (A)maximum displacement from equilibrium position
(B)total displacement (C)maximum distance from where the object is released

25. *For a system in simple harmonic motion, which of the following is the number of cycles or vibrations per unit of time?* (A)period (B) frequency (C)amplitude

26. *When we use the words "spectra, wavelengths "we are talking in …. Language.:*
(A) quantum (B) wavelike (C) particulate

27. *Both reflection and refraction of light –together- can't be treated unless considering light as:* (A) photons (B) waves (C) particles

28. *Path difference for constructive interference equal*:
(A) $n\lambda$ (B)$(n+1/2)\lambda$ (C)$2n\pi$

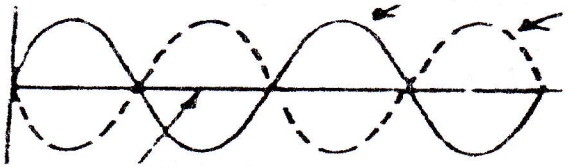
29. *Path difference for destructive interference equal*:
(A) $n\lambda$ (B)$(n+1/2)\lambda$ (C)$2n\pi$

30. *Angular difference for destructive interference equal*
(A) $n\lambda$ (B)$(2n+1)\pi$ (C)$2n\pi$

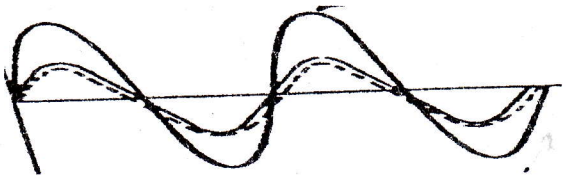
15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30

Question No. 4 : (10 degrees)

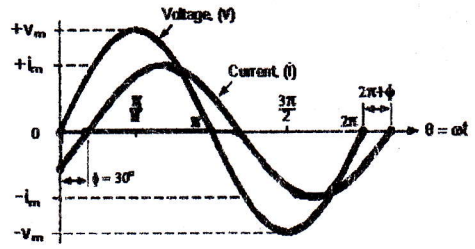
Mark the right choice:



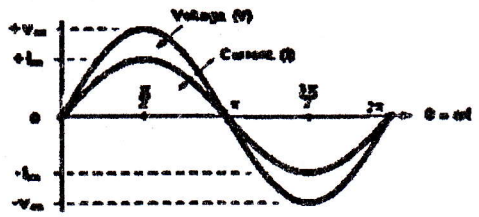
- destructive interference
- Constructive interference
- Path difference= $(n + {}^{1}/_{2})\lambda$
- Path difference $= n\lambda$
- Angular difference= $2n\pi$
- Angular difference= $(2n + 1)\pi$



- Constructive interference
- destructive interference
- Path difference $= n\lambda$
- Path difference= $(n + {}^{1}/_{2})\lambda$
- Angular difference= $2n\pi$
- Angular difference= $(2n + 1)\pi$



- *Two Sinusoidal Waveforms – "in-phase*
- *current, i "lags" voltage, v by phase angle*
- *current, i "leads" voltage v by phase angle*



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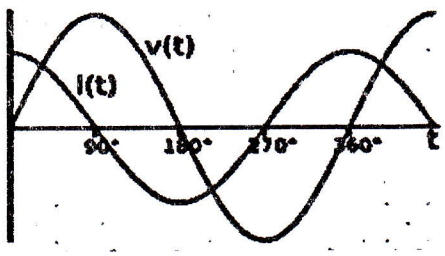
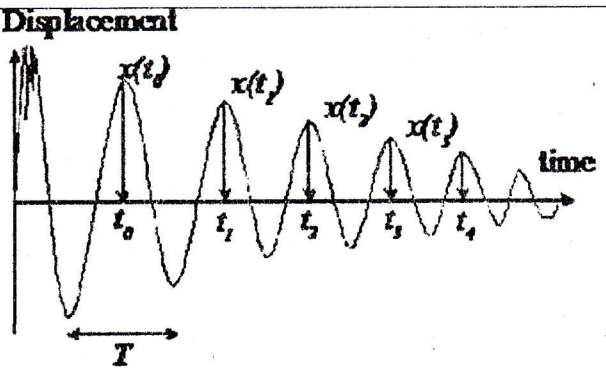


- *Two Sinusoidal Waveforms – "in-phase*
- *current, i "lags" voltage, v by phase angle*
- *current, i "leads" voltage v by phase angle*



- *SHM oscillation*
- *Damped oscillation*

انتهت الأسئلة مع التمنيات بالتوفيق_____ Best wishes_____

حسام وحيد

Assiut University
Faculty of Science
Department of Chemistry

September 2023
Time: 3 h
Summer Semester

Physical Chemistry II Examination (C-203) For 2nd Level Students of Applied Industrial Chemistry Program

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Answer ALL the following questions: (50 Marks)

Q1: Answer Two only of the following: (16 Marks)

1. **Discuss the kinetics of the following:**
   - (i) **First order reactions**
   - (ii) **Opposing reactions.**
   - (iii) **Consecutive reactions.**
2. **Derive the relation between the rate constant and reaction temperature.**
3. **Discuss the initial reaction rate method used for measuring the reaction order.**

Q2: Answer Two only of the following: (17 Marks)

4. **Discuss the influence of Ionic strength on reaction rate.**
5. **State the different postulations given by Shpitaloky for the theory of homogenous catalysis and explain its verification through the decomposition of H_2O_2 in presence of MoO_4^{2-} as a catalyst.**
6. **Discuss the catalytic oxidation of thiosulfate ions by hydrogen peroxides in presence of either iodide ions or molybdic acid.**

Q3: Shad True or False for each of the following statements: (17 Marks)

1. **Crystal that contains little amounts of defects is called perfect crystal.**
2. **Metallic solids are made up of positive and negative ions and held together by electrostatic attractions.**
3. **Ionic solids are characterized by low melting points and flexibility and are good conductors in the solid state.**

Please turn of the paper

4. Polycrystalline solid is made up of an aggregate of many small single crystals (crystallites or grains).
5. All solids tend to exist in the crystalline state rather than the amorphous state because the crystalline structure always has a larger binding energy.
6. Polymorphism refers to the ability of a solid to exist in more than one crystalline form or structure.
7. A hexagonal structure exhibits a ratio of c/a of 1.633.
8. A substitutional impurity atom is an atom of a different type than the bulk atoms, which has replaced one of the bulk atoms in the lattice.
9. The body centered cubic lattice has coordination number of 8 and APF of 68%.
10. A self-interstitial atom is an extra atom that has crowded its way into an interstitial void in the crystal structure.
11. In the Laue method, a stationary single crystal is irradiated by a range of X-ray wavelengths.
12. Schottky defects is a pair of cation and anion vacancies.
13. There are five Bravais lattices in two dimensions.
14. In four dimensions, there are 52 Bravais lattices.
15. The face centered cubic and hexagonal close packed structures both have a packing factor of 0.74.
16. The APF of diamond crystal structure is 0.34.
17. Frenkel defect is a pair of cation vacancy and cation interstitial.

Good Luck

Prof. Rabei M. Gabr and Dr. Mohamed Nady Abd El-Hameed

Assiut University **Faculty of Science** **Physics Department**		**Final: Summer 2022-2023** **Date**: September 7th, 2023 **Allowed time:** 3 hours

Course Name: Physics of Metals, Alloys and Ceramics **Course Code**: P256
Coordinator: Dr. Alaa Abd-Elnaiem **Grade:** 50

Answer all the following questions.

