Assiut University Faculty of Science Department of Physics		Term: Spring 2023- 2024 Date: 21 May, 2024 Time: 3 Hours

Course Title: Nuclear Physics 1 – Code P342 – Final Exam. (50%)

Constants: $R_o = 1.3$ fm, $e^2/4\pi\varepsilon_o = 1.44$ MeV·fm, $m_e = 0.511$MeV, $1amu = 931.5\,\text{MeV}/c^2$

Part I: Circle the correct answer for the following questions: (15 Marks)

1. The "magic numbers" for atoms are

a) numbers of electrons that confer atomic stability
b) numbers of protons and/or neutrons that confer nuclear stability
c) n/p ratios that confer nuclear stability *d)* atomic masses that confer nuclear stability.

2. The difference between the sum of the components of $^{4}_{2}He$ and the mass of the total nucleus is 0.030375 u, then **the binding energy** of the nucleus is equal to:

a) 3.26×10^{-5} MeV *b)* 7.1 MeV *c)* 28.29 MeV *d)* 931.5 MeV

3. Which of them are atomic models?

i- Thomson's plum pudding model *ii-* Rutherford's nuclear model
iii- Bohr's model *iv-* Sommerfeld's model

a) i & ii *b) i & ii & iii* *c) ii & iii & iv* *d)* All of these

4. Emission of **which** one of the following leaves both atomic number and mass number unchanged?

a) positron *b)* neutron *c)* alpha particle *d)* gamma radiation

5. A radioisotope of argon, ^{35}Ar, lies below the "band of stability: (n/p ratio too low). **One** would predict that it decays via .....

a) neutron emission *b)* beta emission *c)* positron emission *d)* alpha emission

6. A Geiger-Muller tube is a

a) gas ionization detector *b)* cloud chamber
c) fluorescence detector *d)* photographic detector

7. When ^{59}Cu undergoes positron emission, **what** is the immediate nuclear product?

a) ^{59}Ni *b)* ^{58}Ni *c)* ^{58}Cu *d)* ^{59}Zn

8. As a result of the process of electron capture (K-capture) by $^{211}_{85}At$, **the new isotope** formed is:

a) $^{210}_{85}At$ *b)* $^{211}_{85}At$ *c)* $^{211}_{86}Rn$ *d)* $^{211}_{84}Po$

9. When ^{235}U is bombarded with one neutron, fission occurs and the products are three neutrons, ^{94}Kr, **and** .....

a) ^{139}Ba *b)* ^{139}Ce *c)* ^{139}Xe *d)* ^{141}Ba

10. Which of the following nuclides has the greatest binding energy per nucleon?

a) ^{238}U *b)* ^{1}H *c)* ^{4}He *d)* ^{56}Fe

11. What is the force that holds protons and neutrons together in the nucleus of an atom?

a) gravity *b)* electric force *c)* friction *d)* strong nuclear force

12. Consider a nuclear reaction $^{200}X \rightarrow {}^{110}A + {}^{90}B + Q$. If **the binding energy** per nucleon for X, A and B is 7.4 MeV, 8.2 MeV and 8.2 MeV respectively, what is the energy released:

a) 90 MeV *b)* 160 MeV *c)* 110 MeV *d)* 200 MeV

13. If you know that the radius of the nucleus of an unknown element is equal $2.977\,fm$, **the mass number** is equal to:

a) 16 *b)* 12 *c)* 14 *d)* 9

14. In the uranium radioactive series, the initial nucleus is $^{238}_{92}\mathrm{U}$ and that the final nucleus is $^{206}_{82}\mathrm{Pb}$. When uranium nucleus decays to lead, **the number** of α particles and β particles

a) 8α, 6β *b)* 6α, 7β *c)* 6α, 8β *d)* 4α, 3β

15. The electrons cannot exist inside the nucleus because:

a) de-Broglie wavelength associated with electron decay is much less than the size of nucleus

b) de-Broglie wavelength associated with electron decay is much greater than the size of nucleus

c) de-Broglie wavelength associated with electron decay is equal to the size of nucleus

d) negative charge cannot exist in the nucleus.

Part II : Answer the following questions (35 Marks)

1. Alpha particles with kinetic energy 6.8 MeV are coulomb scattered by a gold foil.

a) What is the impact parameter for particles which are scattered through 90°?

b) What is the distance of closest approach of the alpha particle to the gold nucleus in this case of 90° scattering?.

2. *a.* In a scattering experiment it was found that $^{12}\mathrm{C}$ has a nuclear radius of 2.7 *fm*. The experiment is then repeated with another, unknown element and it is found the nuclear radius is twice as big. ***What*** is the mass number of this unknown element?

b. What is meant by: *Mass spectrometer – Magnetic dipole moment.*

3. The following are atomic masses in units of ***amu***:

Electron	0.000549	$^{152}_{62}Sm$	151.919756
Neutron	1.008665	$^{152}_{63}\mathrm{Eu}$	151.921749
$^{1}_{1}\mathrm{H}$	1.007825	$^{152}_{64}\mathrm{Gd}$	151.919794

a. What is the Q-value of the reaction $^{152}\mathrm{Eu}(\mathrm{n},\mathrm{p})$?

b. What types of weak-interaction decay can occur for $^{152}\mathrm{Eu}$?

c. What is the maximum energy of the particles emitted in each of the processes given in (b)?.

4. *a. Show* that the nucleons are not elementary particles but have an internal structure.

b. $^{27}\mathrm{Si}$ is a positron emitter with an end point energy of 1.35 MeV. ***Determine*** the threshold E_{th} of the reaction: $\mathrm{p} + {}^{27}\mathrm{Al} \rightarrow {}^{27}\mathrm{Si} + {}^{1}_{0}\mathrm{n}$, if the difference $\mathrm{M}_{{}^{1}_{0}\mathrm{n}} - \mathrm{M}_{\mathrm{H}} = 0.78$ MeV.

5. *a. Show* that the electric quadrupole moment of a nucleus vanishes for spherically symmetric charge distribution.

b. Prove that the number of energy levels produced from two nucleons ($\ell_1 = \ell_2 = 1$) ***does not depend on*** whether the type of bonding (L-S or J-J coupling).

******** ***Good Luck*** ********

Answer four questions only:

Question 1:

(a) Define the following expression

1- Primitive unit cell .
2- Bravais lattice .
3- Atomic packing fraction

(b) Iron crystallizes as body centered cubic (bCC) and the unite cell constant a= 2.68 Å calculate

1. The inter-planar distance for (1 1 0) planes .
2. Wavelength of X-ray that diffract from the (1 1 0) plane at Bragg angle equal 55°
3. packing fraction for the bcc unite cell for iron.

Question 2:

Choose the correct answer:

a) the atomic radius in bcc structure is .....

1- $r=\frac{a\sqrt{3}}{4}$ 2- $r=\frac{a\sqrt{2}}{2}$ 3-$r=\frac{2a}{\sqrt{3}}$ 4- $r=\frac{2a}{\sqrt{2}}$

b) The number of atoms present in the unit cell of the simple cubic .....

1- Two atoms 2- four atoms 3- one atom 4-three atoms

c) A plane intercept at a, b/2, 3c in a simple cubic unit cell . The miller indices of the plane are .....

1- (1 3 2) 2-(2 6 1) 3- (3 6 1) 4- (1 2 3)

d) Classify the following unit cell : a=b=c and α=β=γ=90

1- Hexagonal 2- Cubic 3- Trigonal 4- triclinic

e) The variation of the intensity (I) of x-ray with the thickness (x) of the absorbing materials is given by:

1- $I=I_0e^{(-\mu x)}$ 2) $I=I_0e^{(\mu x)}$ 3- $I=I_0e^{(-\mu/x)}$ 4- $I=I_0e^{(\mu/x)}$

Question 3:

If the potential energy (E) of system is given by:

$$E=N\frac{A}{R^n}-\frac{N\alpha e^2}{4\pi\varepsilon_0 R}$$

Where N is the number of ion-pairs α is constant and A, n is determined experimentally . prove that

1- $R_0^{n-1}=\frac{4\pi\varepsilon_0 A}{\alpha e^2}\,n$ 2- $\varepsilon_0=\frac{\alpha N e^2}{4\pi\varepsilon_0 R_0}\left(1-\frac{1}{n}\right)$

Question 4:

a) prove that the spacing between consecutive parallel planes of the miller indices (h k l) is given by

$$d_{hkl}=\frac{a}{\sqrt{h^2+k^2+l^2}}$$

b) Copper has Fcc structure and the atomic radius is 0.127nm calculate the interplanar spacing for (1 1 1) and (3 2 1) planes

Question 5:

a) Prove the volume of the unit cell of the reciprocal lattice is inversely proportional to the volume of unit cell of the crystal lattice

b) Obtain an expression for the specific heat capacity at constant volume of solids on the basis of Einstein model

Assiut University

Physics Department
Faculty of Science
Assiut University
2nd Semester - 2023/2024
3rd Level
Final-term Exam

Physics and Electronics Program
Course Code: EC 325
Microprocessors
(معالجات دقيقة)
Date: May 20th, 2024
Time: 9:00 am - 12:00 pm **(3 hours)**

Faculty of Science

Important Notes: Marks: 50, Number of Pages: 2, Number of Questions: 4

Answer All the Following Questions:

Question 1 *10 Marks*

Choose the correct answer to each of the following statements: *(1 Mark for Each Point)*
(Note: multiple choices are not allowed)

1. In 1642, Pascal invented a calculator which its principle of work was based on .....
   A strings of beads
   B motor-driven adding machines
   C gears and wheels
   D non of the previous

2. The ..... bus selects the memory or I/O device and causes them to perform a read or write operation.
   A data
   B control
   C address
   D non of the previous

3. The maximum size of memory that can be accessed in the real mode operation is .....
   A 1 MB
   B 64 KB
   C 4 MB
   D 256 KB

4. The main processing unit in Intel 8086 which is responsible for updating control flags is .....
   A ALU
   B BIU
   C EU
   D non of the previous

5. ..... is the computing machine which can be considered the first electromechanical computer.
   A Colossus
   B Z3
   C ENIAC
   D Abacus

6. The first microprocessor in Intel which has 32-bit address bus and 64-bit data bus is .....
   A Intel 80286
   B Intel 80386
   C Intel 80486
   D Intel Pentium

7. ..... can be considered as a suitable combination of segment:offset registers.
   A CS:SI
   B DS:BX
   C ES:BP
   D non of the previous

8. Assume that the machine code of `MOV AL,06H` is B406 H. The value B406 H is stored in the .....
   A data segment
   B extra segment
   C code segment
   D stack segment

9. IF SP = 582C H, the offset address of the first location in the stack to pop data from is ..... after the execution of the following assembly line: `POP AX`
   A 582E H
   B 582C H
   C 582A H
   D 5828 H

10. Consider CF = 1 and AL = 10100011 B. After the execution of `RCL AL,2` .....
    A AL = 01000111 B
    B AL = 11101000 B
    C AL = 10001110 B
    D AL = 10001111 B

Question 2 *16 Marks*

i) Consider the following assembly lines, the part of data segment, and the values of some registers:

```
MOV AX,[3778H]
MOV CX,[BX+DI]
MOV DX,[SI+100H]
```

25779 H	C6 H
25778 H	3B H
25777 H	7A H
25776 H	2D H
25775 H	F4 H
25774 H	5E H

BX = 2764 H, DI = 1010 H, SI = 3676 H, DS = 2200 H, and SS = 2000 H.

