Assiut University
Faculty of Science
Physics Department

The Final & the Term Activities Exams.
for the Introduction To Physics of
Metals& Alloys and Ceramics .P.256
For the students of 2nd level Ph&Ph/chem
and Ph/elect.

Allowable time:3 hours
Date: 2/7/2021
Total marks: 100 degree

The exam consists of two parts (100 marks)

Part I: The Final Exam: (50 Marks)

Q.1:

Put (T) or (F) in front of each sentences from the following:

1- For Bravies lattices all lattice points are equivalent and all atoms in the crystal lattice are of the same type ( )

2 - The unit cell volume for all crystalline systems have the same value. ( )

3- The *coordination number of any crystalline system unit cell is* the *number of nearest neighbor or touching atoms* ( )

4-The number of atoms per unit cell for the Body -centered cubic unit cell is Four. ( )

5-The relation between the atomic radius (R) and the unit cell edge length (a) for FCC unit cell is $a= 2\sqrt{2}\ R$ ( )

6-The Atomic Packing Factor (APF) for HCP structure is greater than that for FCC structure. ( )

7-For simple cubic structure unit cell (SC) the coordination number is 8. ( )

8-The theoretical density (ρ)for different materials have the same crystal structure must have different values. ( )

9-For cubic crystal structure, the following directions [100], [010],[001] are equivalent. ( )

10-For the cubic crystal structure, [100] direction is normal to (100) plane. ( )

11- If the projections of a certain vector in the cubic structure unit cell are a/2,

b. 0c in the x, y and z directions respectively, then the indices of this directionil is [210]. ( )

12- For all crystal structure systems the equivalent directions <100> are normal to the equivalent planes {100}. ( )

13-Generally for any crystal structure unit cell, the d-spacing between planes of the same Miller Indices (hkl) depends only on h, k, l values. ( )

14-The linear density (LD) of atoms in FCC structure unit cell for [100] direction is greater that for that [110] direction. ( )

15-The planer density (PD) of atoms in the (110) plane has the same value for both FCC and BCC unit cell structures. ( )

16-Amorphous solids are those materials in which the atoms are arranged in a highly ordered manner relative to each other. ( )

17-For the simple crystal structure (SC) unit cell, the Planer density (PD) for the six faces of the cube has deferent values. ( )

18-For the FCC crystal structure unit cell, the Planer density (PD) for the six faces of the cube has the same value. ( )

19-Single crystals are generally formed from a collection of many small crystals or grains with random crystallographic orientation. ( )

20-Polycrystalls materials with grains that are less than 100nm in diameter are called nano-crystals. ( )

21-The physical properties of many material have a single crystalline structure depends on the crystallographic direction in which the measurements are taken. ( )

22-Substances in which the measured physical properties are independent of the direction of measurement are called isotropic materials. ( )

23-X-ray diffraction can take place from crystalline solid when the wavelength of x-ray beam is in the order of the lattice constant of this material. ( )

24 -Frenkel defect is equivalent to missing atom leaves its original site and migrates to an interior surface. ( )

25-The equilibrium number of vacancies Nv for a given quantity of material depends on and increases with temperature. ( )

26-External surfaces and grain boundaries are 2-dimensional defects along which distinct crystallites are joined together. ( )

27- Cu and Ni have mutual complete solid solubility in each other. ( )

28-The screw dislocation may be though of as being formed by a shear stress that is applied to produce the distortion. ( )

29-High magnification and resolving power of Transmission Electron Microscopes are consequences of the short wavelengths of the electron beam. ( )

30-During vacancy diffusion process, the substitutional impurity atoms exchange with vacancies. ( )

31-The diffusion coefficient (D) for steady state diffusion decreases with temperature. ( )

32-During tensile test experiments, for a metallic wire, the stress-strain (σ-ε) relation obeys HooK,s low during plastic deformation. ( )

33-The strength of a metal is the property that enables a metal to resist deformation under load. ( )

34-Ductility is a measure of the degree of plastic deformation that has been sustained at fracture. ( )

35- The hardness number for any specific material depends only on the test method used. ( )

Q.2:

Choose the correct answer for these statements from a,b.c and d:

36-The physical properties of solids are mainly controlled by:

a)- Type of material only b)- Its atomic and electronic structure only

c)- Its crystal structure only d)-All the above

37- Ceramic materials are characterized by:

a)- More electric insulator than metals

b)- Less resistance to high temperature than metals.

C)-Less resistance to harsh environment than metals

d)-None of the above.

38-The coordination number of FCC crystal structure unit cell is:

a)- 6 b)-4 c)-2 d)-8

39-The cubic crystal unit cell has the highest symmetry because:

a)- $a \neq b \neq c, \alpha = \beta = \gamma = 90^{\circ}$ b)-$a=b=c$, $\alpha=\beta=\gamma=90^{0}$

c)-$a=b=c$, $\alpha \neq \beta \neq \gamma$ d)- None of the above

40-The theoretical density (ρ) of a certain crystalline metal depends on:
a)-Its Atomic weight (A) only b)-The volume of its unit cell(Vc) only.

c)- The number of atoms per unit cell (n) only d)- All of the above

41-The equivalent planes in cubic crystal structure has:

a)- The same area only b)- The same planner density only

c)-The same planner packing factor only d)- All of the above

42-The amorphous solids are characterized by :

a)-Long range order of atomic arrangement.

b)-isotropic physical properties.

c)- generally has a cubic crystal structure

d)- All of the above.

43-The atomic packing factor (APF) for BCC crystal structure unit cell is:

a)-0.52 b)- 1 c)- 0.68 d)-0.74

44-The point locates at the center of a cubic unit cell has the point coordination as :

a)- 111 b)-101 c)-1/2 1/2 1/2 d)- 000

45-The d-spacing between planes of the same Miller Indices (hkl) in cubic crystal structure changes with h,k,l values as

a)- h+k+l b)- 1/h+k+l c)- $h^2+k^2+l^2$ d)_ $(h^2+k^2+L^2)^{-1/2}$

46-For BCC unit cell, the planar density(PD} of the (100) plane has the same value as that of the :

a)- (110) b) - (111) c)- (001) d)- (200)

47-The equilibrium number of vacancies Nv for a certain material and a given quantity of the material depends on:

a)- The total number of atomic sites N only.

b)- The absolute temperature only.

c)-The activation energy of vacancy formation only.

d)- All the above.