Question (I): **(30 Marks)**

In the following multiple-choice questions, please circle the correct answer(s). You must write down the steps to get the correct answer.

1. The atomic packing factor for BCC is:

a. 68% **b.** 74% **c.** 63% **d.** 28%

.....

.....

2. Calculate the radius of a vanadium atom, given that V has a BCC crystal structure, a density of 5.96 g/cm^3, and an atomic weight of 50.9 g/mol (N_A= 6.022×10^{23} *atoms/mol*).

a. 0.124 nm **b.** 0.132 nm **c.** 0.148 nm **d.** 0.156 nm

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.....

3. Rhodium has an atomic radius of 0.1345 nm, a density of 12.41 g/cm^3 and an atomic weight is 102.91 g/mol, its crystal structure should be:

a. SC **b.** FCC **c.** BCC **d.** HCP

.....

.....

4. Zinc has an HCP crystal structure, a c/a ratio of 1.856, and a density of 7.13 g/cm^3. Compute the atomic radius for Zn (Hint M_w for Zn is 65.41 g/mol):

a. 0.133 nm **b.** 0.142 nm **c.** 0.153 nm **d.** 0.167 nm

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5. The atomic radius for tungsten (W) is 0.137 nm, W has a BCC crystal structure, therefore, the linear density for the [111] direction is:

a. 2.46 nm^{-1} **b.** 1.42 nm^{-1} **c.** 2.23 nm^{-1} **d.** 3.65 nm^{-1}

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.....

6. The atomic radius for nickel (Ni) is 0.125 nm, Ni has an FCC crystal structure, therefore, the planar density for the (111) plane is:

a. 16.00 nm^{-2} **b.** 18.48 nm^{-2} **c.** 19.20 nm^{-2} **d.** 20.56 nm^{-2}

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7. Molybdenum (Mo) has a BCC crystal structure and an atomic radius of 0.1363 nm. the interplanar spacing d_{111} equals:

a. 0.1817 nm **b.** 0.1432 nm **c.** 0.1527 nm **d.** 0.1707 nm

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8. Determine the expected diffraction angle (2θ) for the first-order reflection from the (113) set of planes for FCC platinum (Pt) when monochromatic radiation of wavelength 0.1542 nm is used (Hint R=0.1387 nm):

a. 81.38° **b.** 76.31° **c.** 38.85° **d.** 17.88°

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9. For which set of crystallographic planes will a first-order diffraction peak occur at a diffraction angle (2θ) of 46.21° for BCC iron when monochromatic radiation having a wavelength of 0.0711 nm is used? (Hint R=0.1241 nm)

a. (011) **b.** (310) **c.** (200) **d.** (330)

.....

.....

10. Calculate the number of vacancies per cubic meter in iron at 850°C. The energy for vacancy formation is 1.08 eV/atom. Furthermore, the density and atomic weight for Fe are 7.65 g/cm^3 and 55.85 g/mol, respectively, (K_B 8.62×10^{-5} eV/atom K):

a. 1.18×10^{24} m^{-3} **b.** 1.18×10^{-24} m^{-3} **c.** 2.75×10^{22} m^{-3} **d.** 3.40×10^{28} m^{-3}

.....

.....

11. The concentration of carbon in an iron-carbon alloy is 0.15 wt%. What is the concentration in kilograms of carbon per cubic meter of alloy? (densities for carbon and iron are 2.25 and 7.87 g/cm^3)

a. 11.80 kg/m^3 **b.** 9.72 kg/m^3 **c.** 7.33 kg/m^3 **d.** 2.48 kg/m^3

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12. Gold (196.97 g/mol) forms a substitutional solid solution with silver. Compute the number of gold atoms per cubic centimeter for a silver-gold alloy that contains 10 wt% Au and 90 wt% Ag. The densities of pure gold and silver are 19.32 and 10.49 g/cm^3, respectively.

a. 7.36×10^{21} **b.** 5.66×10^{21} **c.** 3.36×10^{21} **d.** 1.44×10^{21}

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13. Iron (Fe) and vanadium (V) both have the BCC crystal structure and V forms a substitutional solid solution in Fe for concentrations up to approximately 20 wt% V at room temperature. Determine the concentration in weight percent of V that must be added to Fe to yield a unit cell edge length of 0.289 nm. (Hint: ρ_V= 6.11 g/cm³, ρ_{Fe} = 7.86 g/cm³, A_V = 50.94 g/mol, A_{Fe}= 55.85 g/mol).

a. 8 wt% **b.** 12.9 wt% **c.** 26 wt% **d.** 92 wt%

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14. Determine the indices for the direction shown in the cubic unit cell shown in **Figure (a)**:

a. $[0\bar{1}\bar{1}]$ **b.** $[\bar{2}10]$ **c.** $[112]$ **d.** $[11\bar{2}]$

.....

.....

15. Determine the Miller indices for plane **A** shown in the following unit cell (**Figure (b)**):

a. $(0\bar{1}\bar{1})$ **b.** $(3\bar{2}4)$ **c.** (221) **d.** $(0\bar{2}\bar{1})$

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Figure (a)

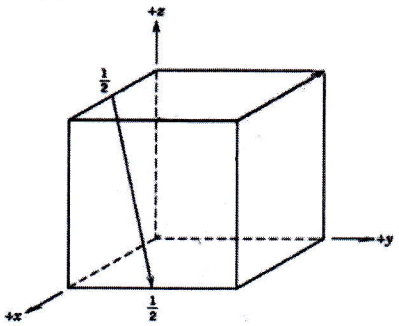
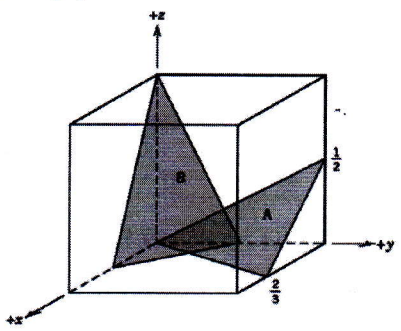


Figure (b)



Question (II): Put (√) or (×) in a below Table for all the following sentences:(9 Marks)

1. The structure of a material usually relates to the arrangement of its internal components.
2. Structural elements that may be viewed with the naked eye are termed "microscopic".
3. Ceramics are compounds between polymers and nonmetallic elements; they are most frequently oxides, nitrides, and carbides.
4. A composite is composed of two (or more) individual materials, which come from the categories: metals, ceramics, and polymers.
5. The cubic system has the greatest degree of symmetry, but the orthorhombic system has the least symmetry.

6. The primitive unit cell contains the same kind of atoms, while the Bravais lattice contains only one lattice point.
7. The coordination number is the number of nearest-neighbor or touching atoms.
8. The coordination number for FCC and HCP structure is 12.
9. The atomic packing factor (APF) for the HCP structure is 0.74.
10. Substances in which measured properties are independent of the direction of measurement are isotropic.
11. Frenkel defect is equivalent to a missing atom that leaves its original site and migrates to the surface of the crystal.
12. A screw dislocation is formed by shear stress that is applied to produce the distortion.
13. Planar defects include external surfaces, grain boundaries, twin boundaries, precipitates, stacking faults, and phase boundaries.
14. Grain size and shape are only two features of what is termed the microstructure.
15. For many alloy systems and at some specific temperature, there is a maximum concentration of solute atoms that may dissolve in the solvent to form a solid solution; this is called a solubility limit.
16. A stable state or microstructure may persist indefinitely, experiencing only extremely slight and almost imperceptible changes as time progresses.
17. The binary isomorphous phase diagram presents the complete liquid and solid solubility of the two components.
18. Point defects are thermodynamically stable defects.