a) Compute the starting and ending addresses of the stack segment. *(2 Marks)*

b) Show the physical memory locations and the contents of the registers AX, CX, and DX after the execution of the above assembly lines. *(6 Marks)*

ii) Suppose that AL = 00011000 B. Using only the logical instructions, write the assembly lines to preform the following operations, and then show the contents of AL: *(8 Marks)*

a) Multiply AL by 4

b) Divide AL by 8

c) Set the bits No. 0, 3 and 5 in AL

d) Toggle the bits No. 2, 4 and 7 in AL

Question 3 *14 Marks*

i) Check if the jump to `Next` will occur or not in the following cases: *(6 Marks)*
(Note: answer with occur or not occur, and also write the reason)

a)
```
MOV AX,32B7H
CMP AX,9A2DH
JG NEXT
```

b)
```
XOR AX,AX
CMP AX,0
JNZ NEXT
```

c)
```
MOV AL,0F5H
ADD AL,41H
JC NEXT
```

ii) Show the contents of BX and the flag bits (CF, ZF, SF, OF, PF and AF) after the execution of the following assembly lines: *(8 Marks)*

```
MOV BH,23H
ADD BH,89H
CMC
MOV BL,0C5H
SBB BL,47H
```

Question 4 *10 Marks*

Write the assembly code that: *(8 Marks)*

- adds and counts the even and odd numbers in the following series of byte size data: 37, 62, 28, 51, 46, 14, 72, 111 and 0
- stores the sum and count of the even numbers in CL and CH, respectively
- stores the sum and count of the odd numbers in DL and DH, respectively
- stops when the number 0 is read

then show the contents of CX and DX after the execution of the assembly code. *(2 Marks)*

Best Wishes

Dr. Abdelrahman Morsi

The exam is written in two (2) pages

Answer only five (5) from the following questions:

Question (1): ***(10 Marks)***

i- State phenomena that classical physics failed to explain and led the rise of old quantum mechanics.

ii- Proove that: "Any two eigenfunctions of a Hermitian operator, belonging to different eigenvalues are orthogonal."

iii- Is the operator $\hat{A} = d/dx$ a Hermitian or non-Hermitian operato?

Question(2): ***(10 Marks)***

i- State the phenomena that old quantum mechanics failed to explain.

ii- The wave function $\psi_n(x) = \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi x}{a}\right)$ describes the motion of a free particle of mass m moving in an infinite potential well, where $0 \leq x \leq a$ is the position of the particle. Calculate the energy of the particle E_n.

iii- Prove that the function $\psi_n(x) = \cos(nx)$ is an eigen function of the operator $\hat{A} = -\partial^2/\partial x^2$ and then derive its eigen value.

Question (3): ***(10 Marks)***

i- What is meant by the stationary states?

ii- A particle is known to be in the ground state of an infinite square well with length a. Calculate the probability that this particle will be found in the middle half of the well, that is, between $x = a/4$ and $x = 3a/4$.

iii- Calculate $[\hat{x}, \hat{p}_y]$

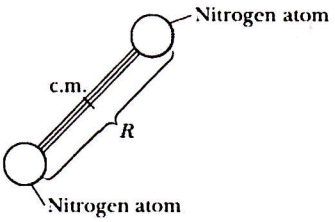
turn the page ←

Question (4): ***(10 Marks)***

i- Using the classical relationship $p_x = m\,\dot{x} = mv_x$, find the Schrödinger representation for the velocity operator.

ii- Prove that: "If the operators $\hat{A}$ and $\hat{B}$ have a complete set of simultaneous eigen functions then the operators commute."

iii- Consider the diatomic nitrogen molecule N_2 as a rigid rotator, with an equilibrium separation "bond length" $R = 0.11\,nm$ between atomic centers. Estimate the value of E_{rot} for the lowest rotational energy state of N_2. Hint: the mass of a nitrogen atom is $2.33 \times 10^{-26}\,kg$ and Plank's constant *h equal* 6.626×10^{-34} Joul. sec



Question (5): ***(10 Marks)***

The time-dependent Schrödinger equation can be solved by the method of separation of variables, if the potential $V(x)$ is time-independent. The solutions are of the form:

$$\Psi_n(x,t) = \psi_n(x)\, e^{-iE_n t/\hbar}$$

i- Is the function $\psi_n(x)$ a stationary state? Why?

ii- Is the function $\Psi_n(x,t)$ a stationary state? Prove your answer?

iii- Construct the much more general solution. Is that an eigen function of the Hamiltonian? Prove your answer?

Question (6): ***(10 Marks)***

To solve the time-independent Schrödinger equation of the Harmonic Oscillator we use the ladder operators which:

$$\hat{a}_{\pm} = \frac{1}{\sqrt{2\hbar m\omega}}\,(\mp i\,\hat{p} + m\omega x)$$

i- Calculate $[\hat{a}_-\,,\ \hat{a}_+\,]$

ii- Deduce the normalized ground state $\psi_0(x)$ of the quantum Harmonic oscillator.

iii- Determine the ground state energy E_0 of the Harmonic Oscillator.

WITH MY BEST WISHES ***Hesham Al-Attar***

كلية العلوم – قسم الفيزياء

جامعة أسيوط

Final Exam. "Diffraction rays & its applications" (352 P)

June. 2024

time: 3 hours

السؤال الأول (إجبارى): 17 درجة

I) **Choose the right answer between brackets:**

1) The Bragg's angle of the 1st order reflection (equal – higher – lower) than of the 2nd reflection.

2) For the 2nd order reflections the wavelength of the incident X-ray (equal – higher – lower) the d- spacing.

3) The XRD of the polycrystalline material is characterized by (broadening peaks – sharp peak – both of them)

4) Polycrystalline material includes grains with (different- semi – same) atomic orientation.

5) The unit cell in reciprocal lattice equal ($\pi / a - \pi / 2a - 2\pi / a$) and a is the lattice const. of the direct lattice.

6) The packing factor of simple cubic (lower- higher – equal) value of FCC structure.

7) If d-spacing have the same order of magnitude of lattice parameter the crystal plane is (*010, 011,101*).

8) The energy of the incident neutron beam at room temp.(lower–higher – equal) to that for atomic oscillator.

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

1) Space lattice represents an infinite arrangement of array points in one dimension

2) One can not prepare the perfect crystal due to surface effects.

3) XRD through single crystal used to study the symmetry of the unit cell of the crystal

4) X-ray is totally absorbed through material medium of certain width.

5) Monochromatic X-ray beam used to study the XRD through polycrystalline material.

6) The path difference of the incident X-ray beam on parallel crystal planes is $2d \sin\theta$

7) The diameter of the BCC contains the diameter of the center atom and two radii of the corner atoms.

8) The reflected Bragg,s angle satisfy the condition that $\theta > \sin\theta < 1$

9) The correction factor of the Bragg's low for the higher reflections includes the refractive index of the crystal.

أجب عن ثلاثة اسئلة فقط ممايلى:

السؤال الثانى: (11 درجة)

2. a) Illustrate with the eqns. that the lattice constant of cubic system is related to d-spacing of the set parallel crystalline planes having the same Miller indices (hkl) as: $a = d(h^2 + k^2 + \ell^2)^{1/2}$.

b) X-ray beam with energy 2.7 KeV incident on BCC crystal with angle 30^0, determine the crystalline plane reflected the 1St the order spectrum (given: atomic radius of 0. 2 nm, and h = 6.62×10^{-27} erg.sec)

c) Describe The experimental method used to study the crystal structure of polycrystalline material by applying the XRD data.

للأسئلة بقية خلف هذه الورقة ←

السؤال الثالث: (11 درجة)

3. a) Compare between the atomic radius dependence on the lattice const. for the simple and FCC structures.

b) Aluminum has FCC structure with the atomic radius 1.43 A^0, If energetic X-ray beam of 7.38 KeV incident on (100) plane, calculate the Bragg's angle considering the 1^{St} order reflection ($h = 6.62 \times 10^{-34}$ J.sec).

c) Use the simple reflection circle to explain the condition of using reciprocal lattice to study the XRD

السؤال الرابع: (11 درجة)

4. a) Prove that the Bragg's low for n-order reflections is expressed as: $n\lambda = 2d \sin\theta$, explain in details the necessary conditions required for applying this low.

b) Show with the eqn. a theoretical method used for identification of the crystallographic planes. If the Miller indices satisfy that: $h^2 + k^2 + \ell^2 = 5$, 7, and 15, determine the different crystalline planes. Draw the crystal plane corresponding to the value of 5

c) Determine the energy of X-ray beam when Bragg's angle of 19.21^0 is observed during in (111) plane of FCC structure (given: w = 27, ρ=2.7 gm/cm^3, $N_A = 6.023 \times 10^{23}$).

السؤال الخامس: (11 درجة)

5. a) Prove that the quantity: $[1 - \frac{(1-\mu^2)}{\sin^2\theta}]^{1/2}$ represents the modification of Bragg's low for the higher reflections of X-ray beam , where μ is the refractive index of the crystal.

b) A certain crystal reflect monochromatic X-rays strongly when the Bragg's angle of the 2^{nd} order is 31^0, satisfy the Bragg's reflection for the 1^{st} and 3^{d} order spectrum.

c) Deduce by the eqns. the necessary conditions required to study the crystal structure by neutron diffraction.

انتهت الأسئلة

أ.د. عبد المنعم سلطان

كلية العلوم – قسم الفيزياء

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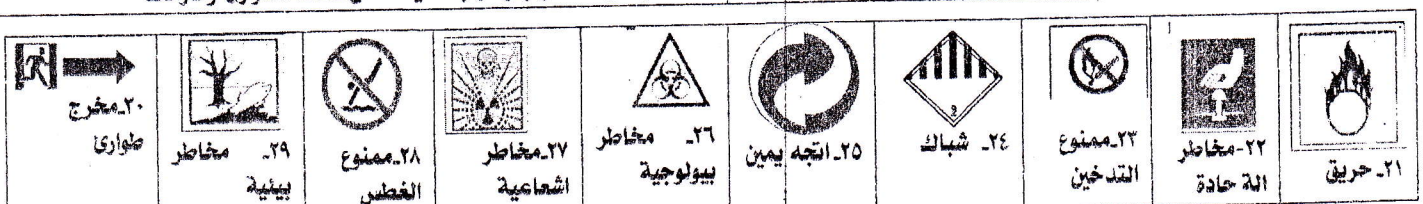
انتهت الأسئلة

أ.د. عبد المنعم سلطان

امتحان نهاية الفصل الدراسي لجميع المستويات المقرر: أخلاقيات المهنة والسلامة المهنية رقم المقرر ورمزه: F300	جامعة أسيوط كلية العلوم جامعة أسيوط	الزمن: ساعتان ٣ يونيـــة ٢٠٢٤ الاجابة في ورقة البابل

السؤال الاول: في ورقة البابل ظلل (T) للعبارة الصحيحة أو ظلل (F) للعبارة الخاطئة لما يأتي: (٣٠ درجة)