48-The rate of vacancy diffusion depends on :

a)- Number of vacancies present only.

b)-The activation energy to exchange positions only

c)-The temperature only d)- All the above

49-Ductility is a measure of the degree of plastic deformation that hasbeen sustained :

a)- Before fracture b)- after fracture.

C)- Before elastic limit. D)- None of the above

50-Hardness of a metal surface is defined as:

a)- Resistance of the surface to sudden stress.

b)- Resistance of the surface for penetration.

c)- Resistance of the surface to repeated stresses.

d)- Resistance of the surface to shear stress

Part II: The Term Activities (50 Marks)

Q.1:

Put (T) or (F) in front of each sentence from the following:

51- For Non-Bravies lattices all lattice points are not equivalent. ( )

52- The triclinic crystalline system has the highest degree of symmetry ( )

53- For the face centered- cubic unit cell the coordination number is 6. ( )

54-For the Hexagonal -close packed structure (HCp) the number of atoms per unit cell is 12. ( )

55-The atomic packing Factor (APF) for SC structure equals 0.68. ( )

56-For the Cubic crystal structure, the following planes (110), (101), (011) are equivalent. ( )

57-For cubic crystal structure unit cell, if a certain plane intercepts the three axes of the cell in the x, y and Z directions at a, b/2, c/2 respectively , then Miller Indices of this plane is (122). ( )

58- For a certain cubic crystal structure unit cell, the d-spacing for (111) planes is greater than for (200) planes. ( )

59-The linear density (LD) of atoms in the [110] direction in the FCC unit cell has the same value as that for [110] direction for BCC unit cell. ( )

60- For the BCC crystal structure unit cell, the Planer density (PD) for the six faces of the cube has the same value. ( )

61- Ploy-crystalline solids are characterized by short - range order for atomic arrangements. ( )

62-single crystals of solids are characterized by medium- range order for atomic arrangements. ( )

63-The directionality of some physical properties of single crystalline solids are termed anisotropy. ( )

64- The x-ray powder diffraction technique is the most popular method generally used to determine the crystal structure of crystalline solids. ( )

65-Precipitates are small particles that are introduced into the matrix by solid state reaction. ( )

66-During examination of metal surface using optical microscopes, the maximum magnification possible is approximately 50,000 times ( )

67-Intersititial diffusion is slower than vacancy diffusion. ( )

68-Impact strength is the ability of a metal to resist various kinds of rapidly changing stresses. ( )

Q.2:

Choose the correct answer from (a, b, c and d) for these statments:

69-The polymers include the families of plastic and rubber materials which are:

a)-Organic compounds based on carbon and hydrogen.

b)- Have high density c)- Stiff and strong

d)-All the above

70- The atomic packing factor (APF) of both FCC and HCP close packed structures are the same and equal:

a)-0.68 b)- 1 c)-0.74 d)-0.52

71-The equivalent directions in the cubic crystal structure has:

a)- The same directions. b)-The same linear density (LD).

c)- The same u,v,w d)- All of the above.

72- Generally, all metals are prepared in industry in a polycrystalline form and are characterized by:

a)- Short range order of atomic arrangement.

b)-Consist of a collection of so many small crystals known as grains.

c)-The measured physical properties are anisotropic.

d)-All of the above.

73-The physical properties of the solid materials depends on :

a)-The type of bonding between atoms only.

b)-The crystal structure only

c)-The type and amounts of defects present only.

d)- All the above.

74- Diffusion in solids is slower for:

a)- Open crystal structures.

b)- Close-packed structures.

c)- Smaller diffusing atoms.

d)- Lower density materials.

75-During plastic deformation in tensile test experiments:

a)- Stress is proportional to strain

b)- Deformation is reversible'

c)-Deformation is irreversible.

D)- All of the above.

==========

With my best wishes

Prof. Dr Atta Yousef Abdel-latief

Prof. of Material Science

Physics Department- Faculty of Science- Assiut University

Assiut University
Faculty of Science
Department of Physics

Vibration and Waves
(212 P)

June 2021
Time Allow: Three and half hours

Answer all questions

Part 1

1-a) Study the motion of a vertical spring to deduce the differential equation and write the general solution.

b) A mass of 2.5 kg is attached to a horizontal spring of force constant of 4.5 kN/m. The spring is stretched 10 cm from equilibrium and released. Find: the maximum acceleration – the maximum speed.

2- a) The position of a mass (0.5 Kg) is given by $x = (7\text{ cm})\cos 6\pi t$ Calculate:
the natural frequency - the force constant – the kinetic energy after 3s.

b) Study the oscillation of the light damped oscillator to deduce the oscillating angular frequency.

3-a) Calculate the transmission and reflection coefficient of amplitude for a wave travels from a medium to another if the mass of the unit length of the second medium is 4 times that of the first medium.

b) Deduce the heard frequency by a stationary observer when the source is moving:

i) toward the observer. ii) away from the observer.

Part 2

1- a) Explain the characteristics of simple harmonic motion using the simple pendulum as a model.

b) A simple pendulum is displaced by 3 cm then left from rest. If the period is 3 s, calculate the time at which the rod is at 2 cm from equilibrium.

2-a) The energy of a damped harmonic oscillator is observed to reduce by a factor 3 after 12 complete cycles. By what factor will it reduce after 36 complete cycles. Draw the results.

b) Deduce differential equation for the damped electrical oscillator. Write its solution. Express its angular frequency in terms of its natural frequency.

3-a) A wave incidents from a medium to different one. Deduce the transmission and reflection coefficients (T_{12} and R_{12}) of amplitudes for the transmitted and reflected waves.

b) A radar moves with a speed of 20m/s behind a car of speed 15m/s and voice of frequency 400 Hz. Calculate the frequency recorded by the radar in the two cases of the radar is behind and ahead of the car.

Best wishes,
Prof. Dr. Mostafa Buody

	Faculty of science Assiut University Final exam 2020/2021 Prof. Mustafa Mekki DR. Mahmoud A. Farghaly	قسم فيزياء و الكترونيات تصميم دوائر رقمية ٢٢٨ هـ Time: 3hours
Important remarks	• No of pages 4 – The exam comes in two parts: each has 25 Questions. • 100 Marks.	