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Sign																		

Question (III): Answer the following problems:

1. In **Figure**, cite the phases that are present and the phase compositions for 90 wt% Zn-10 wt% Cu at 400°C. Determine the relative amounts (in terms of mass fractions) of the phases for the alloys. **(3 Marks)**

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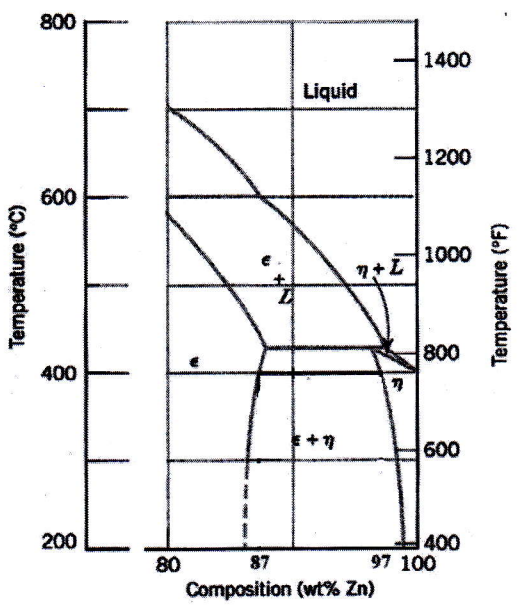


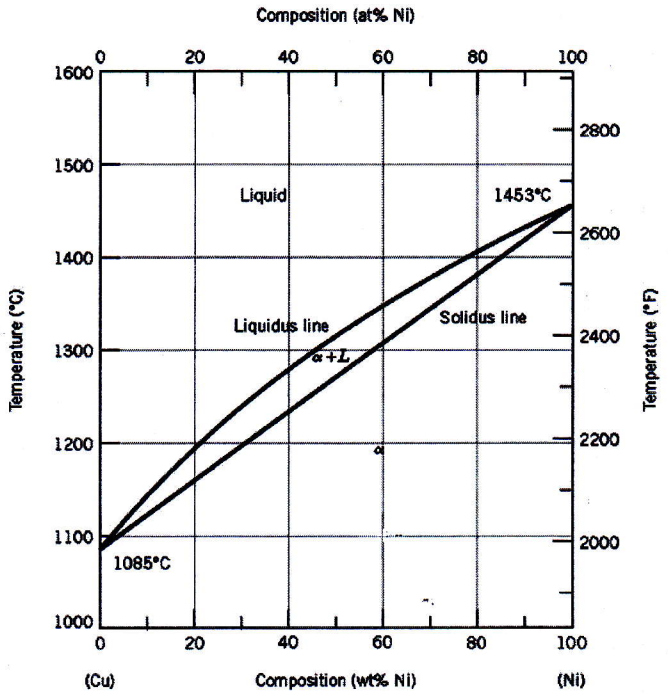
2. In **Figure**, a copper (Cu)-nickel (Ni) alloy of composition 70 wt% Ni-30 wt% Cu is slowly heated from a temperature of 1300°C (2370°F), *using the below phase diagram*: **(4 Marks)**

(a) At what temperature does the first liquid phase form?

(b) What is the composition of this liquid phase?

(c) At what temperature does complete melting of the alloy occur?

(d) What is the composition of the last solid remaining before complete melting?



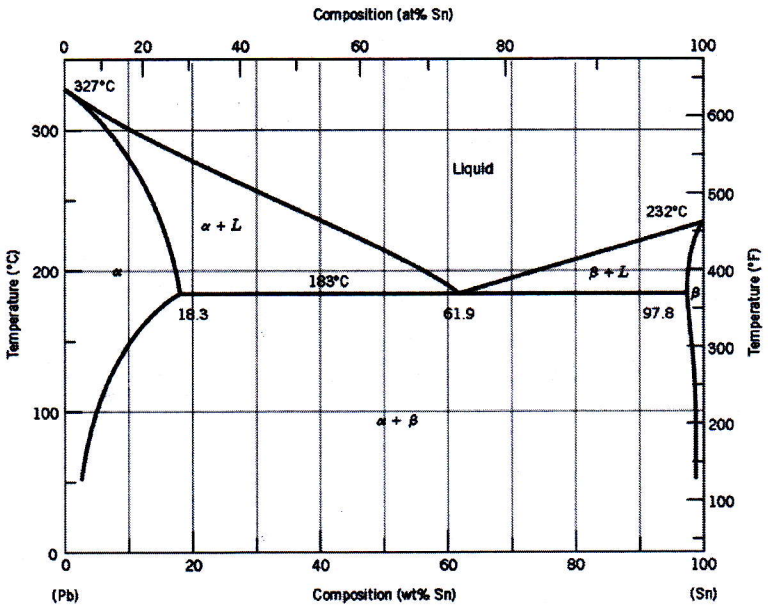
3. In **Figure**, for a 40 wt% Sn-60 wt% Pb alloy at 150°C, *in below phase diagram*: **(4 Marks)**

(a) What phase(s) is (are) present?

(b) What is (are) the composition(s) of the phase(s)?

(c) Calculate the relative amount of each phase present in terms of the mass fraction.

(d) Describe in detail the phase diagram shown below and state the different equilibrium lines.



Best wishes,

FINAL EXAM

Plasma Physics – Course code: P 342 P332

DURATION OF TEST: THREE HOURS

Date: 06th September 2023

Examiner: Dr. Ahmed Mostafa Amry

Answer ALL questions in section A and B. [25 marks]

A. M C Questions:

1. Which equation describes the behavior of ordinary fluids?
   a) Navier–Stokes equation
   b) Maxwell's equations
   c) Einstein's field equations
   d) Schrödinger equation

2. What is a plasma?
   a) Mixture of atoms and molecules in gaseous state.
   b) Soup of electrons and ions.
   c) Ionized gaseous state.
   d) A gas with equal number of electrons and ions with no uncharged particles.

3. What is the frequency usually used for plasma applications and why?
   a) 2.54 GHz , Cheap source.
   b) 13.56 GHz , We get good property plasmas at this frequency.
   c) 13.56 MHz , Federal government mandated frequency.
   d) 13.56 GHz , Federal government mandated frequency.

4. Is plasma frequency a good parameter for measurement (Yes/No), why?
   a) Yes, We can measure it easily.
   b) No, It's hard to measure the plasma frequency.
   c) Yes, Plasma frequency is same as the electron frequency in plasma.
   d) No, Other waves too can exist in the same frequency.

5. What is a Debye length?

a) It is the 1/e distance for reducing the momentum.

b) An effective length over which a plasma will shield a magnetic field.

c) It is the length an electron can travel without collision.

d) Length over which sheath exist in a plasma.

6. What happens to sheath potential as we go into the sheath (from plasma)?

a) Potential decreases.

b) Potential increases.

c) Potential remains a constant.

d) Potential changes as a sinusoidal function.