١- الميثاق الأخلاقي: مجموعة من القيم التي تسعي المؤسسة للالتزام بها اثناء العمل.	١١- يؤدي النهوض بالملكية الفكرية الي دفع عجلة التنمية الاقتصادية
٢- من مبادئ واخلاقيات مهنه التعليم الثقة والاحترام المتبادل	١٢- الخبرة والسلامة من أخلاقيات البحث العلمي
٣- اعـــرف اكثر عن علامات السلامة المهنية فهي لغة عالميـــة	١٣- أن تضيء شمعة صغيرة خير لك من أن تلعن الظلام.
٤- التخلص من مخلفات المعامل يكون بالحرق الآمن ودفن الرماد في مدفن آمن	١٤- احرص على التدريب فهو نشاط منظم لتحسين الأداء الوظيفي
٥- التقرير هو عرض كتابي او شفوي مركز لموضوع معين يقدمه فرد او مجموعه	١٥- الالتزام بالأخلاقيات يقوم السلوك، والاهتمام بالسلامة يحمي الحياة.
٦- Code of Ethics تعني اخلاقيات المهنة والسلامة المهنية	١٦- الدفاع عن شرف المهنة ليس من مبررات إفشاء الأسرار المختبرية
٧- احرص على الجودة في عملك فالجودة لها سقف	١٧- اللون الازرق في العلامات الارشادية يعني ممنوع
٨- يعد سرقة علمية استخدم افكار من موقع على الانترنت والاشارة اليه	١٨- تعرف الكوارث بأنها حوادث غير مفاجئة لقوي الطبيعة او الانسان
٩- معرفة علامات السلامة المهنية من المهارات المهنية المكتسبة للمقرر	١٩- عند حدوث الزلزال يجب تدريب العاملين
١٠- ضرورة استخدام معدات الوقاية والسلامة الشخصية بعد العمل.	٢٠- المفاجأة و الاضطراب والارتباك ليست من سمات الطوارئ والازمات



٢١- حريق | ٢٢- مخاطر الة حادة | ٢٣- ممنوع التدخين | ٢٤- شباك | ٢٥- اتجه يمين | ٢٦- مخاطر بيولوجية | ٢٧- مخاطر اشعاعية | ٢٨- ممنوع الغطس | ٢٩- مخاطر بيئية | ٣٠- مخرج طوارئ

السؤال الثاني: في ورقة البابل ظلل حرف A او B او C او D للإجابة الصحيحة: (٢٠ درجات)

٣١- مقرر اخلاقيات المهنة Scientific Ethics يتناول اخلاقيات مهنة (A-العلميين – B-الاطباء – C-المهندسين – D-كل ما سبق)

٣٢- من اساسيات تجهيز مختبرات الكيمياء (A- وجود شفاطات هواء - B- وجود كراسي - C- وجود سلالم - D- كل ما سبق)

٣٣- .....هو كمية المادة التي تؤدي لوفاة نصف مستخدميها اذا تم تناولها دفعة واحدة (A-LD50 - B-LOL - C- LEL - D- LC50)

٣٤- من الآداب العامة لمزاولة مهنه المختبرات الطبية (A-الخبرة - B-الزهو - C-الدعاية الشخصية - D-كل ما سبق)

٣٥- مجموعه من الوظائف المتشابهة التي يمكن أن يقوم بها فرد واحد عند اللزوم (A- العمل - B- المهنة - C- الوظيفة – D-كل ما سبق)

٣٦- من الأساليب التي يمكن اللجوء اليها في إدارة الأزمة (A-المناورة والالتفاف B- الضغوط الاقتصادية C-الدبلوماسية D-كل ما سبق)

٣٧- من طرق علاج الشائعات (A- المنطقية في التعامل - B- نشر الحقائق - C- التوعية - D-كل ما سبق)

٣٨- من الأهداف العامة التي تسعي السلامة والصحة المهنية لتحقيقها (A- حماية الممتلكات B-حماية الافراد - C – العمل بأمان - D – كل ما سبق)

٣٩- MSDS لأي مادة أو جهاز هامة لسلامة (A- الجهاز - B- المستخدم - C- المادة - D- كل ما سبق)

٤٠- من عوامل ادارة الازمة (A-اتخاذ القرار المناسب في الوقت المناسب B-ضبط النفس- C-التدريب D-كل ماسبق)

٤١- التبليغ فورا في حالة اكتشاف تحاليل ايجابية لمرض (A-الجرب – B- شلل الأطفال - C- الكوليرا – D - كل ما سبق)

٤٢- عدد الدرجات الوظيفية في الجامعات المصرية (A-٤ - B-٥ – C-٦ – D-٧)

٤٣- يجب ان يحتوى شنطة الاسعافات الأولية على (A- ملينات- B- مقلصات- C- قطن طبي وشاش - D-كل ما سبق)

٤٤- الرعاف هو (A-صدمة عصبية B- رعشة الجسم- C- نزيف دموي من الانف – D-كل ما سبق)

٤٥- من الخطوات الرئيسية عند تنفيذ عملية مواجهة الكوارث (A-الانذار والتحذير – B-الاخلاء - C-الايواء - D-كل ماسبق)

٤٦- من نفايات المعامل (A-اطباق مزارع بكتيرية - B-نفايات كيمائية - C- بقايا احياء بريه - D-كل ما سبق)

٤٧- من مجالات الاخلاقيات البيولوجية (A-تأجير الارحام B- القرصنة البيولوجية – C- سرقة الجينات – D-كل ما سبق)

٤٨- من انواع الشائعات (A- الشائعة البطيئة – B - الشائعة السريعة - C - الشائعة الاستطلاعية - D- كل ما سبق)

٤٩- Plagiarism يعني (A-الانتحال - B-الاقتباس – C-البحث – D-كل ما سبق)

٥٠- من يعد ميثاق اخلاقيات المهنة ؟ (A- فريق عمل - B- رئيس المؤسسة C - الطلاب – D- كل ما سبق)

انتهت الأسئلة

مع تمنياتي بالتفوق

أ.د. ناصر الشيمي

Assiut University
Date: 8/6/2024
Time allowed: 3 hours

Final Exam
The exam is equivalent to
50 marks
Examiner:
Dr. Mohamed A. Sabet

Faculty of Science
Biophysics
Code: 323P

First Question: True or False **(25 marks, 1 mark each)**

1. Acceleration is assumed to be a basic quantity in physics.
2. The second as a standard of time, is obtained from the speed of light.
3. For any material, higher the atomic mass, higher its density.
4. The dimensions of energy is ML^2T^{-2}.
5. 1 hecto meter equals to 100 meter.
6. A scalar quantity is completely described by a number and appropriate units plus a direction.
7. Force and torque are both vectors.
8. A body is said to be static if its linear and angular velocities are zero.
9. Smaller optical density for any medium means, smaller the refractive index of this medium
10. Total internal reflection occurs only when light attempts to pass from a less optically dense medium to a more optically dense medium with an angle greater than the critical angle.
11. The hypermetropia is treated with a diverging lens.
12. If the far point of a myopic eye is 100 cm, the power of the lens needed to enable the eye to see far objects distinctly is -1 diopter.
13. Density is defined as the mass per unit volume while the specific density of any material is defined as the ratio of its density to the density of water at 4°C.
14. For incompressible fluids, pressure increases with depth.
15. For incompressible ideal fluid, and according to the continuity equation, the velocity of the fluid is inversely proportional to the cross-sectional area of the pipe if the flow rate is kept constant.
16. If watering nozzle with a radius of 0.1 m and the water flow rate is 5×10^{-3} m^3/s, the speed of the water is 0.159 m/s.
17. Turbulent flow is characterized by the smooth flow of fluid layers that do not mix.
18. While monitoring the blood pressure, and when the cuff pressure just gets below the diastolic pressure the sounds in the stethoscope disappear, then the pressure that is noted on the manometer, is the diastolic pressure.
19. The relation between the Celsius and the Kelvin scales is given by $\boldsymbol{T}$ (°C) = $\boldsymbol{T}$ (K) - **273.15**.
20. One joule is the amount of energy it takes to increase the temperature of 1 g of water from 14.5°C to 15.5°C at 1 atmosphere of pressure.
21. Basal metabolic rate (BMR) is the highest energy rate consumed, and it is the amount of energy needed to perform the maximum body functions.

22. The hypothalamus controls the body temperature. If the body temperature is increased, it initiates the vasoconstriction to decrease the blood supply to the skin for more loss of heat and increases the sweating and breathing rates.
23. Cryotherapy increases circulation, bringing more blood to the area, this provides more oxygen and nutrients, giving muscles more energy.
24. Ice packs or cold compresses should not be placed where large blood vessels lie close to the skin surface.
25. Cryosurgery is a fast cooling process of the cells, causes the water inside cells to freeze and is used to kill cells, whereas the slow cooling as in cryopreservation is done by using cryoprotectants, which are chemicals that help to prevent the formation of ice crystals.

Second Question: Choose the most accurate answer (25 marks, 1 mark each)

26. In the MKS system of units, mass is measured in …
    a) Meter
    b) Kg
    c) Second
    d) Pound
27. Becquerel is the unit used in the measurement of …
    a) Luminous intensity
    b) Amount of substance
    c) Solid angle
    d) Radioactivity
28. Mass of any atom can be obtained from …
    a) The atomic mass/Avogardo's number
    b) Avogardo's number/ the atomic mass
    c) Avorgadro's number × the atomic mass
    d) Avogadro's number × the atomic mass × density
29. The SI unit of the torque is …
    a) J.m
    b) N.m
    c) J/m
    d) Degree/sec
30. The direction of the torque is given by …
    a) The left-hand rule.
    b) The right-hand rule.
    c) The left-foot rule.
    d) The right-foot rule.
31. What happens to a rigid body in static equilibrium that experiences a small displacement angle, i.e., small rotation (its center of mass is above its original base) from its original position?
    a) Nothing happens because no forces or torques are acting on it.
    b) It returns to its original position due to restoring forces that bring it back into balance.

c) It oscillates about its new position until it comes back to rest at that position again.
d) It moves farther away from its original position and continues moving indefinitely.

32. The height of a person whose center of gravity is at 95 cm, measured from the soles of his feet is around …
a) 56 cm
b) 150 cm
c) 170 cm
d) 200 cm

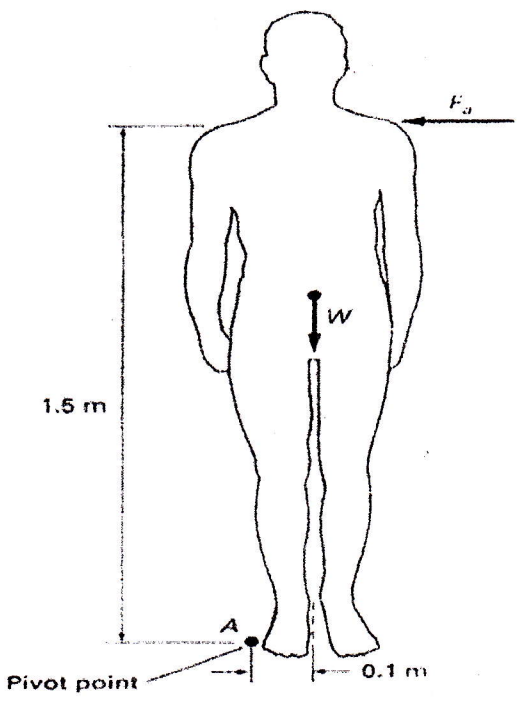
33. Carrying a back bag, …
a) lowers the center of gravity
b) increases the stability
c) makes the body tends to bend forward
d) makes the body tends to bend backward

34. The applied force is located between the load and the fulcrum in …
a) Class 1 lever
b) Class 2 lever
c) Class 3 lever
d) Class 4 lever

35. If the elbow contraction is assumed to be a lever, its mechanical advantage M is …
a) -1
b) Less than 1
c) 1
d) Larger than 1

36. In the right figure, the restoring torque T_w, due to the person's weight, against toppling, is … **N.m** if the mass of this person shown in the figure is 100 kg (assume the gravity g=10 m/s^2)
a) 1500
b) 495
c) 100
d) 68.6

37. In the right figure, Spreading the legs makes the base of support wider which …
a) makes the center of gravity moves right
b) makes the center of gravity moves left
c) increases the stability against a toppling force
d) decreases the stability against a toppling force



38. In the previous figure, if the applied force F_a, needed to make this person on the verge of toppling, is 80 N and the gravity g=10 m/s^2, then this person's mass is …
   a) 70 kg
   b) 75 kg
   c) 100 kg
   d) 120 kg

39. Which of the following is **not** from the general properties of light?
   a) It obeys the conservation of energy laws
   b) It is an electromagnetic radiation
   c) It can be interfered, diffracted, and polarized
   d) It needs a medium to travel through.