Part I:[FINAL EXAM] choose the correct answer (50Marks, 2 Marks each):

In the following part: x,y,z are Boolean variables and (x', y', z') are their complements.

1. Binary system is called … system			
a) base-2	b)base-10	c)base-8	d)none
2. In a 4-bit binary number ($d_3d_2d_1d_0$), the least significant bit d_0 has the weight of			
a) 16	b)8	c)4	d)1
3. In a 4-bit binary number ($d_3d_2d_1d_0$), d_2 has the weight of			
a) 16	b)8	c)4	d)1
4.$(1101)_2$ is represented in decimal system as			
a) 10	b)12	c)13	d)15
5.$(41)_{10}$ is represented in binary as			
a) 110010	b) 101001	c)111111	d)000110
6.The 1's complement of $(110010)_2$ is			
a) 110010	b)001111	c) 001101	d)001110
7.The 2's complement of $(110010)_2$ is			
a) 110010	b)001111	c) 001101	d)001110
8. Using the 2's complement, the arithmetic operation $(1010100)_2 - (1000011)_2$ results in, including the carry,			
a) 00001111	b) 10010001	c)10011110	d) 11001111
9. The binary number $(1110)_2$ is saved in a 5-bit memory register and a shift left operation is done on it to be $(1110\ 0)_2$. This arithmetically is equivalent to			
a) division by 2	b) multiplication by 2	c) subtracting 2	d)adding 2
10. The AND gate is expressed in Boolean algebra as			
a) xy	b)x+y	c)x'y	d)xy'
11.The NAND gate is expressed in Boolean algebra as			
a) x'+y'	b)x+y	c)x'y	d)xy'
12. The Boolean function x+x'y can be simplified to			
a) xy	b)x+y	c)x'y	d)xy'
13. The expression x(x'+x) can be simplified to			
a) x	b)1	c)0	d)x'
14.The expression x'.x can be simplified to			
a) x	b)1	c)0	d)x'

15.Using De Morgan's theorem (xyz)' can be written as			
a) x+y+z	b)xy+z	c)x+yz	d) x'+y'+z'
16. Using De Morgan's theorem (x+yz)' can be written as			
a) x'+y'+z'	b)x'(y'+z')	c)x'(y+z)	d) x+yz
17.The expression (x+y)(x+y') is simplified to			
a) x	b)1	c) x+y	d)0
18.The expression (x+y)'(x'+y')' can be simplified to			
a) x	b)1	c)x+y	d)0
19.The expression x'yz+xyz'+xyz+x'yz' can be simplified to			
a) x+z	b)y	c)x'y	d)yz'
20.The expression (x'+z')(x+y'+z')can be simplified to			
a) y+xz	b)z+xy	c)z'+x'y'	d)z
21. If F_1=xy and F_2=x'+y', the F_1+F_2 equals to			
a) x	b)1	c)y	d)xy
22. If F_1=xy and F_2=x'+y', the F_1.F_2 equals to			
a) x	b)1	c)0	d)xy'
23.If F= xy+xy'+y'z, it can be written as sum of minterms equal to			
a) $\sum$(1,2,3,4,5,6,7)	b)$\sum$(1,4,5)	c)$\sum$(0,1)	d)$\sum$(1,4,5,6,7)
24. If F= xy+xy'+y'z, it can be written as product of maxterms equal to			
a) Π(0,1)	b) Π(0,2,3)	c) Π(2,3,4,5,6,7)	d) Π(0,2,3,7)
25. The binary number $(0000)_2$ when converted to Excess-3 code, it is written as			
a) 0000	b)1100	c)0011	d)0110

Part II:[Midterm, Oral] choose the correct answer (50Marks, 2 Marks each): (Note that Questions 31-40 are on circuit in Figure1. And Questions 41-50 are on circuit of Figure2.)

26. The 4-bit binary number ($d_3d_2d_1d_0$) can be determined as odd or even from the value of the bit … whether it is 0 or 1.			
a) d_3	b) d_2	c)d_1	d)d_0
27. The standard forms to represent Boolean functions are			
a) Sum of minterms	b) product of maxterms	c) both a) and b)	d) none
28. K-map is effective tool for gate-minimization and representation of simplified boolen expressions			
a) True	b)|False	c)--	d)--
29. If F_1=$\sum$(1,4,5), then F_1'=			
a) $\sum$ (1,4,5)	b) $\sum$(0,2,3,6,7)	c) both a & b	d) none
30. If F_1=$\sum$(1,4,5), then F_1'=			
a) Π(1,4,5)	b) Π (0,2,3,6,7)	c) both a & b	d) none

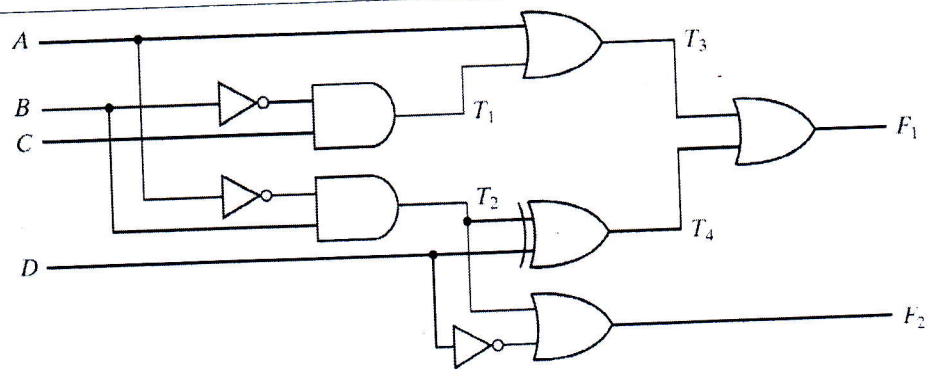


Figure 1 Logic circuit

Hint: Output of Exclusive OR (XOR) expression with two inputs x and y= x⊕y= xy'+x'y