7. Plasma with small Debye length shields out

a) A.C field b) D.C field c) Nothing d) Both a) and b)

8. In the phenomenon of electric discharge through gases at low pressure, the coloured glow in the tube appears as a result of:

a) Excitation of electrons in the atoms.

b) The collision between the atoms of the gas.

c) The collisions between the charged particles emitted from the cathode and the atoms of the gas.

d) The collision between different electrons of the atoms of the gas.

9. The transition of non-sustaining discharge into self-sustaining discharge is called

a) ionization b) collision

c) spark breakdown d) vacuum breakdown

10. According to Townsend current growth process the current (I) in a uniform electric field gap is:

a) $I_o exp(-\alpha d)$ b) $I_o\, exp(\alpha d)$

c) $I_o\, exp(\gamma d)$ d) $I_o\, exp(-\gamma d)$

11. In a self-sustained discharge the anode current I_a is given in the form:

a) $I_a = I_o exp(-\alpha d)$ b) $I_a = I_o\, exp(-\gamma d)$

c) $I_a = \gamma I_o exp(-\alpha d)$ d) $I_a = I_o exp(\alpha d)/[1 + \gamma - \gamma exp(\alpha d)]$

12. A plasma is a :

a) Gas heated beyond its gaseous state, to a temperature so high that atoms are stripped of at least one electron in their outer shells, so that what remains are positive ions in a sea of free electrons.

b) Quasineutral gas of charged and neutral particles which exhibits collective behavior.

c) Fourth state of matter.

d) All of the above.

13. The conversion factor between degrees and eV is

a) 1eV = 1,600° K

b) 1eV = 11,600° K

c) 1eV = 111,600° K

d) 1eV = 600° K

14. By "collective behavior" we mean

a) The plasma consists in most cases of neutral atoms or molecules, positive ions and electrons.

b) Motions that depend not only on local conditions but on the state of the plasma in remote regions as well.

c) Stationary plasma.

d) All of the above.

15. The plasma is "quasineutral"; that is,

a) The electron temperature of plasma is in the order of a few eV,

b) The plasma consists in most cases of neutral atoms or molecules, positive ions and electrons.

c) All of the above.

d) Neutral enough so that one can take n_i, n_e, n, where n is a common density called the plasma density.

16. The collisional cross section is defined as

a) An "effective area" that quantifies the likelihood of a scattering event when an incident species strikes a target species.

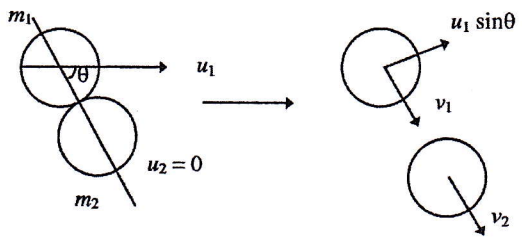
b) The area around a particle in which the center of another particle must be in order for a collision to occur.

c) Quantify the probability of a collision taking place between two or more particles.

d) All of the above.

17. The maximum energy δ transferred to the internal energy of the target particle is given by,

a) $\delta = (m_2/(m_1 + m_2))\, cos^2\, \theta$
b) $\delta = (m_2/(m_1 + m_2))\, cos\, 2\theta$
c) $\delta = (m_1/(m_1 + m_2))\, cos\, 2\theta$
d) $\delta = (m_2/(m_1 + m_2))\, sin\, 2\theta$



18. Ionization coefficients α, γ are functions of

a) applied voltage
b) pressure and temperature
c) electric field
d) ratio of electric field to pressure

19. Time lag for breakdown is

a) Time difference between instant of applied voltage and occurrence of breakdown.
b) Time taken for the voltage to rise before breakdown occurs.
c) Time required for gas to breakdown under pulse application.
d) None of the above.

20. Streamer mechanism of breakdown explains the phenomena of electrical breakdown of

a) Very short spark gaps.
b) When *pd* is less than 1000 torr. cm.
c) Very long gaps where field is non-uniform.
d) Spark gaps subjected to impulse voltages.

21. What is the maximum temperature of the plasma arc cutting process

a) 14000°C b) 10000°C c) 8000°C d) 6000°C

22. The mechanism of breakdown in vacuum is due to

a) Particle exchange
b) Field emission
c) Clump formation
d) All of the above.

23. SF_6 has the following property which is not favorable for use in electrical apparatus.

a) High dielectric strength.
b) High quenching ability.
c) It is not environmental friendly and causes global warming.
d) None of the above.

24. The breakdown voltage of gas or air with increase in pressure under uniform field has_____relation with pressure

a) linear b) square c) non-linear d) reciprocal

25. Which forces accelerate the rocket?

a) Lorentz force b) Centripetal force

c) Reaction force d) Gravitational force

26. The most common method to invert population is?

a) Quantum effects b) Gas discharge

c) Temperature effect d) All of these

27. Plasma accelerators are used to generate?

a) Arcs b) Vacuum systems

c) Electric fields d) Plasma waves

28. Which is application of Plasma in industry?

a) Magnetrons b) Arcs

c) Eye glasses d) All of these

29. How plasmas find application in atmospheric plasma?

a) Argon jet b) Rou to roll processing

c) Cauterizing skin d) All of these

30. Low pressure glow discharge is applicable for?

a) Pulsed laser b) DC laser

c) Light laser d) Ultraviolet laser

31. Plasma kinetic theory has been used to predict the development of?

a) Stars b) Galaxies c) Planets d) Black holes

32. High pressure glow discharge is applicable for?

a) Pulsed laser b) DC laser

c) Light laser d) Ultraviolet laser

33. The breakdown criterion in a uniform field electrode gap is

a) $\gamma exp(\alpha d) = -1$ b) $\alpha\, exp(\gamma d) = 1$

c) $\gamma exp(\alpha d) = 1$ d) $\gamma exp(\alpha d) = -\alpha$

34. In a plasma welding torch a tungsten electrode is located within the nozzle, which is made up of_____

a) Ceramic b) Copper c) Brass d) Tin

35. Townsend's first ionization coefficients define as

a) Maximum number of ionizing collisions made by an electron per centimeter travel in the direction of field.

b) Minimum number of ionizing collisions made by an electron per centimeter.

c) Average number of ionizing collisions made by an electron per centimeter travel in the direction of field.

d) Maximum number of ionizing collisions made by an electron per millimeter.

36. Townsend's first ionization coefficients A depends upon (T=gas temperature, p= gas pressure, E= voltage across gas medium)

a) T b) P c) E/P d) P and E/P

37. What is the critical threshold distance for sustained discharge if $\alpha = 2.43/cm$ and $\gamma = 6.823 \times 10^{-4}$.

a) *1cm* b) *2cm* c) *3cm* d) *4cm*

38. For a certain gap with uniform field electrodes, α was 7.676 /cm with a gap distance of 0.9 cm before breakdown. What will be the secondary ionization coefficient γ?

a) 9.521×10^{-4} b) 9.876×10^{-4}

c) 9.78×10^{-4} d) 9.993×10^{-4}

39. Townsend's Primary Ionization coefficient is the

a) Number of electrons liberated by an electron due to collision with neutral gas molecule in travelling unit distance in the direction of applied electric field.

b) Number of electrons liberated from cathode surface due to impact of single positive ion, photon or metastable.

c) Quantity of radiation that produces the primary electrons.

d) Amount of pre-ionization preset gap.