40. If the light velocities in the 1st medium and the 2nd medium are v_1 and v_2, respectively, then the ratio of the sine of the incident angle in the 1st medium to the sine of the refracted angle in the 2nd medium equals …
   a) $v_1 v_2$
   b) $\frac{1}{v_1 v_2}$
   c) $\frac{v_2}{v_1}$
   d) $\frac{v_1}{v_2}$

41. Light passes from a material with an index of refraction of 1.3 into one with an index of refraction of 1.5. Compared to the incident ray, the refracted ray….
   a) bends away from the normal
   b) bends toward the normal
   c) is un-deflected.
   d) (not enough information to know)

42. The critical angle for the glass-air boundary is … (n_{glass}=1.49, n_{air}=1)
   a) 24.4°
   b) 42.2°
   c) 73.6°
   d) 0.73°

43. A converging lens of focal length 10 cm forms real images of objects placed at … from the lens.
   a) 5 cm
   b) 7.5 cm
   c) 10 cm
   d) 15 cm

44. An object 50 cm high is placed 1 m in front of a converging lens whose focal length is 1.5 m. The image height is … cm.
   a) 150
   b) 77
   c) 52
   d) 17

45. What is the difference between the pressure at the bottom of a pool with a depth of 2.5 m and the atmospheric pressure (water density is $\rho_{water} = 1000$ kg/m^3, the acceleration of gravity is $g = 10$ m/s^2)?
    a) 4000 Pa
    b) 25000 Pa
    c) 40000 Pa
    d) 50000 Pa
46. The term that represents the potential energy of the fluid in Bernoulli's equation is
    a) ρgh
    b) $\frac{1}{2}\rho v^2$
    c) P
    d) A
47. Pressure applied to an enclosed fluid is transmitted undiminished to every portion of the fluid and the walls of the containing vessel, this is known as …
    a) Bernoulli's principle
    b) Flow rate
    c) Pascal's law
    d) Archimedes' principle
48. If the measured blood pressure is 70/40 mmHg, the patient is advised to …
    a) Take a hot water bath
    b) Drink less water
    c) Lay down flat with raised legs
    d) Stand straight
49. If the resistances of a platinum resistance thermometer at lower and upper fixed points (0 °C–100 °C) are R_0=3.50 Ω and R_{100}=3.65 Ω, respectively, the resistance of platinum wire at 60°C is … Ω
    a) 3.55
    b) 3.59
    c) 3.41
    d) 3.09
50. The heat stroke temperature (41°C) on the Fahrenheit scale is around …
    a) 314
    b) 106
    c) 73
    d) 58

End of questions
With my Best Wishes

Assiut University	*Radiation Physics*	*Level: III* المستوى: الثالث
Faculty of science	*P 344*	*8/6/2024*
Physics department	*2023–2024*	*Time: 3 hours*

Question No.1: (8 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 universe
2. The stars are not eternal because its transformations from energy to mass
3. The method of vision according to the latest theories are vibrations and translations
4. A mass of one kilogram contains energy equivalent to C^2
5. Energy has no priority over mass nor mass over energy
6. A nucleon is: $p + e$
7. Radioactive decay leads to: *instability*
8. Radiation can be defined as the emission of: *excess mass or excess energy*
9. Gamma radiation originates in the *electronic shells*
10. The isotope has the same number of: *protons*
11. Alpha decay occurs when the atom ejects: *2 neutrons & 2 electrons*
12. Gamma decay affects the mass of the atom
13. Gamma rays are produced by the combination of: $e^+ + e^-$
14. Most of the background radiation comes from: *Radon gas*
15. The conventional unit of the "radiation absorbed dose" is: *Joule*
16. Exposure doses to terrestrial radiation vary depending on: *location& geology*

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

Question No.2: (18 degrees)

Write in the attached table the symbol indicating the correct answer/s:

1. Physics is the science which study... *A) Material* *B) radiation* *C) all the above*
2. The human used the universe without suffering thanks to:
   A) His understanding of the universe *B) Harness the Creator of the Universe* *C) All the above*
3. Heat transfer in the universe is done from
   A) Hot to cold *B) Cold to hot* *C) All of the above*
4. Different colors are: *A) photons* *B) particles* *C) vibrations*
5. Spectra emitted from some materials gives us an idea about:
   A) Light components *B) material structure* *C) Nature of light*
6. Atoms are stable, when: *A)* $p \cong n$ *B)* $p = e$ *C)* $p > n$
7. ..... are examples of particulate radiation *A) Alpha* *B) Beta* *C) Gamma*
8. The isotope has the same number of: *A) protons* *B) neutrons*
   but a different number of: *A) protons* *B) neutrons*
9. Gamma radiation originates in the *A) electronic shells* *B) nucleus*
   While x- ray comes from *A) electronic shells* *B) nucleus*
10. Beta decay occurs when ..... is emitted from the nucleus.
    A) neutron *B) proton* *C) electron*
11. X-rays are a form of radiation similar to: *A)* α *radiation* *B)* β *radiation* *C)* Υ *radiation*
12. X- rays are produced mainly by: *A) natural sources* *B) artificial*
13. The major sources of public exposure to natural radiation is:
    A) cosmic radiation *B) inhalation* *C) ingestion*
14. Exposure to natural radiation can occur from indoors (in building materials)
    as a result of the presence of ..... Traces
    A) Uranium *B) Thorium* *C) Germanium*
15. Exposure through inhalation comes from:
    A) Uranium + thorium *B) Radon+ Thoron* *C) Ne + C*
16. Energy "deposited" in a Kg. of substance by the radiation:
    A) Absorbed dose *B) equivalent dose* *C) effective dose*
17. equivalent dose weighted for susceptibility to harm of different tissues:
    A) Absorbed dose *B) equivalent dose* *C) effective dose*
18. The conventional unit of the radiation absorbed dose is:
    A) joule *B) rad* *C) gray*

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

Question No.3: (14 deg.)

Choose and discuss the correct answer- (Or answers):

1. Radiation is one of the elements of: *(A) light* *(B) material* *(C) energy*

.....

.....

2. Nonionizing radiation can be considered as: *(A) particles* *(B) waves* *(C) energy*

.....

.....

3. Ionizing radiation can be considered as: *(A) particles* *(B) waves* *(C) energy*

.....

.....

4. Electrons move around the nucleus according to: *(A) Newton's laws* *(B) Einstein's laws*

.....

.....

.....

5. Radioactive decay leads to: *(A) instability* *(B) stability*

.....

.....

6. Radiation can be defined as the emission of : *(A) excess mass* *(B) excess energy*

.....

7. The radioactive decay occurs when the atom ejects:

(A) electrons *(B) protons* *(C) neutrons*

.....

8. Beta decay occurs when ..... Is emitted from the nucleus :

(A) an electron *(B) proton* *(C) neutron*

.....

.....

9. Gamma radiation can be considered as:.

(A)an energy *(B)waves* *(C)particles*

.....

.....

10. Half-life is the time it takes for a radioisotope to decay to half of its starting

(A) mass *(B) activity* *(C) volume*

.....

.....

11- The deep penetrating type of radiation is:

*(A)*α *(B)*β *(C)*γ ..... **Because of its:**

(A) Mass *(B) charge* *(C) velocity*

.....

.....

.....

12. **1 (G_y) of $\alpha\ rad.$ ..... Harmful to tissue than 1 (G_y) of $\beta\ rad$:**

(A) more *(B) less* *(C) less or equal*

.....

.....

.....

13. Regions at higher altitudes receive ..... cosmic radiation:

(A) more *(B) less* *(C) less or equal*

.....

.....

14. DNA contains information and predictions about genetic:

(A) disease *(B) mutation* *(C) disorders*

.....

.....

.....

.....

.....

Question No.4: (10 deg.)

A) Find & correct the mistake in the following sentences

1. Matter and energy interact to give natural phenomena

……

2. The human used his mind, so he was able to harness and adapt the universe

……

……

3. The progress in using behaviors &understanding is enormous

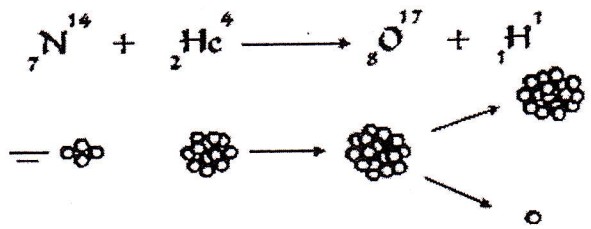
……

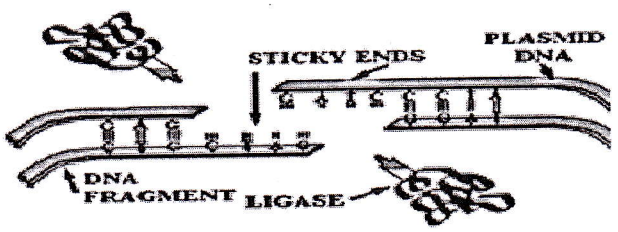
……

4. The absolute beginning of the universe is an energy ……

……

B). Comment shortly on the following images





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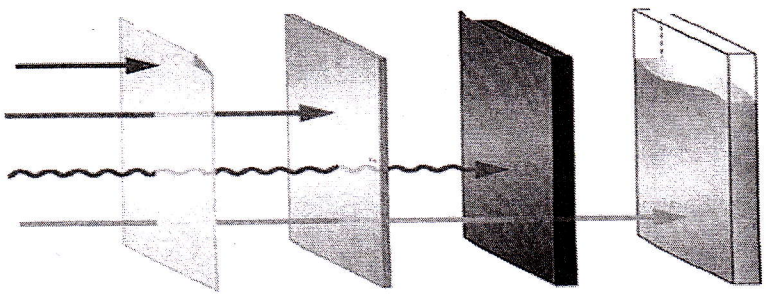
C). Suggest a title for the following

$H1_1 + H_1^1 \longrightarrow H_1^2(D) + e_{+1}^0 + \nu + energy$ ……

$H_1^1 + H_1^2 \longrightarrow He_2^3 + energy$ ……

$He_2^3 + He_2^3 \longrightarrow He_2^4 + H_1^1 + H_1^1 + h.energy$ ……



……

……

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Best wishes ___ إنتهت الاسئلة مع التمنيات بالتوفيق

حسام وحيد

Assiut University
Faculty of Science
Department of Physics
Second Semester 2023-2024
Date: 23/05/2024

Physics Program (Level 3)
Course: Plasma Physics
Code: P332
Final Exam (50 points)
Time: 3 hours

The final exam is in 3 pages (50 points)

First question: Choose the correct answer (20 points: 1 point each)