31.T_1 expression is			
a) AB	b)B'C	c)1	d)A
32. T_2 expression is			
a) B'D	b)B'C'	c)A'C	d)A'B
33. T_3 expression is			
a) B'C	b)A	c)A+B'C	d)A'D'
34. T_4 expression is			
a) A'BD'+A'D+B'D	b) A'BD+AD+B'D	c) A'B'D'+AD+BD	d) A'D+B'D
35. F_1 expression is			
a) A+BD'+B'C+B'D	b) ABD'+B'C+BD	c) AD'+B'C'+B'D	d) AD'+BC'+BD
36. If D=1, T_4 expression becomes			
a) A+B'	b)A	c)B'	d)D'
37.If D=1, F_1 expression becomes			
a) A+B'	b)A+C	c)B+C	d)AC
38. F_2 expression is			
a) A+D	b)D'+A'B	c) A'BD'	d)ABD
39.If D=1, F_2 expression becomes			
a) B'C	b)B'C'	c)A'C	d)A'B
40. If A=1, expressions of F_1 and F_2 becomes			
a) F_1=0 F_2=1	b) F_1=A F_2=C'	c) F_1=1 F_2=D'	d) F_1=C F_2=A'

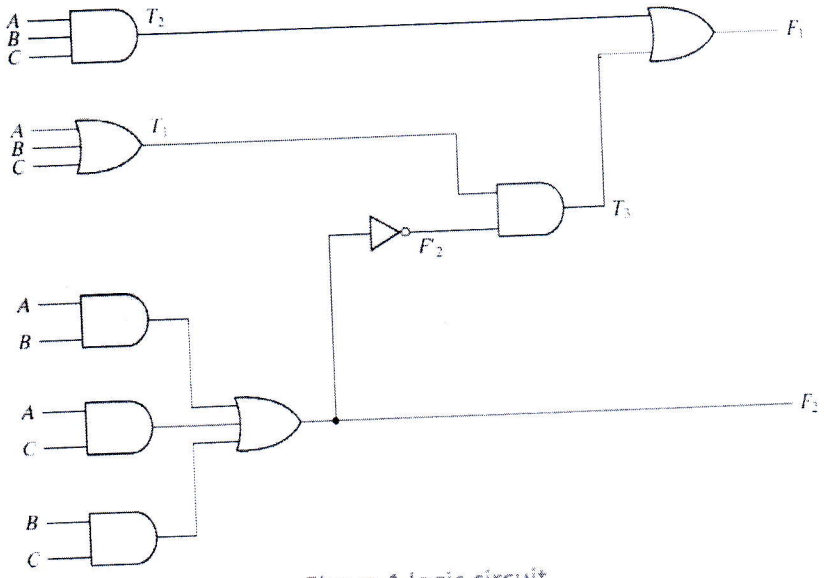


Figure 1 logic circuit

Hint: use Truth table method instead of Boolean algebra for simplification. A is the most significant bit and C is the least significant bit.

41. T_1 expression is			
a) ABC	b)A'BC	c) A+B+C	d)A+B+C'
42.T_2 expression is			
a) ABC	b)A'BC	c) A+B+C	d)A+B+C'
43.F_2 equals			
a) $\sum(0,2,3,6,7)$	b) $\sum(3,5,6,7)$	c) $\sum(0,2,6,7)$	d) $\sum(0,1,2,3,6,7)$
44. F_2' equals			
a) $\sum(1,4,5)$	b) $\sum(0,1,2,3,4)$	c) $\sum(1,3,4,5)$	d) $\sum(4,5)$
45. T_3 equals			
a) $\sum(0,1,2,3,6,7)$	b) $\sum(0,2,6,7)$	c) $\sum(4,5)$	d) $\sum(1,2,4)$
46. F_1 equals			
a) $\sum(1,4,5)$	b) $\sum(1,2,4,7)$	c) $\sum(0,2,6,7)$	d) $\sum(3,5,6,7)$
47.If A=B=1, F1 and F_2 will be			
a) F_1=1 F_2=1	b) F_1=0 F_2=0	c) F_1=1 F_2=0	d) F_1=0 F_2=1
48. If A=B=0, F1 and F_2 will be			
a) F_1=C F_2=0	b) F_1=0 F_2=0	c) F_1=C' F_2=0	d) F_1=0 F_2=0
49.F_1 contains the sum of the minterms of T_3 and T_2.			
a) True	b)False	c)--	d)--
50. T_3 contains only the minterms that are common between F_2' and T_1.			
a) True	b)False	c)--	d)--

==========Goodluck==========

Assiut University
Faculty of Science
Physics Department

Course: Electricity and alternating current
Code: P226
Final Exam (80 Marks)

Exam date: Monday, 21/06/2021
Exam Time: 3 hours
2nd semester 2020-2021

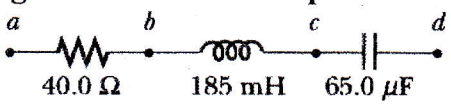
"يتم طمس(تسويد) الإجابة المختارة من قبل الطالب بإستخدام القلم الجاف فقط"

Permeability of free space (μ_0)	$4\pi \times 10^{-7}$ H/m

The exam is written in (11) pages

First part (I) Final Exam (50 Marks)

1st Question: Choose the correct answer (Every question 1.0 Mark)

1	**The unit of inductance is .....**
	a) Volt/ampere b) Volt-sec/ampere c) Joule/ampere d) Volt-ampere/sec
2	**An AC source with ΔV_{max} =150 V and f =50 Hz is connected between points a and d in the following Figure. What is the impedance of the circuit?** 
	a) Z = 41 Ω b) Z = 410 Ω c) Z = 4.1 Ω d) Z = 41 kΩ
3	**What is the reactance of a 0.01 μF capacitor at a frequency of 1 MHz?**
	a) 15.9 Ω b) 1 MΩ c) 62 kΩ d) 0.01 Ω
4	**A 2 mH, a 3.3 mH, and a 0.2 mH inductor are connected in series. The total inductance is .....**
	a) 55 mH b) Less than 0.2 mH c) Less than 5.5 mH d) 5.5 mH