40. What is the primary use of plasmas in industry?

a) Power generation b) Welding and cutting

c) Medical treatments d) All of the above

41. What is the name of the process in which a gas is heated to the point that its electrons are separated from its atoms?

a) Ionization b) Fusion

c) Fission d) None of the above

42. Plasma have _____ collisions

a) Continuous
b) Frequent
c) In frequent
d) Both a and b

43. Larmor radius is equal to

a) $v_\perp/\omega$ b) $v_\perp.\omega$ c) $v_\perp/2\omega$ d) $\omega/v_\perp$

44. The cyclotron frequency ω_c is:

a) $|q|/mB$ b) $(|q|B)/m$ c) $mB/|q|E$ d) $|q|B^2/m$

45. We define the Larmor radius r_L to be

a) $|q|/mB$
b) $mB/|q|E$
c) $mv_\perp/|q|B$
d) $(|q|B)/m$

46. The Solar Corona is hot, tenuous plasma with temperature up to?

a) 2KeV b) 300KeV c) 200KeV d) 200eV

47. Which of the following is a characteristic of a plasma?

a) It has a definite shape
b) It has a definite volume
c) It can conduct electricity
d) It is a good insulator

48. Which of the following is a key parameter used to describe a plasma?

a) Pressure
b) Temperature
c) Density
d) All of the above

49. Which of the following devices is used to confine and control a plasma using

a) Tokamak
b) Van de Graaff generator
c) Particle accelerator
d) Cathode ray tube

50. What is the term for the state of a plasma when it becomes self-sustaining and does not require external heating?

a) Equilibrium b) Ionization c) Ignition d) Neutrality

51. What is the term for the device used to measure the density of a plasma?

a) Spectrometer
b) Mass spectrometer
c) Particle detector
d) Langmuir probe

52. Which of the following phenomena is associated with plasma physics?

a) Aurora borealis (Northern Lights)
b) Solar flares
c) Lightning
d) All of the above

53. Most of the plasma diagnostic techniques assume that the emitting plasma is

a) Thermal.

b) Homogeneous and isothermal.

c) In collisional ionization equilibrium.

d) All of the above.

54. The plasma diagnostic techniques can be used to measure.

a) The electron and ion temperatures,

b) Electron density and the thermal structure of the plasma,

c) Its chemical composition and ionization state,

d) All of the above

55. The process that gives rise to the emission of radiation from the plasma namely

a) Bremsstrahlung,

b) recombination

c) Radiative decay

d) All of the above

56. Langmuir probe can be used to determine the fundamental plasma parameters, such as:

a) The electron density,

b) Electron temperature,

c) Plasma potential and in some cases the electron energy distribution function

d) All of the above

57. What is a plasma display?

a) A display technology that uses tiny crystals to produce images.

b) A display technology that uses organic materials to emit light.

c) A display technology that uses ionized gases to create images.

d) A display technology that uses liquid crystals to control light transmission.

58. How does a plasma display create images?

a) By manipulating electric currents to control the brightness of pixels.

b) By using a backlight to illuminate liquid crystals.

c) By exciting phosphors with ultraviolet light to emit visible light.

d) By modulating the intensity of organic light-emitting diodes (OLEDs)

B. Problems. Answer the following questions. [25 marks]

1. Calculate the electron plasma frequency in a plasma of density $n=10^{20}\,m^{-3}$.

SOLUTION:

2. What is the collisional cross section for this reaction. $H+F \rightarrow HF$. The radius of fluorine atom is $4.2 \times 10^{-11}\ m$.

SOLUTION:

3. In an experiment in a certain gas it was found that the steady state current is $5.5 \times 10^{-8}\ A$ at 8 kV at a distance of 0.4 cm between the plane electrodes. Keeping the field constant and reducing the distance to 0.1 cm results in a current of 5.5×10^{-9} A. (i) Calculate Townsend's primary ionization coefficient α. (ii) If the breakdown occurred when the gap distance was increased to 0.9 cm, what is the value of γ?

SOLUTION:

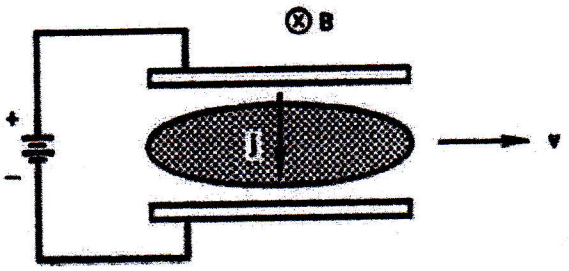
4. Compute λ_D and N_D for the following cases:

i. A glow discharge, with $n = 10^{16}\ m^{-3}$, $KT_e = 2\ eV$.

ii. The earth's ionosphere, with $n = 10^{12}\ m^{-3}$, $KT_e = 0.1\ eV$.

SOLUTION:

5. An ion engine has a $1T$ magnetic field, and a hydrogen plasma is to be shot out at an $E \times B$ velocity of 1150 km/s. How much internal electric field must be present in the plasma?



$$\epsilon_o = 8.854 \times 10^{-12} F/m$$
$$\mu_o = 4\pi \times 10^{-7}\ H/m$$

SOLUTION:

END OF EXAM

Assiut University
Faculty of Science
Physics Department

General Physics 2 (P105)
2nd semester 2022-2023
Final Exam (50 Marks)

Exam date: Saturday, 26/08/2023
Exam Time: 2 hours

"يتم طمس(تسويد) الإجابة المختارة من قبل الطالب باستخدام القلم الجاف فقط"

1st Question: Choose the correct answer from the given options below and put your answers in the answer sheet (40 Marks)

1. Which magnitude of charge is stored on each plate of a 6 μF capacitor with 12 V applied across it?
   a. -2 μC
   b. -72 μC
   c. 2 μC
   d. 72 μC

2. Which factors determine the capacitance of a device?
   a. Capacitance depends only on the materials that make up the device.
   b. Capacitance depends on the electric field surrounding the device.
   c. Capacitance depends on the geometric and material parameters of the device.
   d. Capacitance depends only on the mass of the capacitor.

3. The energy required to bring a charge q = 9 nC from far away to 6 cm from a point charge Q is 18 mJ. What is the potential at the final position of q?
   a. -162×10^6 V
   b. -2×10^6 V
   c. -0.5×10^6 V
   d. 2×10^6 V

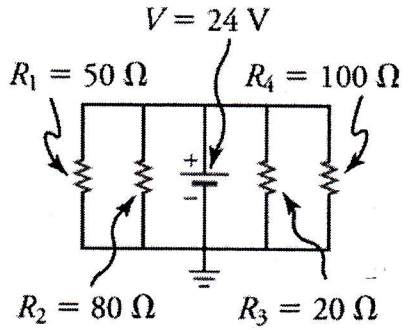
4. What power is dissipated in a circuit through which 0.12 A flows across a potential drop of 3.0 V?
   a. 0.36 W
   b. 0.011 W
   c. 5V
   d. 2.5 W

5. You connect a single resistor R across a 10 V battery and find that 0.01 A flows through the circuit. You add another resistor R after the first resistor and find that 0.005 A flows through the circuit. If you have 5 resistors R connected parallelly, what would be their total resistance?
   a. R/5
   b. 5R
   c. 5/R
   d. 10R

6. What current is flowing if 0.67 C of charge pass a point in 0.30 s?
   a. 2.2 A
   b. 0.67 A
   c. 0.30 A
   d. 0.20 A

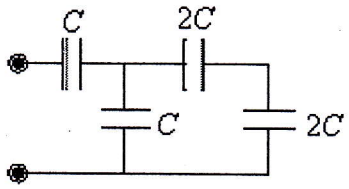
7. The electric potential is:
   a. potential energy per unit charge.
   b. electrical force per unit charge.
   c. simply electrical energy.
   d. is simply electrical charge.