1) The definition "charged particles interact simultaneously with many other charged particles" is present			
A. Plasma	B. Quasineutral gas	C. Collective behavior	D. Saha equation
2) The Temperature of 2 eV plasma is ... K			
A. 5800	B. 11600	C. 23200	D. 4.6×10^4
3) For ordinary air at room temperature and $U_i = 14.5\ eV$, The fractional ionization (n_i/n_e) predicted by Saha equation is ...			
A. 10^{22}	B. 10^{-22}	C. 10^{-122}	D. 10^{122}
4) "The radius of circular motion of charged particle in presence of uniform magnetic field.", is the definition of ...			
A. Debye shield	B. Larmor radius	C. Cyclotron	D. circular motion
5) In presence of B and absence of E fields, plasma particles tend to ... the magnetic field, and plasmas are			
A. reduce-diamagnetic	B. reduce-paramagnetic	C. enlarge-diamagnetic	D. enlarge-paramagnetic
6) The magnitude of gravitational velocity is usually negligible but when the lines of force are curved, there is an effective gravitational force due to ...			
A. Debye shield	B. Larmor radius	C. centrifugal force	D. circular motion
7) Compute r_L for solar wind proton with streaming velocity 300 km/s, $B = 5 \times 10^{-9}\ T$, while $v_{\|}$ is negligible.			
A. $1.3 \times 10^7\ m$	B. $2.19 \times 10^5\ m$	C. $5.9 \times 10^7\ m$	D. $6.26 \times 10^5 m$
8) In the gravitational field, the net current density in the plasma given by ...			
A. $n(M+m)\frac{g \times B}{B^2}$	B. $(\rho_e + \rho_i)v_g$	C. Both A&B	D. None of mentioned
9) An ion engine has a 3T magnetic field, a hydrogen plasma is to be shot out at an E ⊥ B velocity of 3600 km/s. What internal electric field must be present in the plasma?			
A. $1.1 \times 10^4\ V/m$	B. $1.1 \times 10^7\ V/m$	C. $1.2 \times 10^6\ V/m$	D. $1.2 \times 10^3\ V/m$
10) A typical plasma density might be ... ion– electron pairs per m^3			
A. 10^{-38}	B. 10^{38}	C. 10^{-18}	D. 10^{18}
11) Perhaps 80 % of plasma phenomena observed can be explained by ...			
A. Debye model	B. crude model	C. waves model	D. None of mentioned
12) Equation of ... means that the incoming fluid equals the outcoming fluid.			
A. continuity	B. state	C. motion	D. Saha

13) Equation of motion including collisions can be generalized to include ..... pressure and neutral collisions.

A. stress	B. tensor	C. anisotropic	D. adiabatic

14) the ratio of specific heats C_p/C_V in 3 degrees of freedom has value ....

A. 5/3	B. 3/2	C. 5/2	D. 3/5

15) In a plasma with no neutrals and few collisions, an analogous phenomenon occurs. This is called an ... wave

A. electron	B. sound	C. ion acoustic	D. all mentioned

16) If the electrons in a plasma are displaced from a uniform background of ions, Because of their...., the electrons will oscillate around their equilibrium positions with a characteristic frequency known as the ...

A. Overshoot- phase frequency	B. Inertia- phase frequency	C. Overshoot-plasma frequency	D. Inertia- plasma frequency

17) The plasma density in the lower ionosphere has been measured during satellite reentry to be about 10^{14} at 85 km. What is the plasma frequency there?

A. 0.9 GHz	B. 0.09 GHz	C. 7.6 GHz	D. 0.76 GHz

18) Electron plasma waves are propagated in a uniform plasma with $KT_e = 100$ eV, $n = 10^{16}m^{-3}$, and $B = 0$. If the frequency f is 1.1 GHz, what is the wave number (cm^{-1})?

A. 550	B. 1628	C. 0.0114	D. 4×10^{-3}

19) When the distribution function is an isotropic Maxwellian, P is written as ...

A. $\begin{pmatrix} p_\perp & 0 & 0 \\ 0 & p_\perp & 0 \\ 0 & 0 & p_\parallel \end{pmatrix}$	B. $\begin{pmatrix} p_\perp & 0 & 0 \\ 0 & p_\parallel & 0 \\ 0 & 0 & p_\parallel \end{pmatrix}$	C. $\begin{pmatrix} p_\perp & 0 & 0 \\ 0 & p_\perp & 0 \\ 0 & 0 & p_\perp \end{pmatrix}$	D. $\begin{pmatrix} p_\parallel & 0 & 0 \\ 0 & p_\parallel & 0 \\ 0 & 0 & p_\parallel \end{pmatrix}$

20) Assume that there are no collisions and no thermal motions. Then all the particles in a fluid element move together, the average velocity of the particles in the element is as ..

A. Light velocity	B. group velocity	C. phase velocity	D. individual particle velocity

Second question: Put T for true and F for false statements (10 points: 1 point each)

1) On Earth plasmas do not occur naturally.

2) Charged particle gas have straight line orbits between collisions.

3) The components of velocity perpendicular to B and parallel to B may then belong to different Maxwellian distributions with temperatures $T_\perp$ and $T_\parallel$.

4) In presence of B and E fields, in the first half-cycle of the ion's orbit, it gains energy from the electric field and increases in $v\perp$

5) In the fluid equation, the tensor cannot be represented by a scalar p but must be given by shear stress P.

6) In equation of continuity, sink means that the incomed fluid is larger than the outcome.

7) The modulation information does not travel at the group velocity but at the phase velocity.

8) The electrostatic and pressure gradient forces on the electrons must be closely in balance. This condition leads to the Boltzmann relation.

9) Fluid equations of motion very difficult and complicated mostly because it is nonlinear.

10) The group velocity of a wave in a plasma often exceeds the velocity of light c.

Third question: Answer the following (20 points: 5 points for each)

1- **(a) Plasma could shield out electric potentials that are applied to it. Prove from the electron distribution function that Debye length has value [2.5p]:**

$$\lambda_D = \sqrt{\frac{\epsilon_\circ KT}{e^2 n}}$$

(b) In the TFTR (Tokamak Fusion Test Reactor) at Princeton, the plasma was heated by injection of $200keV$ neutral deuterium atoms, which, after entering the magnetic field, are converted to $200keV$ D ions $(A = 2)$ by charge exchange. These ions are confined only if $r_L \ll a$, where $a = 0.6\,m$ is the minor radius of the toroidal plasma. Compute the maximum Larmor radius in a 5 T field to see if this is satisfied [2.5p].

2- **Two waves E1 and E2 differ in frequency by $2\Delta\omega$ and differ wave number $2\Delta k$ in propagation constant. Each wave has the phase velocity ω/k appropriate to the medium in which they propagate. What is the amplitude of resultant wave and draw it? (plot the wave shape)**

3- **(a) From the Navier–Stokes equation of motion, find the expression for the velocity C_S of sound waves in a neutral gas [2.5p].**
(b) Find the frequency of plasma ion waves relation and plot the dispersion relation, in the plot show sound speed in plasma [2.5].

4- **Find the frequency of electron plasmas wave relation and plot the dispersion relation, in the plot show the plasma frequency, the group velocity, the phase velocity and the thermal velocity (one-dimensional problem).**

End of Questions
Good Luck
Dr. Hadeer El-Hawary

Electron charge (e)	$1.6 \times 10^{-19} C$	Boltzmann's constant (k_B)	$1.38 \times 10^{-23}\, JK^{-1}$
Electron mass (m_e)	$9.1 \times 10^{-31} kg$	Universal gas constant (R)	$8.314\, J/mol.K$
Avogadro's number	6.022×10^{23}	Proton mass (m_p)	$1.67 \times 10^{-27} kg$

Physics Department

Faculty of Science

Assiut University

Physics 312F – Electromagnetic Theory & Electrodynamics

THIS TEST HAS TWELVE PAGES

DURATION OF TEST: 3 HOURS

Examiner: Dr. Ahmed Mostafa Amry

Table of Physical Constants

Electron rest mass	m_e	9.109×10^{-31} kg
Proton rest mass	M_p	1.6726×10^{-27} kg
Electronic charge	e	1.6022×10^{-19} C
Speed of light in free space	c	2.9979×10^{8} m s^{-1}
Permeability of free space	μ_0	$4\pi \times 10^{-7}$ H m^{-1}
Permittivity of free space	ϵ_0	8.854×10^{-12} F m^{-1}
Planck's constant	h	6.626×10^{-34} J s
Reduced Planck's constant	$\hbar = h/2\pi$	1.0546×10^{-34} J s
	$\hbar c$	197.33 MeV fm
Boltzmann's constant	k_B	1.3807×10^{-23} J K^{-1}
Gas constant	$\mathcal{R} = k_B/m_H$	8.250×10^{3} J kg^{-1} K^{-1}
Molar gas constant	R	8.315 J mol^{-1} K^{-1}
Avogadro's number	N_A	6.022×10^{23} mol^{-1}
Standard molar volume		22.414×10^{-3} m^3 mol^{-1}
Unified atomic mass unit (^{12}C scale)	u	931.5 MeV/c^2 $= 1.660538 \times 10^{-27}$ kg
Mass of hydrogen atom	m_H	$1.0078u = 1.6735 \times 10^{-27}$ kg
Bohr magneton	μ_B	9.274×10^{-24} A m^2 or J T^{-1}
Nuclear magneton	μ_N	5.051×10^{-27} A m^2 or J T^{-1}
Proton magnetic moment	μ_p	$2.7928\mu_N$
Neutron magnetic moment	μ_n	$-1.9130\mu_N$
Bohr radius	a_0	5.292×10^{-11} m
Fine structure constant	$\alpha = e^2/(4\pi\epsilon_0\hbar c)$	$(137.04)^{-1}$
Compton wavelength of electron	$\lambda_C = h/(m_e c)$	2.4263×10^{-12} m
Rydberg's constant	R_∞	1.0974×10^{7} m^{-1}
	$R_\infty hc$	13.606 eV
Stefan-Boltzmann constant	σ	5.671×10^{-8} W m^{-2} K^{-4}
Radiation density constant	$a = 4\sigma/c$	7.561×10^{-16} J m^{-3} K^{-4}
Gravitational constant	G	6.673×10^{-11} N m^2 kg^{-2}

Answer ONLY 40 question from Part I.
Answer ALL questions in Part II&III.

Part I: Multiple Choice (*Circle the one best answer to each question*) (20Points).

1. Electric field intensity (E) at any point in an electric field is equal to

   a. $\bar{E} = -\nabla V$ b. $\bar{E} = -\nabla V^2$ c. $\bar{E} = -\nabla V^{1/2}$ d. $\bar{E} = -\nabla V^{1/3}$

2. If magnetic field in region is given by $\bar{B} = 4\bar{\imath} + 8\bar{k}$, then flux passing through a $5\ m^2$ area loop will be

   a. $20\bar{\imath} + 40\bar{k}\ Wb$ b. $20\ Wb$ c. $40\ Wb$ d. $30\ Wb$

3. Value of magnetic field that will cause a max force of $7 \times 10^{-3} N$ on a $20\ cm$ wire carrying current of $10\ A$ will be

   a. $3.5 \times 10^{-3}\ T$ b. $1.5 \times 10^{-3}\ T$ c. $4.5 \times 10^{-3}\ T$ d. $2.5 \times 10^{-3}\ T$

4. The Fundamental Theorem for Gradients is

   a. $\int_a^b (\bar{\nabla} f).d\bar{l} = f(a) - f(b)$ b. $-\int_a^b (\bar{\nabla} f).d\bar{l} = f(a) - f(b)$

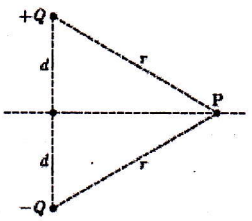
   c. $\int_a^b (\bar{\nabla} f).d\bar{l} = f(b)/f(a)$ d. $\int_a^b (\bar{\nabla} f).d\bar{l} = f(ab)$

5. Poisson's equation is

   a. $\nabla \cdot \bar{D} = \rho_v$ b. $\nabla^2 V = -\frac{\rho}{\varepsilon_o}$ c. $\nabla \cdot \bar{E} = \varepsilon_o \rho_v$ d. $\nabla^2 V = 0$

6. What is the value of total electric flux coming out of a closed surface?
   a. Zero.
   b. Equal to volume charge density.
   c. Equal to the total charge enclosed by the surface.
   d. Equal to the surface charge density.