5	**A sinusoidal voltage Δv(t)=(40 V) sin (100t) is applied to a series RLC circuit with L=160 mH, C=99 μF, and R=68 Ω. What is the impedance of the circuit?**
	a) 109 Ω b) 1.09 Ω c) 10.9 Ω d) 100 Ω
6	**From Q. 5, Determine the phase angle?**
	a) -51.3° b) -513° c) -50° d) 51.3°
7	**The formula used to calculate the time constant in inductive circuit is .....**
	a) RC b) L/R c) R/C d) LC/R
8	**In electromagnetic induction, the induced e.m.f. in a coil is independent of .....**
	a) Change in the flux b) Time c) Resistance of the circuit d) None of the above
9	**An 8 μF capacitor is connected to the terminals of a 60 Hz AC source whose rms voltage is 150 V. Find the rms current in the circuit?**
	a) 0.45 A b) 45 A c) 450 A d) 0.45 μA
10	**Consider an RLC circuit in which R =7.6Ω, L=2.2 mH, and C=1.8 μF. Calculate the frequency of the damped oscillation of the circuit?**
	a) 2.5 kHz b) 2.5 Hz c) 25 Hz d) 0.25 Hz
11	**Voltage and current in an ac circuit are given by** $V = 5\sin(100\pi t - \frac{\pi}{6})$ $I = 4\sin(100\pi t + \frac{\pi}{6})$
	a) Voltage leads the current by 30° b) Current leads the voltage by 30° c) Current leads the voltage by 60° d) Voltage leads the current by 60°

12	**A series RLC circuit has components with following values: L=20 mH, C=100 nF, R=20 Ω and ΔVmax=100 V, with ΔV=ΔVmax sin ωt. Find the resonant frequency?**
	a) 3.56 kHz b) 35.3 kHz c) 356 kHz d) 3.56 Hz
13	**From Q. 12, calculate the amplitude of the current at the resonant frequency?**
	a) 5 A b) 50 A c) 5 mA d) 0.5 A
14	**From Q. 12, calculate the quality factor?**
	a) 22.4 b) 224 c) 2.24 d) 20
15	**If the current is halved in a coil, then the energy stored is how much times the previous value?**
	a) ½ b) ¼ c) 2 d) 4
16	**A 100 mH coil carries a current of 1 ampere. Energy stored in its magnetic field is .....**
	a) 0.5 J b) 1.0 J c) 0.1 J d) 0.05 J
17	**In L-R circuit, for the case of increasing current, the magnitude of current can be calculated by using the formula .....**
	a) $I = I_0 e^{-\frac{Rt}{L}}$ b) $I = I_0 e^{\frac{Rt}{L}}$ c) $I = I_0(1 - e^{-\frac{Rt}{L}})$ d) $I = I_0(1 - e^{\frac{Rt}{L}})$
18	**The inductance of a closed-packed coil of 400 turns is 8 mH. A current of 5 mA is passed through it. The magnetic flux through each turn of the coil is .....**
	a) $\frac{1}{4\pi}\mu_0$ web

	b) $\frac{1}{2\pi}\mu_0$ web c) $\frac{1}{3\pi}\mu_0$ web d) $0.4\mu_0$ web
19	**At what frequency does the inductive reactance of a 57 μH inductor equal the capacitive reactance of a 57 μF capacitor?**
	a) 2.79 kHz b) Zero Hz c) 1 Hz d) 100 Hz
20	**Consider a series RLC circuit for which R=150 Ω, L=20 mH, ΔVrms =20 V, and ω=5000 s^{-1}. Determine the value of the capacitance for which the current is a maximum?**
	a) 2 μF b) 0.2 μF c) 20 μF d) 200 μF
21	**In a purely resistive ac circuit, the current .....**
	a) Lags behind the e.m.f. in phase b) Is in phase with the e.m.f. c) Leads the e.m.f. in phase d) Leads the e.m.f. in half the cycle and lags behind it in the other half
22	**A series RLC AC circuit has R=425 Ω, L=1.25 H, C=3.50 μF, ω=377 s^{-1}, and ΔV_{max} =150 V. Determine the impedance of the circuit?**
	a) 513 Ω b) 0.513 Ω c) 5.13 Ω d) 600 Ω
23	**In a purely inductive AC circuit, L=25 mH and the rms voltage is 150 V, if the frequency is 60 Hz. Calculate the inductive reactance?**
	a) 9.42 Ω b) 94.2 Ω c) 942 Ω d) 900 Ω
24	**A solenoid of length l metre has self-inductance L henry. If number of turns are doubled, its self-inductance .....**
	a) Remains same b) Becomes 2L henry c) Becomes 4L henry d) Becomes $\frac{L}{\sqrt{2}}$ henry
25	**The formula of the impedance Z of the RLC circuit is .....**

	a) $Z \equiv \sqrt{R^2 + (X_L + X_C)^2}$ b) $Z \equiv R$ c) $Z \equiv \sqrt{(X_L + X_C)}$ d) $Z \equiv \sqrt{R^2 + (X_L - X_C)^2}$
26	**The voltage output of an AC source is given by the expression $\Delta v =$ (200 V) sin wt. Find the rms current in the circuit when this source is connected to a 100 Ω resistor.**
	a) 1.41 A b) 141 A c) 14 A d) 0.141 A
27	**An LC circuit consists of a 20 mH inductor and a 0.5 μF capacitor. If the maximum instantaneous current is 0.1 A, what is the greatest potential difference across the capacitor?**
	a) 10 V b) 20 V c) 30 V d) 200 V
28	**A coil has an inductance of 2.5 H and a resistance of 0.5 Ω. If the coil is suddenly connected across a 6 volt battery, then the time required for the current to rise 0.63 of its final value is .....**
	a) 3.5 sec b) 5.0 sec c) 4.0 sec d) 4.5 sec
29	**An e.m.f. of 100 millivolts is induced in a coil when the current in another nearby coil becomes 10 ampere from zero in 0.1 second. The coefficient of mutual induction between the two coils will be .....**
	a) 1 mH b) 10 mH c) 100 mH d) 1000 mH
30	**An ideal coil of 10 henry is joined in series with a resistance of 5 Ω and a battery of 5 volt. 2 second after joining, the current flowing in ampere in the circuit will be .....**
	a) e^{-1} b) $1 - e^{-1}$ c) $1 - e$ d) e
31	**In a series RLC circuit, the applied voltage has a maximum value of 120 V and oscillates at a frequency of 60 Hz. The circuit contains an inductor whose**