8. What is the current through each resistor in the circuit?



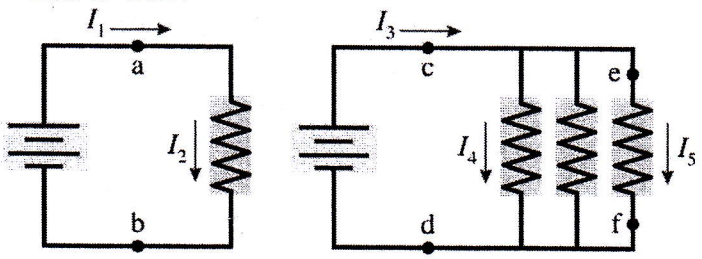
a. Current through resistors R_1, R_2, R_3, and R_4 is 0.48 A, 0.30 A, 1.2 A, and 0.24 A, respectively.
b. Current through resistors R_1, R_2, R_3, and R_4 is 1,200 A, 1,920 A, 480 A, and 2,400 A, respectively.
c. Current through resistors R_1, R_2, R_3, and R_4 is 2.08 A, 3.34 A, 0.833 A, and 4.17 A, respectively.
d. The same amount of current, 0.096 A, flows through all the resistors.

9. If C = 24 μF, determine the equivalent capacitance for the combination shown.



a. 36 μF
b. 32 μF
c. 16 μF
d. 24 μF

10. In the two circuits on the right, the batteries are identical, and all resistors are identical. Which of the statements is true?



a. $I_1 > I_2$
b. $I_1 = I_3$
c. $I_1 = I_4$
d. $I_1 = 3\ I_3$

11. To measure the power consumed by your laptop computer, you place an ammeter in series with its DC power supply. When the screen is off, the computer draws 0.40 A of current. When the screen is on at full brightness, it draws 0.90 A of current. Knowing the DC power supply delivers 16 V, how much power is used by the screen?
a. The power used by the screen is -8.0 W.
b. The power used by the screen is 0.3 W.
c. The power used by the screen is 3.2 W.
d. The power used by the screen is 8.0 W.

12. A pair of parallel plates is forming a charged capacitor. The plates are pulled apart to double the original separation distance, the charges on the plates remain the same. What is the ratio of the final energy stored to the original energy stored?

a. 4 b. 2
c. 1 d. 0.5

13. A metallic conductor has a resistivity of 18×10^{-6} Ω.m. What is the resistance of a piece of this conductor that is 30 m long and has a uniform cross-sectional area of 3×10^{-6} m^2?

a. 0.056 Ω b. 180 Ω
c. 160 Ω d. 90 Ω

14. A tungsten wire is used to determine the melting point of indium. The resistance of the tungsten wire is 3 Ω at 20 °C and increases to 4.85 Ω as the indium starts to melt. $\alpha_{tungsten} = 4.5 \times 10^{-3}$ °C^{-1}. What is the melting temperature of indium?

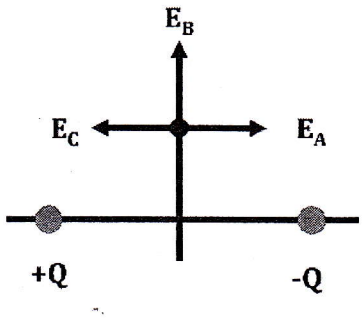
a. 132°C b. 157°C
c. 351°C d. 731°C

15. An electron with a charge value of 1.6×10^{-19} C is moving in the presence of an electric field of 400 N/C. What force does the electron experience?

a. 2.3×10^{-22} N b. 1.9×10^{-21} N
c. 6.4×10^{-17} N d. 4.9×10^{-17} N

16. Two point charges, +Q and -Q, are located 2 m apart and there is a point along the line that is middle from the two charges as indicated. Which vector best represents the direction of the electric field at that point?

a. Vector E_A
b. Vector E_B
c. Vector E_C
d. The electric field at that point is zero.



17. The electric field in a cathode ray tube is supposed to accelerate electrons from 0 to 1.60×10^7 m/s in a distance of 2.00 cm. What electric field is required? ($m_e = 9.11 \times 10^{-31}$ kg and $e = 1.6 \times 10^{-19}$ C)

a. 9110 N/C b. 18200 N/C
c. 36400 N/C d. 72800 N/C

18. A charge Q_1 has 50 electric field lines radiating outward and Q_2 has 100 field lines converging inward. What is the ratio Q_1/Q_2?

a. 2 b. -2
c. 0.5 d. -0.5

19. A 9 V battery is connected between two parallel metal plates 4.0 mm apart. What is the magnitude of the electric field between the plates?

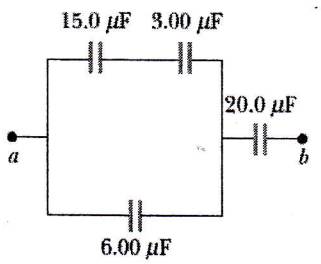
a. 2.3×10^3 N/C b. 9.0 N/C
c. 2.3 N/C d. 0.75×10^{-6} N/C

20. The electric potential is

a. potential energy per unit charge. b. electrical force per unit charge.
c. simply electrical energy. d. is simply electrical charge.

2nd Question: Choose whether the following is true or false and put your answers in the answer sheet **(10 Marks)**

21. The potential energy (U) of a system that consists of four-point charges (Q_1, Q_2, Q_3, Q_i) can be estimated from $U = K\left(\frac{Q_1Q_2}{r_{12}} + \frac{Q_1Q_4}{r_{14}} + \frac{Q_2Q_3}{r_{23}} + \frac{Q_3Q_4}{r_{34}}\right)$. ( )
22. The direction of electric filed ($\vec{E}$) is always in the direction, which the electrical potential decreases. ( )
23. The electric field ($\vec{E}$) inside a charged conductor is constant, meanwhile the electric potential (V) is zero at every point inside the conductor. ( )
24. Inserting a dielectric between the parallel plate capacitor will reduce the electric potential (ΔV) ( )
25. The storge energy per unit volume (U_E) between parallel plate capacitor that includes insulator material with electric permittivity (**ε**) and dielectric constant **(K)** is defined as $U_E = \frac{1}{2}\frac{\varepsilon}{K}E^2$ ( )
26. The average current (I_{av}) flowing in the conductor can be estimated from the following equation: $I_{av} = \frac{nqA}{v_d}$ ( )
27. The capacitance of isolated charged sphere with radius **R** can be estimated from $4\pi\varepsilon_o R$ ( )
28. The relation between current (I) and the applied potential difference (ΔV) is nonlinear for ohmic materials ( )
29. If two capacitors connected in **series** with capacitance of $2\mu F$ and $5\mu F$ are connected in **parallel** with a third capacitor of $3\mu F$. Hence, the equivalent capacitance $C_{eq} = \frac{31}{7}\ \mu F$ ( )
30. The increase of conductor temperature leads to a decrease in it's conductivity (σ) ( )
31. the maximum power delivered to the load resistance R in the case of non-ideal battery occurs when internal resistance (r) equals to the load resistance ( )
32. The temperature coefficient of resistivity (α) is given by $\alpha = \frac{T-T_o}{T_o(\rho_o-\rho)}$ ( )
33. If the potential difference (V_{ab}) between point **a** and **b** equals 10 V. Hence, the charge (Q_C) on the capacitor ($C = 20\mu F$) equal 6.95 μC.