7. Consider the right diagram. Which of the following statements is correct? The electric field *E* at a point P due to the presence of dipole as shown in the above diagram (considering distance r>> distance *d*) is proportional to



   a. $1/r$ b. $1/r^2$ c. $1/r^3$ d. $1/r^4$

8. Gauss's law in differential form is

   a. $\nabla \cdot \bar{D} = \rho_v$ b. $\nabla \cdot \bar{E} = \rho_v$ c. $\nabla \cdot \bar{E} = \varepsilon_o \rho_v$ d. $\nabla \cdot \bar{E} = \rho_v / \varepsilon_o$

9. For electrostatic fields in charge free atmosphere, which one of the following is correct?

   a. $\nabla \times \bar{E} = 0$ *and* $\nabla \cdot \bar{E} = 0$ b. $\nabla \times \bar{E} \neq 0$ *and* $\nabla \cdot \bar{E} = 0$

   c. $\nabla \times \bar{E} = 0$ *and* $\nabla \cdot \bar{E} \neq 0$ d. $\nabla \times \bar{E} \neq 0$ *and* $\nabla \cdot \bar{E} \neq 0$

10. In free space, if ρ = 0, the Poisson's equation becomes
    a. Maxwell's divergence equation $\nabla \cdot \overline{B} = 0$.
    b. Laplace's equation $\nabla^2 V = 0$.
    c. Kirchhoff's voltage equation $\Sigma V = 0$.
    d. None of the above.

11. What is the force on a unit charge moving with velocity $\bar{v}$ in presenceof electric field $\overline{E}$ and magnetic field $\overline{B}$?
    a. $\overline{E} - \bar{v} \cdot \overline{B}$
    b. $\overline{E} + \bar{v} \cdot \overline{B}$
    c. $\overline{E} + \bar{v} \times \overline{B}$
    d. $\overline{E} + \overline{B} \times \bar{v}$

12. Equation $\nabla \cdot \overline{B} = 0$ is based on
    a.Gauss's Law
    b. Lenz's Law
    c. Ampere's Law
    d. Continuity Equation.

13. Differential form of Gauss's law in magneto statics is _____
    a) $div\, \overline{B} = \rho/\varepsilon_o$
    b) $div\, \overline{B} = 0$
    c) $div\, \overline{B} = -dB/dT$
    d) $div\, \overline{B} = \mu J$

14. Which of the following laws do not form a Maxwell equation?
    a) Planck's law
    b) Gauss's Law
    c) Faraday's law
    d) Ampere's Law

15. Induced electric currents can be explained using which of the following laws?
    a) Gauss's Law
    b) Faraday's Law
    c) Ohm's Law
    d) Ampere's Law

16. Given that $f(x, y, z) = sin(xyz)$ what is del f ?
    a) $xz\ sin\ (xyz)\ \boldsymbol{i} + xz\ sin\ (xyz)\ \boldsymbol{j} + xz\ sin\ (xyz)\ \boldsymbol{k}$
    b) $xy\ cos\ (xyz)\ \boldsymbol{i} + yz\ cos\ (xyz)\ \boldsymbol{j} + xz\ cos\ (xyz)\ \boldsymbol{k}$
    c) $yz\ cos\ (xyz)\ \boldsymbol{i} + xz\ cos\ (xyz)\ \boldsymbol{j} + xy\ cos\ (xyz)\ \boldsymbol{k}$
    d) $yz\ cos\ (xyz)\ \boldsymbol{i} + xz\ sin\ (xyz)\ \boldsymbol{j} + xz\ cos\ (xyz)\ \boldsymbol{k}$

17. Given that $f(x, y, z) = xyz + xy + z$ what is del f ?
    a) $(yz + y)\ \boldsymbol{i} + (xy + 1)\ \boldsymbol{j} + (xz + y)\ \boldsymbol{k}$
    b) $(yz + y)\ \boldsymbol{i} + (xz + 1)\ \boldsymbol{j} + (xy + z)\boldsymbol{k}$
    c) $(xy + z)\ \boldsymbol{i} + xyz\ \boldsymbol{j} + xy\ \boldsymbol{k}$
    d) $(yz + y)\ \boldsymbol{i} + (xz + x)\ \boldsymbol{j} + (xy + 1)\boldsymbol{k}$

18. What is the divergence of the vector field $\mathbf{F}$ where $\mathbf{F} = x\ \boldsymbol{i} + y\ \boldsymbol{j} + z\ \boldsymbol{k}$?
    a) x
    b) y
    c) z
    d) 3

19. The electric field intensity at a point situated 4 meters from a point charge is 200 N/C. If the distance is reduced to 2 meters, the field intensity will be
    a) 400 N/C
    b) 600 N/C
    c) 800 N/C
    d) 1200 N/C

20. The electric field at a point situated at a distance d from straight charged conductor is

a) proportional to d
b) inversely proportional to d
c) inversely proportional to d^2
d) none of the above

21. "The total electric flux through any closed surface surrounding charges is equal to the amount of the charge enclosed". The above statement is associated with

a) Coulomb's square law
b) Gauss's law
c) Maxwell's first law
d) Maxwell's second law

22. The four underlying equations in electromagnetic theory are called:

a) Einstein's Equations
b) Maxwell's Equations
c) Newton's Equations
d) Faraday's Law

23. Gauss' law of electricity, Gauss' law of magnetism, Faraday's law of induction, and Amperes' law form the basic equations of electromagnetism. This combination is collectively known as:

a) Coulomb's equations
b) Maxwell's equations
c) Fermi's equations
d) Fermi's equations

24. The electric field associated with an electromagnetic wave in vacuum is given by $\mathbf{E} = 40 \cos(kz - 6\times10^8 t)\, \boldsymbol{i}$, where $\mathbf{E}$, z and t are in volt/m, meter and seconds respectively. The value of wave vector K is

a) $2\ m^{-1}$
b) $0.5\ m^{-1}$
c) $6\ m^{-1}$
d) $3\ m^{-1}$

25. What is the divergence of a vector field $\mathbf{F}$ where $\mathbf{F} = \sin x\, \boldsymbol{i} + \sin y\, \boldsymbol{j} + \sin z\, \boldsymbol{k}$?

a) $\cos x + \cos y + \cos z$
b) $\sin x + \sin y + \sin z$
c) $\cos x + \sin y + \sin z$
d) $\sin x + \cos y + \cos z$

26. What is the curl of the vector field $\mathbf{F}$ where $\mathbf{F} = x\mathbf{i} + yz\mathbf{j}$?

a) $-x\mathbf{i}$
b) $-y\mathbf{i}$
c) $-x\mathbf{j}$
d) $-y\mathbf{j}$

27. Curl is defined as the angular velocity at every point of the vector field. State True/False.

a) True
b) False

28. Which of the following theorem use the curl operation?

a) Green's theorem
b) Gauss Divergence theorem
c) Stoke's theorem
d) Maxwell equation

29. Find the curl of $\bar{A} = (y \cos ax)\boldsymbol{i} + (y + ex)\boldsymbol{k}$

a) $2\boldsymbol{i} - ex\boldsymbol{j} - \cos ax\,\boldsymbol{k}$ b) $\boldsymbol{i} - ex\boldsymbol{j} - \cos ax\,\boldsymbol{k}$

c) $2\boldsymbol{i} - ex\boldsymbol{j} + \cos ax\,\boldsymbol{k}$ d) $\boldsymbol{i} - ex\boldsymbol{j} + \cos ax\,\boldsymbol{k}$

30. The curl of a curl of a vector gives a

a) Scalar b) Vector

c) Zero value d) Non zero value

31. Given the potential $V = 25 \sin \vartheta$, in free space, determine whether V satisfies Laplace's equation

a) Yes b) No

c) Data sufficient d) Potential is not defined

32. Find the Laplace equation value of the following potential field: $V = x^2 - y^2 + z^2$

a) 0 b) 2 c) 4 d) 6

33. Find the electric field intensity of two charges 2C and -1C separated by a distance 1m in air.

a) 18×10^9 N/C b) 9×10^9 N/C c) 36×10^9 N/C d) -18×10^9 N/C

34. The electric field intensity of two charges 2C and -1C separated by a distance 1m in air.

a) 18×10^9 N/C b) 9×10^9 N/C

c) 36×10^9 N/C d) -18×10^9 N/C

35. The Stoke's theorem uses which of the following operation?

a) 0 b) 2 c) 4 d) 6

36. The Laplace equation value of the following potential $V = x^2 - y^2 + z^2$

a) 0 b) 2 c) 4 d) 6

37. The electric field intensity is defined as

a) Force per unit charge b) Force on a test charge

c) Force per unit charge on a test charge d) Product of force and charge

38. The force on a charge 2C in a field 1V/m

a) 0 N b) 1 N c) 2 N d) 3 N

39. Find the Gauss value for a position vector in Cartesian system from the origin to one unit in three dimensions

a) 0 b) 3 c) -3 d) 1

40. The divergence theorem value for the function given by $(e^z, \sin x, y^2)$

a) 1 b) 0 c) -1 d) 2

41. A point charge 2nC is located at origin. What is the potential at (1,0,0)?

a) 12 b) 14 c) 16 d) 18

42. A point charge 0.4nC is located at (2, 3, 3). Find the potential differences between (2, 3, 3)m and (-2, 3, 3)m due to the charge

a) 2.5 b) 2.6 c) 2.7 d) 2.8

43. In a magnetic field of 2.50×10^{-3} T, if magnetic force is equal to proton's weight, then the proton moves with the speed of

a) $9.4 \times 10^{-2} m$ b) $9 \times 10^{-2} m$ c) $5.4 \times 10^{-2} m$ d) $1.4 \times 10^{-2} m$

Part (II): <u>True or False questions</u> **(5 Points)**

STATMENT	TRUE	FALSE
1. The electric field E of a single point charge q at a distance r is: $\frac{1}{4\pi\varepsilon_o}\frac{q}{r^2}$		
2. The number of electric field lines crossing a closed surface is proportional to the charge enclosed.		
3. Maxwell's equations yield two separate equations for the electric and magnetic fields E and B. How fast are the E waves moving in comparison to the B waves?		
4. Current density is defined as: Electric charge over time per area.		
5. Electromagnets attract objects like pins and needles like a real magnet.		
6. The magnetic field lines, resulting from moving charges are always closed, inde-pendent of the trajectories of the charges.		
7. The acceleration of electrons is more effective using an electric field in comparison to using a magnetic field.		
8. The net magnetic flux of a static magnetic field through a closed surface depends on the net current on that surface.		
9. The principle of superposition states that the interaction between any two charges is completely unaffected by the presence of others.		
10. The flux of E through a surface S is : $\Phi_E \equiv \int_S \mathbf{E} \cdot d\mathbf{a}$,		

Part III: Work Problems **(25 Points)**

Show all your work and explain each major step to receive full credit.

1) Consider a one-dimensional world with two point conductors located at $x = 0$ m and at $x = 10$ m. The conductor at $x = 0$ m is grounded ($V = 0$ V) and the conductor at $x = 10$ m is kept at a constant potential of 200 V. Determine V.