	inductance can be varied, a 200 Ω resistor, and a 4 μF capacitor. What value of L should an engineer analyzing the circuit choose such that the voltage across the capacitor lags the applied voltage by 30.0°?
	a) 0.84 H b) 84 H c) 0.84 μH d) 84 μH
32	**A 1 μF capacitor is charged by a 40 V power supply. The fully charged capacitor is then discharged through a 10 mH inductor. Find the maximum current in the resulting oscillations?**
	a) 0.04 A b) 0.4 A c) 4A d) None of the above
33	**The time constant is the time taken for response to decrease ..... of its maximum value?**
	a) 100% b) 36.8 % c) 68.3% d) 63.2%
34	**Which among the following questions is incorrect?**
	a) Q=C/V b) Q=CV c) V=Q/C d) C=Q/V
35	**What will happen to the capacitor just after the source is removed?**
	a) It will not remine in its charged state. b) It will remine in its charged state. c) It will start discharge. d) It will become zero.
36	**Capacitors charge and discharge in ..... manner.**
	a) Same b) Linear c) Exponential d) square
37	**In the inductive circuit, the equilibrium value of the current is .....**
	a) ε/R b) R/ε c) Zero d) Infinity
38	**The impedance at the resonant frequency of a series RLC circuit with L = 20**

	mH, C = 0.02 μF, and R = 90 Ω is .....
	a) 0 Ω b) 90 Ω c) 20 Ω d) 40 Ω
39	**The mutual inductance of an induction coil is 5 H. In the primary coil, the current reduces from 5 A to zero in 10^{-3} sec. What is the induced emf in the secondary coil?**
	a) 2500 V b) 25000 V c) 2510 V d) Zero
40	**A 24 Ω resistor, an inductor with a reactance of 120 Ω, and a capacitor with a reactance of 120 Ω are in series across a 60 V source. The circuit is at resonance. The voltage across the inductor is .....**
	a) 60 V b) 660 V c) 30 V d) 300 V
41	**5 cm long solenoid having 10 Ω resistance and 5 mH inductance is joined to a 10 volt battery. At steady state the current through the solenoid in ampere will be .....**
	a) 5 b) 1 c) 2 d) zero
42	**In a certain series resonant circuit, VC = 125 V, VL = 125 V, and VR = 40 V. The value ofthe source voltage is .....**
	a) 125 V b) 40 V c) 250 V d) 290 V
43	**In a transformer, the coefficient of mutual inductance between the primary and the secondary coil is 0.2 henry. When the current changes by 5 ampere/second in the primary, the induced e.m.f. in the secondary will be .....**
	a) 5 V b) 1 V c) 0.1 V d) 0.5 V
44	**An uncharged capacitor and a resistor are connected in series to a battery. If ε=12.0 V, C = 5.00 μF, and R = 8.00 ×10^5 Ω, find the charge as functions of**

	time?
	a) $q = 60\,(1 - e^{\frac{-t}{4}})\ \mu C$ b) $q = 60\,(e^{\frac{-t}{4}})\ \mu C$ c) $q = 60\,(1 - e^{\frac{-4}{t}})\ \mu C$ d) $q = 60\,(e^{\frac{-4}{t}})\ \mu C$
45	**A 12 Ω resistor, a 40 μF capacitor, and an 8 mH coil are in series across an ac source. The resonant frequency is .....**
	a) 1.77 kHz b) 281 Hz c) 81.2 Hz d) 10 kHz
46	**A coil of self-inductance 50 henry is joined to the terminals of a battery of e.m.f. 2 volts through a resistance of 10 Ω and a steady current is flowing through the circuit. If the battery is now disconnected, the time in which the current will decay to 1/e of its steady value is .....**
	a) 500 sec b) 5 sec c) 50 sec d) 0.5 sec
47	**The time constant of RC series circuit is .....**
	a) RC b) RC/L c) R/C d) R/LC
48	**A 0.47 μF capacitor is across a 2 kHz sine wave signal source. The capacitive reactance is .....**
	a) 170 Ω b) 17 Ω c) 0.000169 Ω d) 1.7 Ω
49	**Which circuit element(s) will oppose the change in circuit current?**
	a) Resistance only b) Inductance only c) Capacitance only d) All of the above
50	**The self-inductance of a coil is L. Keeping the length and area same, the number of turns in the coil is increased to four times. The self-inductance of the coil will now be .....**
	a) $\frac{1}{4}$L

	b) 16 L c) L d) 4 L

Second Part (II) Mid Term and Oral Exam **(30 Marks)**

2rd Question: State True or False on the following **(Every question 1.0 Mark)**

51	The phase angle in the resistive circuit is zero.
	a) True b) False
52	The initial current at charging a capacitor is maximum.
	a) True b) False
53	XL is directly proportional to frequency and inductance.
	a) True b) False
54	In a pure capacitive circuit if the supply frequency is reduced to 1/2, the current will be doubled.
	a) True b) False
55	In an ac circuit, the r.m.s. value of current I_{rms} is related to the peak current I_0 by the relation $I_{rms} = \frac{1}{\sqrt{2}} I_0$
	a) True b) False
56	If the value of C in a series RLC circuit is decreased, the resonant frequency is not affected.
	a) True b) False
57	An induced voltage is produced as a result of a dc voltage.
	a) True b) False
58	X_L and X_C have opposing effects in an RLC circuit.
	a) True b) False
59	Inductance is the property of an inductor that produces an opposition to any change in current.
	a) True b) False
60	Resonance is a condition in a series RLC circuit in which the capacitive reactance and inductive reactance are equal in magnitude.
	a) True b) False
61	Energy is stored by a capacitor in a magnetic field.
	a) True b) False
62	The unit of time constant is sec^{-1}
	a) True b) False
63	At an instant of time during the oscillations of an LC circuit, the current is at its maximum value. At this instant, the voltage across the capacitor is zero.