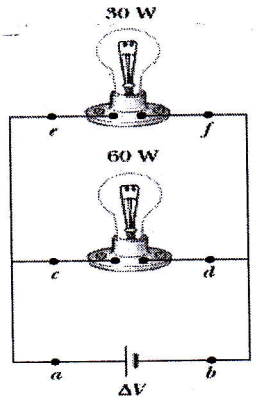
( )

34. The potential energy (U) between three-point charge system (Q_1=2μC, Q_2=3μC, and Q_3=-6μC) with mutual separating distances (r_{12} = 4 m, r_{13}=3m, and r_{23}=5m) equals to -0.0549 J. ( )
35. If a resistance thermometer of materials (α=0.004 $^oC^{-1}$) has a resistance of 40 Ω at ( )

20 °C. Hence, with increasing temperature to 156 °C its resistance will increase to 65 Ω.

36. The Kirchhoff's junction rule states that the sum of the currents entering any junction in a circuit must equal the sum of the currents leaving that junction ( )

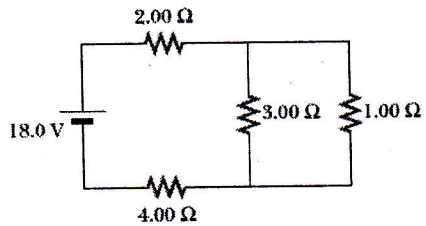
37. If two light bulbs (30 and 60 W) are connected in parallel with applied potential (ΔV) as shown in next figure, hence the bulb with higher electrical power (P) ( )



possesses the higher electrical current (I).

38. The temperature coefficient of resistivity (α) is always positive for all materials including conductors and semiconductors ( )

39. The power (P) delivered to the resistance ($R = 1.0\ \Omega$) is 4.0 W. ( )



( )

40. The change in the potential energy (ΔU) of moving particles between points on the same equipotential surfaces is > 0.

With all my best regards

Dr. Mohaned M. M. Mohammed

Assiut University
Date: 7/9/2023
Time allowed: 2 hour

Final Exam
The exam is in 7 pages and consists of 40 points, equivalent to 50 marks
Examiner:
Dr. Mohamed A. Sabet

Faculty of Science
Intro. to Modern Physics
Code: 255P

Answer all the following questions <u>in the answer tables at the end</u>
غير مسموح بشطب الاجابات او اختيار اكثر من خيار واحد
لن ينظر الى أى اجابات خارج جداول الاجابات فى آخر صفحة

Choose the most accurate answer

1. The mathematical forms that describe the behavior of of macroscopic objects that move with small relative velocities with respect to the speed of light is
   a) Classical mechanics
   b) Quatum mechanics
   c) Relativistic quantum mechanics
   d) Relativistic mechanics
2. The mathematical forms that describe the behavior of of microscopic objects that move with small relative velocities with respect to the speed of light is
   a) Classical mechanics
   b) Quatum mechanics
   c) Relativistic quantum mechanics
   d) Relativistic mechanics
3. The mathematical forms that describe the behavior of of microscopic objects that move with high relative velocities with respect to the speed of light is
   a) Classical mechanics
   b) Quatum mechanics
   c) Relativistic quantum mechanics
   d) Relativistic mechanics
4. A 1000-kg automobile moving with a speed of 24 m/s relative to the road collides with a 500-kg automobile initially at rest. If the two stick together, what is the velocity in m/s of the two cars after the collision according to an observer in a truck moving 10 m/s in the same direction as the moving cars?
   a) 9.33 m/s
   b) 24 m/s
   c) 14 m/s
   d) 6 m/s
5. Which of these is an inertial reference frame (or a very good approximation)?
   a) A sky diver falling at terminal speed
   b) A car rolling down a steep hill
   c) A rocket being launched
   d) None of the above

6. A 1400-kg automobile moving with a speed of 24 m/s relative to the road collides with a 700-kg automobile initially at rest. If the two stick together, what is the velocity in m/s of the two cars after the collision according to an observer in a truck moving 11 m/s in the same direction as the moving cars?
   a) 19.33 m/s
   b) 5 m/s
   c) 6 m/s
   d) 14 m/s
7. A tree and a pole are 3000 m apart. Each is suddenly hit by a bolt of lightning. Mark, who is standing at rest midway between the two, sees the two lightning bolts at the same instant of time. Nancy is at rest under the tree. Define event 1 to be "lightning strikes tree" and event 2 to be "lightning strikes pole." For Nancy, does event 1 occur before, after or at the same time as event 2?
   a) before event 2
   b) after event 2
   c) at the same time as event 2
   d) impossible to measure
8. Boat 1 goes directly across a stream a distance L and back taking a time t1. Boat 2 goes down stream a distance L and back taking a time t2. If both boats had the same speed relative to the water, which of the following statements is true?
   a) no enough information to compare
   b) $t1>t2$
   c) $t1=t2$
   d) $t2>t1$
9. A baseball pitcher with a 90 km/h fastball throws a ball while standing on a railroad flatcar moving at 110 km/h. The ball is thrown in the same direction as that of the velocity of the train. Applying the Galilean velocity transformation equation, the speed of the ball relative to the Earth is
   a) 200 km/h
   b) 90 km/h
   c) 110 km/h
   d) 20 km/h
10. You are driving on a freeway at a nonrelativistic speed and maintains a constant force by means of a car engine. As the speed of the car increases, an observer standing on the ground finds that relative to him the magnitude of the car's acceleration is
   a) increasing
   b) decreasing
   c) constant
   d) zero
11. Which observer in the figure sees the ball's correct path?
   a) both observers
   b) the observer in the truck.

c) the observer on the ground.
d) none of them.

12. From the concepts of space and time in Newtonian mechancis that:
    a) the measured length is not absolute, the simulitinity is absolute.
    b) the measured length is independent of any conditions, the simulitinity is absolute.
    c) the measured length is independent of any conditions, the simulitinity is not absolute.
    d) the measured length is not absolute, the simulitinity is not absolute.
13. Galilean position transformation for two frams S (xyz) and S' (x'y'z') where S' is moving with constant velocity v in the x-x' direction are:
    a) x'=x, y=y'-vt, z=z'
    b) x'=x, y=y', z=z'-vt
    c) x'=x-vt, y=y', z=z'
    d) x'=x-vt, y=y'-vt, z=z'-vt
14. Galilean acceleration transformation for two frams S (xyz) and S' (x'y'z') where S' is moving with constant velocity v in the x-x' direction are:
    a) $a_x'=a_x-v/t$, $a_y'=a_y$, $a_z'=a_z$
    b) $a_x'=a_x$, $a_y'=a_y-v/t$, $a_z'=a_z$
    c) $a_x'=a_x$, $a_y'=a_y$, $a_z'=a_z-v/t$
    d) $a_x'=a_x$, $a_y'=a_y$, $a_z'=a_z$
15. A spaceship moves at a speed of 0.95 c away from the Earth. It shoots a star wars torpedo toward the Earth at a speed of 0.90 c relative to the ship. What is the velocity of the torpedo relative to the Earth?
    a) 0.35 c
    b) -0.35 c
    c) 0.27 c
    d) -0.27 c
16. Proper time is
    a) the time calculated with the correct relativistic expression.
    b) the time interval between two events as measured by an observer who sees the events occur at the same point in space.
    c) the longest possible time interval between two events.
    d) the time measured by a light clock
17. Proper length is
    a) the length of an object measured by someone in a reference frame that is moving relative to the object
    b) the shortest possible length of an object
    c) the length of the object measured by someone who is at rest with respect to the object.
    d) the length measured by the light year
18. A fancy sports car moves past an observer on a corner at a speed of 0.6 c. When the observer indicates a one-second interval has passed, what time interval will be shown on the driver's watch?