Solution

2) Check that the fields:

$$\bar{E}(\bar{r},t) = E_o\, exp(-kz)\, cos(kx-\omega t)\bar{j}$$

$$\bar{B}(\bar{r},t) = \frac{E_o}{\omega} exp(-kz)\,[k\, sin(kx-\omega t)\bar{\imath} + k\, cos(kx-\omega t)\bar{j}\,]$$

satisfy all of Maxwell's equations.

Solution

3) For an electric field $E = E_o \sin(\omega t)$, what is the phase difference between the conduction current and the displacement current ?

Solution

4) Starting with Maxwell's equations in vacuum (no materials, no currents, no charges) derive the wave equation for the $\mathbf{H}$ field.

Solution

5) The vector $\mathbf{A} = 3x\boldsymbol{i} + y\boldsymbol{j} + 2z\boldsymbol{k}$, and $f = x^2 + y^2 + z^2$.

i) Show that $\nabla \bullet (f\mathbf{A})$ at the point (2,2,2) is 120, by first calculating $f\mathbf{A}$ and then calculating its divergence.

ii) Calculate $\nabla \times (f\mathbf{A})$.

Solution

END OF EXAM

Assiut University
Faculty of Engineering
Dep. of Electrical Eng.
Final Year Exam
2024

Faculty of Science
Department of Physics and Electronics
Course: Power Electronics – 3rd year
Time allowed 3 hours
Total Marks: 50 points

Important remarks
- ***This exam measures ILOS no.: a.1 & b.1 & b.3 & c.1 & d.4***
- ***No. of pages: 8 - No. of question: 6***

Answer the following questions

Question (1) True or False (6 points)

1) Currently, B_2/B_6 diode rectifiers are the most commonly used rectifiers in industry. ( )
2) In order to get a smooth current from rectifier circuits, a large capacitor should be connected in parallel with the resistive load. ( )
3) In diode rectifiers, it is possible to control the value of the output DC voltage by adjusting the firing angle. ( )
4) In switching power supply circuits, the efficiency is higher than that of linear power supplies. ( )
5) In the boost DC-DC power converter, the output voltage is lower than the input voltage. ( )
6) The Ćuk DC-DC converter is preferred than the buck-boost one. ( )

Question (2) Cross the correct answers (one or more selections are possible). (7 points)

1) For diode rectifiers, a one-way circuit
[ ] A. needs less switching components than a two-way circuit.
[ ] B. needs a more complex transformer than a two-way circuit.
[ ] C. has higher energy efficiency than a two-way circuit.
[ ] D. generates less electromagnetic interferences than a two-way circuit.

2) Compared with a B_2 rectifier circuit using diodes, an M_2 rectifier circuit under the same condition will output (ignoring the diode voltage drop)
[ ] A. more stable voltage.
[ ] B. the same voltage.
[ ] C. a higher voltage.
[ ] D. a lower voltage.

3) In B_2 thyristor rectifier circuit, in order to get the same output voltage like B_2 diode rectifier, the firing angle should adjust to

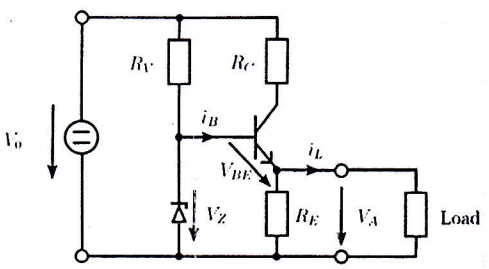
[ ] A. 30 degree.
[ ] B. 60 degree.
[ ] C. 90 degree.
[ ] D. zero degree.

4) Compared to linear power supplies, switching power supplies usually have the following characteristics:

[ ] A. Higher efficiency.
[ ] B. Lower efficiency.
[ ] C. Lower ripple.
[ ] D. Higher ripple.

5) In a linear power supply as shown in the following figure, the keys to keep the output voltage, V_A, stable are that

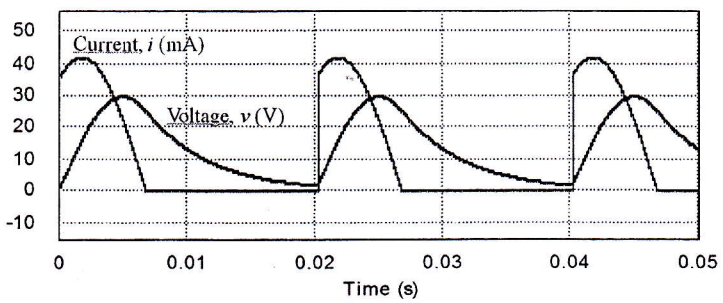
[ ] A. the input voltage V_0 is stable.
[ ] B. the zener diode V_z provides a stable voltage.
[ ] C. the transistor operates in amplifying region.
[ ] D. the switching frequency is very high.



6) A buck converter can

[ ] A. convert a DC voltage to a lower DC voltage.
[ ] B. generate a higher voltage than the input voltage.
[ ] C. generate a sinusoidal voltage without DC component.
[ ] D. operate without switching components.

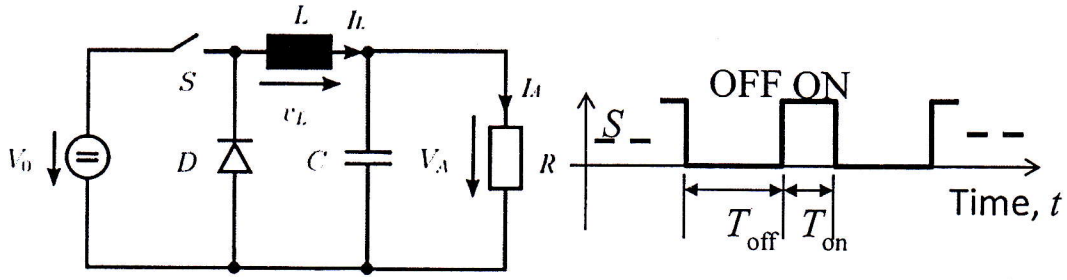
7) The following current and voltage curves are measured at the load of a rectifier circuit. The following conclusions are true:



[ ] A. This is an M1 circuit.
[ ] B. This is a B2 circuit.
[ ] C. The load is capacitive (RC load).
[ ] D. The load is inductive (RL load).

Question (3) (8 points)

a) A buck converter is shown in the following figure with $V_0 = 150$ V, L = 100 mH, C = 200 uF, and R = 20 Ω. The switching sequence is given on the right side of the circuit with $T_{on} = 1$ ms and $T_{off} = 2$ ms. The system already operates in stable state.

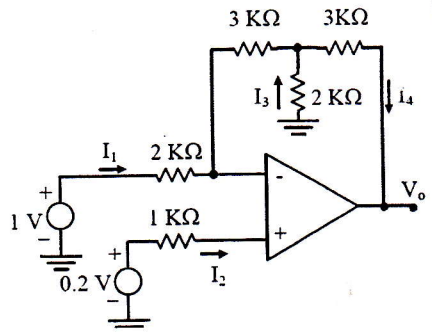


1- Calculate the average output voltage V_A.

2- Calculate the average inductor current I_L.

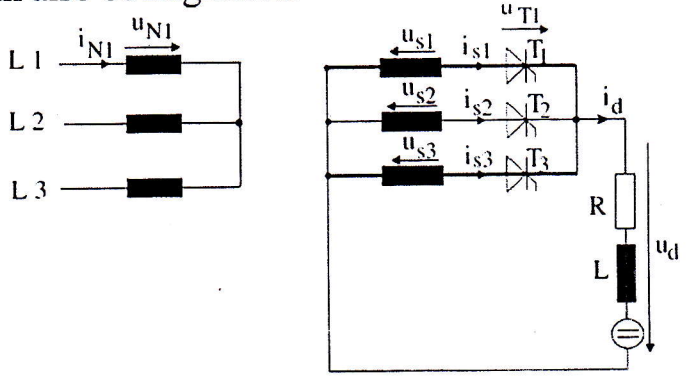
3- Calculate the maximum and minimum values of the inductor current I_L. Suppose the change of the inductor current is approximately linear.

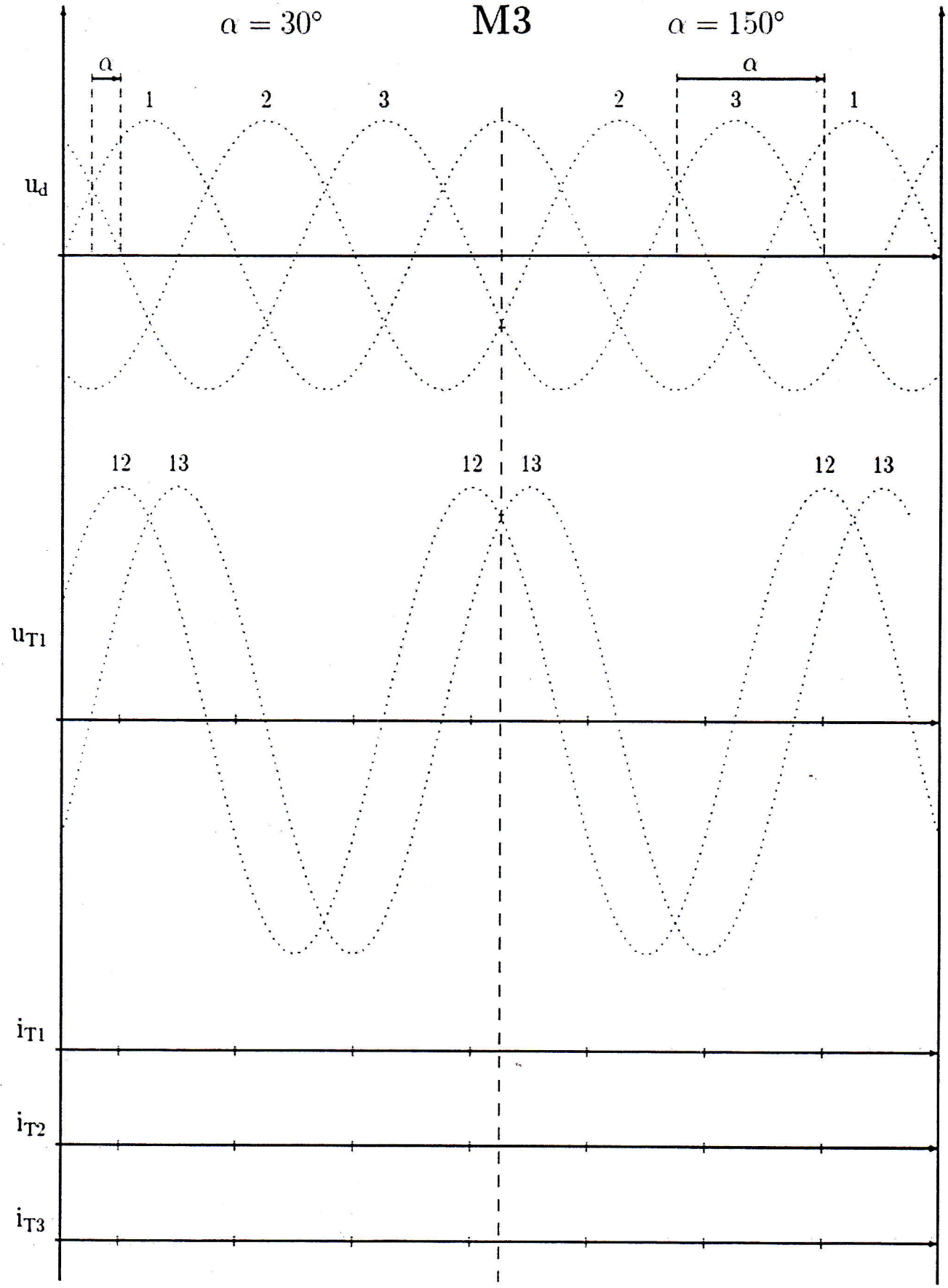
b) The op-amp in the circuit is ideal.
Calculate I_1, I_2, I_3, I_4, and V_o.