	a) True b) False
64	The RLC circuit is analogous to the simple harmonic oscillator.
	a) True b) False
65	When the number of turns and the length of the solenoid are doubled keeping the area of cross-section same, the inductance remains the same.
	a) True b) False
66	For the simple resistive circuit, the average value of the current over one cycle is zero.
	a) True b) False
67	In an LR-circuit, time constant is that time in which current grows from zero to 0.63 I_0 (where I_0 is the steady state current).
	a) True b) False
68	As the capacitor discharges, both the charge on the capacitor and the current decay exponentially.
	a) True b) False
69	The phase angle is positive, when the circuit is more inductive.
	a) True b) False
70	When the capacitor is fully discharged, it stores no energy.
	a) True b) False
71	For a sinusoidal applied voltage, the current in an inductor always lags behind the voltage across the inductor by 90°.
	a) True b) False
72	Inductive reactance (ωL) must have units of ohms.
	a) True b) False
73	The impedance of a series RLC circuit at resonance is equal to R.
	a) True b) False
74	The current at all points in a series AC circuit has the same amplitude and phase.
	a) True b) False
75	The phase angle is negative, when the circuit is more inductive.
	a) True b) False
76	Resistors behave essentially the same way in both DC and AC circuits.
	a) True b) False
77	Inductance is indirectly proportional to the square of the number of turns, the permeability, and the cross-sectional area of the coil.
	a) True b) False
78	Lenz's law gives the magnitude of the induced e.m.f.
	a) True b) False
79	The self-inductance of a straight conductor is zero.
	a) True b) False

80	When the capacitor is fully discharged, the current reaches its minimum value.
	a) True b) False

With my best regards
Dr. Amina abozeed

Assiut University
Faculty of Science
Department of Physics
Second semester 2020-2021
Time: 2 Hour

Course: Principles of *Modern Physics*
Code: P225
Final Exam (50%)
Oral +midterm Exam (30%)

Electron charge e	1.6×10^{-19} C	Plank's constant h	6.626×10^{-34} Joule.sec
Electron mass m_e	9.1×10^{-31} kg	Light velocity c	3×10^{8} m.sec^{-1}
1 eV	1.602×10^{-19} J	Stefan -Boltzmann	5.6705×10^{-8} J/(s.m^2.K^4)

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

The exam is written in six (6) pages

First: The Final Exam (50 Marks)

1- Choose the correct statement: (Every question 1.5 Marks)

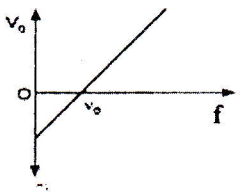
1-	The work function for tungsten metal is 4.52 eV. The cutoff wavelength for tungsten is
	(a) 356 nm (b) 274 nm (c) 456 nm (d) 417 nm
2-	The frequency of a photon having energy 41.25 eV is …..
	(a) 1×10^{16} Hz (b) 3.9×10^{53} Hz (c) 6×10^{34} Hz (d) 1.5×10^{-12} Hz
3-	If 5 eV of energy is supplied to an electron with a binding energy of 2.3 eV, with what kinetic energy will the electron be launched?
	(a) 2.3 eV (b) 7.3 eV (c) 11.5 eV (d) 2.7 eV
4-	Which region of the electromagnetic spectrum will provide photons of the least energy?
	(a) infrared light (b) radio waves (c) ultraviolet light (d) X-rays
5-	Electromagnetic radiation with a wavelength of 5.7×10^{-12} m is incident on stationary electrons. Radiation that has a wavelength of 6.57×10^{-12} m is detected at a scattering angle of:
	(a) 10° (b) 40° (c) 50° (d) 69°
6-	Which of the following is a possible reason why the minimum wavelength of the continuous x-ray spectrum would decrease?
	(a) the kinetic energy of the incident electron increases (b) the target is a thin foil instead of a thick block of the same materials (c) the target is of a lower atomic number (d) the target is of a higher atomic number

7-	The shortest wavelength present in the radiation from an X-ray machine whose accelerating potential is 5×10^4 V.
	(a) 0.0248 nm (b) 0.0125 nm (c) 0.0356 nm (d) 0.0592 nm
8-	What is the de-Broglie wavelength of an electron accelerated from rest through a potential difference of 100 volts?
	(a) 12.3 Å (b) 1.23 Å (c) 0.123 Å (d) None of these
9-	What is the effect of intensity on the stopping potential?
	(a) As intensity increases, stopping potential increases linearly (b) As intensity increases, stopping potential decreases linearly (c) As intensity decreases, stopping potential increases exponentially (d) No effect
10-	The de-Broglie wavelength of particle of mass 1 mg moving with a velocity of 1 m s^{-1}, in terms of Planck's constant h, is given by (in metre):
	(a) 10^5 h (b) 10^6 h (c) 10^{-3} h (d) 10^3 h
11-	Select the correct statement:
	(a) ultraviolet light has a longer wavelength than infrared (b) blue light has a higher frequency than X-rays (c) radio waves have higher frequency than gamma rays (d) gamma rays have higher frequency than infrared waves
12-	The quantity $\sqrt{\mu_0 \varepsilon_0}$ represents
	(a) speed of sound (b) speed of light in vacuum (c) speed of e.m.w. (d) inverse of speed of light in vacuum
13-	During Photoelectric Experiment, what changes are observed when the frequency of the incident radiation is increased?
	(a) The value of saturation current increases (b) The value of stopping potential increases (c) The value of stopping potential decreases (d) No effect
14-	What happens to the wavelength of a photon after it collides with an electron?
	(a) increases (b) decreases (c) remains the same (d) infinite
15-	What is the time lag between the incidence of photons and the ejection of photoelectrons?
	(a) greater than 10^{-5} s (b) between 10^{-5} s and 10^{-9} s (c) less than 10^{-9} s (d) 1 second

16-	If the kinetic energy of a free electron doubles, its de Broglie wavelength changes by the factor .....
	(a) 2 (b) 1/2 (c) $1/\sqrt{2}$ (d) $\sqrt{2}$
17-	The linear attenuation coefficient for 2.0 MeV gamma rays in water is 4.9 m^{-1}, how far must such a beam travel in water before it reduced to 1 percent of its original value?
	(a) 0.61 m (b) 1.22 m (c) 0.82 m (d) 0.94 m
18-	The surface of a metal is illuminated with the light of 400 nm. The kinetic energy of the ejected photoelectrons was found to be 1.68 eV. The work function of the metal is
	(a) 1.41 eV (b) 1.51 eV (c) 1.68 eV (d) 3.09 eV
19-	According to Wien's law, the wavelength corresponding to maximum emission is proportional to
	(a) absolute temperature (b) frequency (c) time (d) inverse of absolute temperature
20-	The ratio of the energy absorbed by the body to total energy falling on it is called.....
	(a) radiant power (b) emissive power (c) absorptivity (d) emissivity