a) 1 s
b) 0.8 s
c) 0.63 s
d) 1.25 s

19. Two fireworks explode at the same position on the 4th of July. A stationary observer notices that the time interval between the two events was 5.00 seconds. A second observer flies past the fireworks at a speed of 0.600 c. What value does she obtain when she measures the time interval between the two explosions?
a) 6.25 s
b) 4.0 s
c) 3.2 s
d) 7.9 s

20. The half-life of a muon is 2.2 μs as measured in a stationary reference frame. What is the half life of the muon (in μs) when it is moving with a speed of v = 0.800 c?
a) 3.67 μs
b) 1.32 μs
c) 0.99 μs
d) 4.92 μs

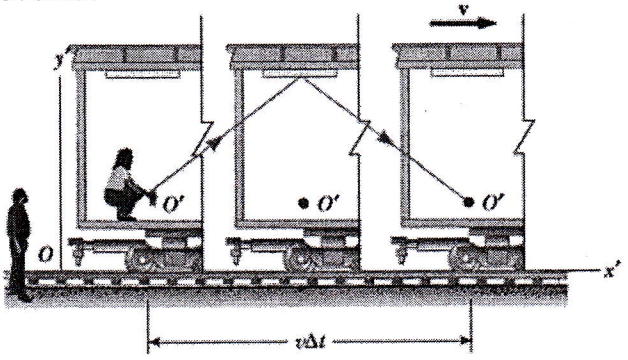
21. A meterstick is shot from a meterstick projector at a speed of 0.90 c. How long will it be relative to an observer's frame of reference?
a) 0.44 m
b) 1.0 m
c) 0.1 m
d) 10 m

22. A starship navigator measures the distance between the Earth and the sun. If the ship is moving at a speed of 0.90 c, instead of obtaining 150 million km, the navigator measures a distance of
a) 28.5 million km
b) 65.4 million km
c) 344.1 million km
d) 47.4 million km

23. An astronaut traveling with a speed v = 0.9 c holds a meterstick in his hand. If he measures its length, he will obtain a value of
a) 0.1 m
b) 10 m
c) 1.0 m
d) 0.44 m

24. As a spaceship heads directly to Earth at a velocity of 0.8c, it sends a radio signal to Earth. When those radio waves arrive on Earth, their velocity relative to Earth is
a) 1.8 c
b) 0.2 c
c) 0.8 c
d) c

25. Suppose the observer O' on the train in the figure aims her flashlight at the far wall of the boxcar and turns it on and off, sending a pulse of light toward the far wall. Both O' and O measure the time interval between when the pulse leaves the flashlight, and it hits the far wall. Which observer measures the proper time interval between these two events?



a) neither observer
b) O'
c) O
d) both observers

26. In relativity, the Galilean transformations are replaced by
a) Newton transformations.
b) Lorentz transformations.
c) Feynman transformations.
d) Maxwell transformations.

27. A crew watches a movie that is two hours long in a spacecraft that is moving at high speed through space. An Earthbound observer, who is watching the movie through a powerful telescope, will measure the duration of the movie to be
a) shorter than
b) equal to two hours
c) longer than
d) impossible to measure

28. You are observing a spacecraft moving away from you. You measure it to be shorter than when it was at rest on the ground next to you. You also see a clock through the spacecraft window, and you observe that the passage of time on the clock is measured to be slower than that of the watch on your wrist. Compared to when the spacecraft was on the ground, what do you measure if the spacecraft turns around and comes toward you at the same speed?
a) The spacecraft is measured to be longer, and the clock runs faster.
b) The spacecraft is measured to be longer, and the clock runs slower.
c) The spacecraft is measured to be shorter, and the clock runs faster.
d) The spacecraft is measured to be shorter, and the clock runs slower.

29. A square measuring 1 m by 1 m is moving away from observer A along a direction parallel to one of its sides at a speed such that γ is equal to 2. The area of this square, as measured by observer A, is

a) 0.5 m^2
b) 4 m^2
c) 2 m^2
d) 1 m^2

30. The reason we do not observe relativistic effects (such as time dilation or length contraction) at ordinary speeds on earth is that
    a) Special relativity is valid at all speeds, but the effects are normally too small to observe at ordinary speeds on earth.
    b) Special relativity is valid only when the speed of an object approaches that of light.
    c) We do readily observe relativistic effects for objects such as jet planes.
    d) Special relativity is valid only for microscopic objects such as electron.

True or false

31. A super train (rest-length = 100 m) travels at a speed of 0.95 c as it passes through a tunnel (rest-length 50 m). As seen by a trackside observer, the train is completely within the tunnel.
32. The proper time is always the shortest time interval.
33. In the theory of relativity, length and time are absolute.
34. In Relativistic mechanics, the mass is conserved.
35. Lorentz transformation is a set of equations connecting space-time coordinates of an event in two different inertial frames.
36. The redshift is the shift of known spectral lines toward longer wavelengths, that is, toward the red end of the visible spectrum.
37. The total energy of a body with relativistic momentum p and rest energy E_0 is given by $E^2 = p^2c^2 + E_0^2$.
38. Nonzero mass objects can move with velocities greater than the speed of light in vacuum.
39. Einstien's mass-energy equivalence for a body with rest mass $m_0$is $E_0 = \frac{1}{2}m_0c^2$.
40. In general, for a body with rest mass m_0 and moving with constant velocity v with respect to an observer, the mass m of the body with respect to the observer is $m = m_0\sqrt{1 - \frac{v^2}{c^2}}$.

End of questions

Answer sheet

First question

	1	2	3	4	5	6	7	8	9	10
a)	O	O	O	O	O	O	O	O	O	O
b)	O	O	O	O	O	O	O	O	O	O
c)	O	O	O	O	O	O	O	O	O	O
d)	O	O	O	O	O	O	O	O	O	O

	11	12	13	14	15	16	17	18	19	20
a)	O	O	O	O	O	O	O	O	O	O
b)	O	O	O	O	O	O	O	O	O	O
c)	O	O	O	O	O	O	O	O	O	O
d)	O	O	O	O	O	O	O	O	O	O

	21	22	23	24	25	26	27	28	29	30
a)	O	O	O	O	O	O	O	O	O	O
b)	O	O	O	O	O	O	O	O	O	O
c)	O	O	O	O	O	O	O	O	O	O
d)	O	O	O	O	O	O	O	O	O	O

Second question

	31	32	33	34	35	36	37	38	39	40
True	O	O	O	O	O	O	O	O	O	O
False	O	O	O	O	O	O	O	O	O	O

With my best wishes