Question (4) (10 points)

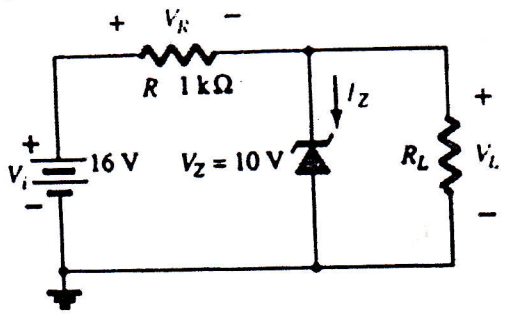
For M_3 circuit with Thyristors, draw the load voltage trajectory $u_d(t)$, the voltage drop $u_{T1}(t)$ across thyristor 1 and the semicondutor current trajectories $i_{Ti}(t)$ for $\alpha = 30°$ and $\alpha = 150°$. In this case the load current $i_d(t)$ can be assumed to be constant, i. e. $i_d(t) = I_d = \text{const.}$ Commutation losses can also be neglected.




α = 30°
M3
α = 150°
α
α
1
2
3
2
3
1
u_d
12
13
12
13
12
13
u_{T1}
i_{T1}
i_{T2}
i_{T3}

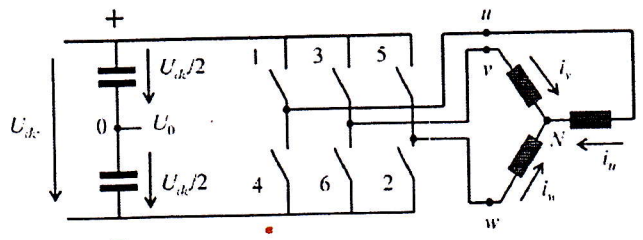
Question (5) (11 points)

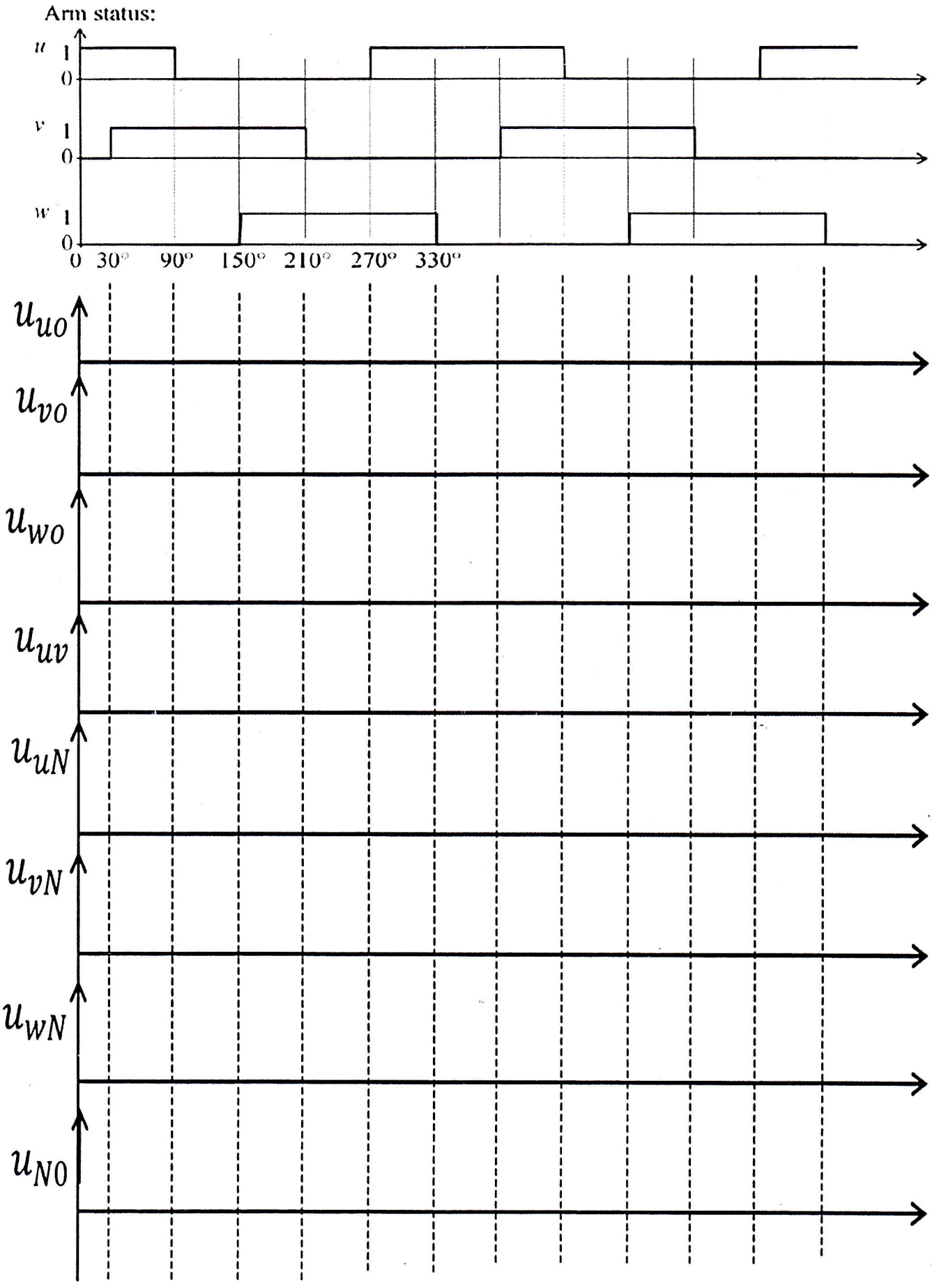
a) For the Zener diode regulator, for R_L=3 kΩ determine V_L , V_R , I_R, I_L, I_Z and P_Z



b) An inverter with a three-phase symmetric load is shown below. The switching status of the three inverter arms based on time are also illustrated below. Please calculate the voltage values in different switching status and draw the curves of the following voltages:

1. u_{u0} (between winding u input point and DC middle point 0)
2. u_{v0} (between winding v input point and DC middle point 0)
3. u_{w0} (between winding w input point and DC middle point 0)
4. u_{uv} (between winding input points u and v, line voltage)
5. u_{uN} (between winding u input point and neutral point, phase voltage of winding u)
6. u_{vN} (between winding v input point and neutral point, phase voltage of winding v)
7. u_{wN} (between winding w input point and neutral point, phase voltage of winding w)
8. u_{N0} (between neutral point N and DC middle point 0)

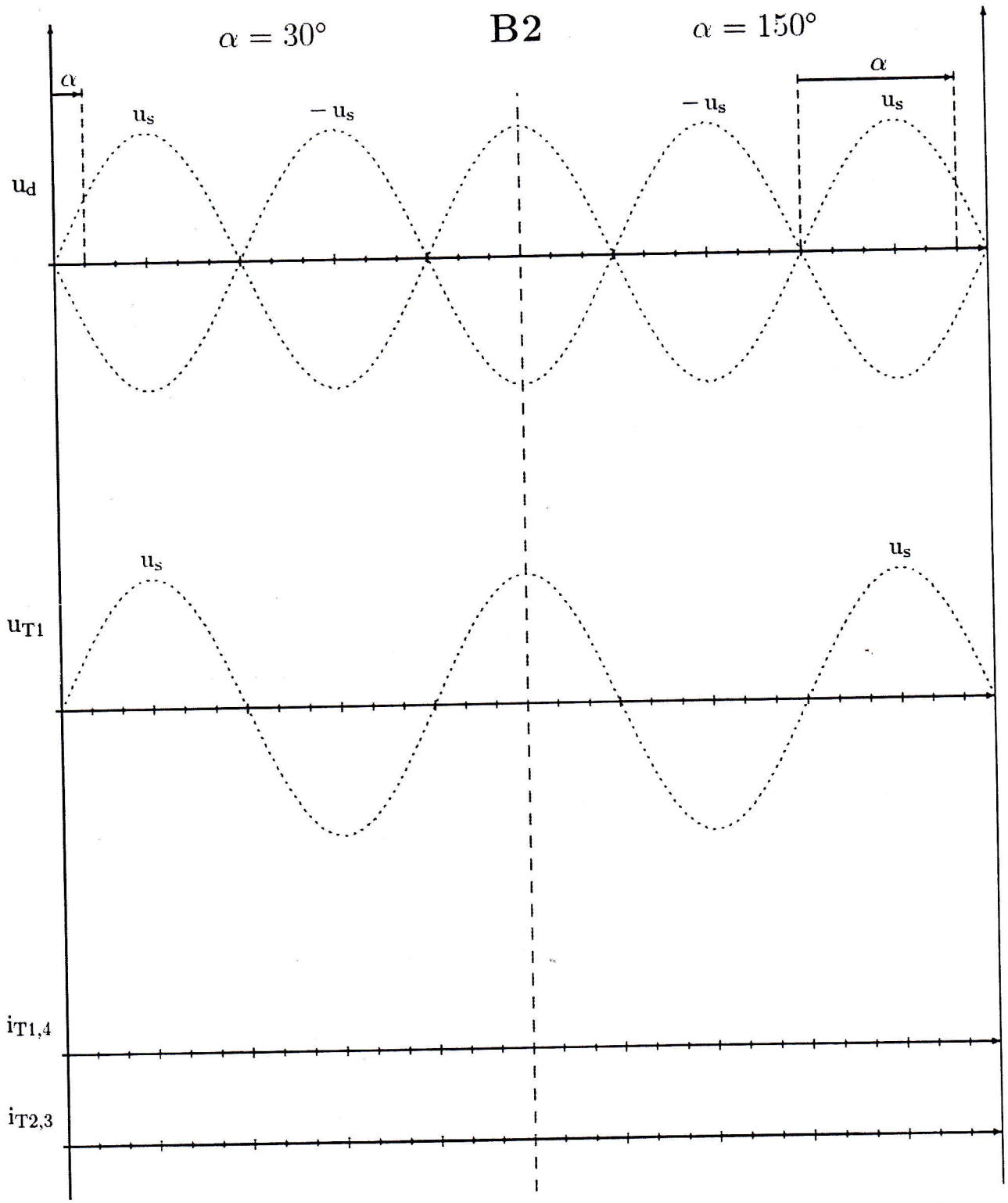



Arm status:
u
v
w
1
0
0 30° 90° 150° 210° 270° 330°
u_{uo}
u_{vo}
u_{wo}
u_{uv}
u_{uN}
u_{vN}
u_{wN}
u_{N0}

Question (6)

(8 points)

For B_2 circuit with Thyristors, draw the load voltage trajectory $u_d(t)$, the voltage drop $u_{T1}(t)$ across thyristor 1 and the semicondutor current trajectories $i_{Ti}(t)$ for $\alpha = 30°$ and $\alpha = 150°$. In this case the load current $i_d(t)$ can be assumed to be constant, i. e. $i_d(t) = I_d$ = const. Commutation losses can also be neglected.



With my best wishes

Dr. Mohamed Abdelsater Swify