2-Choose the correct statement: (Every question 1 Marks)

21-	The de Broglie wavelength of a moving tennis ball is calculated as 1×10^{-33} m. this means that the moving tennis ball
	(a) diffracts through a norrow slit (b) does not behave as a particle (c) does not show wave properties (d) is travelling at the speed of light
22-	Simultaneous determination of exact position and momentum of an electron is
	(a) possible (b) impossible (c) sometimes possible sometimes impossible (d) none of the above
23-	An electron moves in the X direction with a speed of 3.6×10^6 m/s. we can measure its speed to a precision of 1%. With what precision can we simultaneously measure its position?
	(a) 3.2 nm (b) 0.8 nm (c) 1.6 nm (d) 6.4 nm

24-	What is the frequency of photons that have a momentum of 2.80×10^{-27} kg.m/s
	(a) 1.27×10^{15} Hz (b) 1.27×10^{18} Hz (c) 0.75×10^{12} Hz (d) 0.75×10^{18} Hz
25-	A 3.00 MeV photon interacts with a lead nucleus. What would be the kinetic energy of the electron and the positron assuming the nucleus is at rest after the collision?
	(a) 2.01 MeV (b) 1.5 MeV (c) 0.989 MeV (d) electron-positron pair won't be created
26-	In X-ray emission tubes, X-ray is emitted by the acceleration of
	(a) atoms (b) protons (c) electrons (d) photons
27-	In Compton scattering from stationary electrons the change in wavelength equal zero when the photon is scattered through:
	(a) 0° (b) 45° (c) 90° (d) 180°
28-	The stopping potential (V_0) for photoelectric emission from a metal surface is plotted along y-axis and frequency (f) of incident light along x-axis. A straight line is obtained as shown. Planck's constant is given by 
	(a) slope of the line (b) product of the slope of the line and charge on electron (c) intercept along y-axis divided by charge on the electron (d) product of the intercept along x-axis and mass of the electron
29-	Energy released by a radiating surface is not continuous but is in the form of successive and separate packets of energy called
	(a) photons (b) protons (c) electrons (d) neutrons
30-	X-rays of wavelength 0.20 nm are Compton-scattered, and the scattered beam is observed at an angle of 90.0° relative to the incident beam, the kinetic energy of the scattered electrons is .....
	(a) 250 eV (b) 6125 eV (c) 74.5 eV (d) 0.0
31-	In the previous question, the travel direction of the scattered electrons .....
	(a) 30.12° (b) 88.02° (c) 44.57° (d) 0.0°

32-	Two metals A and B have work functions 4 eV and 10 eV respectively. Which metal has a higher threshold wavelength?
	(a) metal A (b) metal B (c) both (d) neither
33-	Calculate the total radiant energy from a black surface at 400 degree Celsius?
	(a) 1631.7 W/m^2 (b) 31.7 W/m^2 (c) 631.7 W/m^2 (d) 6311.7 W/m^2
34-	Which of the following electromagnetic radiations has photons with the greatest momentum?
	(a) yellow light (b) X-rays (c) radio waves (d) microwaves
35-	Maxwell's equations predict that the speed of light in free space is
	(a) an increasing function of frequency (b) a decreasing function of frequency (c) independent of frequency (d) a function of the distance from the source
36-	Rayleigh-Jean's law holds good for which of the following?
	(a) shorter wavelength (b) longer wavelength (c) high temperature (d) high energy
37-	A furnace has walls of temperature 2000 K. what the wavelength of maximum intensity emitted when a small door is opened?
	(a) 1449 nm (b) 1789 nm (c) 2884 μm (d) 2540 nm
38-	A single crystal of table salt (NaCl) is irradiated with abeam of X rays of wavelength 0.250 nm, and the first bragg reflection is observed at an angle of 26.3°. what is the atomic spacing of NaCl.....?
	(a) 0.564 nm (b) 0.282 nm (c) 0.141 nm (d) 1.120 nm
39-	Which of the following is NOT true for electromagnetic waves?
	(a) they consist of changing electric and magnetic fields (b) they travel at different speeds in a vacuum, depending on their frequency (c) they transport energy (d) they transport momentum
40-	For production of characteristic K_β X-rays, the electron transition is
	(a) n = 2 to n = 1 (b) n = 3 to n = 2 (c) n = 3 to n = 1 (d) n = 4 to n = 2

Second: The Oral Exam +midterm +activities) **(30 Mark)**

3-Put [✓] for right or [×] for wrong: **(Every question 1.5 Mark)**

41-	In photoelectric, the number of photoelectrons reach to collector per second depends only on the type of collector metal.	
42-	In the photoelectric, by applying a zero voltage to emitter, the photocurrent decreases to zero.	
43-	Photoelectron emission from a given metal does not take place unless the frequency of incident light is less than a certain minimum frequency f_o.	
44-	Compton shift $\Delta\lambda$ depends on the type of scattering material.	
45-	Pair production cannot take place in empty space.	
46-	In blackbody radiation, as the temperature increases, the maximum of the curve shifts toward higher frequencies.	
47-	Energy can be converted to mass but mass can't be converted to energy.	
48-	In blackbody radiation, as the temperature increases, the total emitted radiant energy increases.	
49-	Thermal radiation wave is electromagnetic wave.	
50-	According to Plank, oscillator can emit radiation by dropped to next lowest energy state.	
51-	Matter wave is electromagnetic waves.	
52-	Visible Light rays cannot show Compton effect.	
53-	According to EM classical theory, electron will emit from metal with higher energy by increasing intensity of incident light.	
54-	When an electron and a positron combine to liberate energy in the form of gamma rays, this process is known as pair annihilation.	
55-	The phenomenon of X-ray production is basically inverse of photoelectric effect.	
56-	Charge and momentum are conserved in Pair Production.	
57-	The minimum wavelength λ_{min} of X-rays depend on the kind of the metal target.	
58-	In Compton scattering, the scattered photon has a smaller wavelength than the incident one.	
59-	Existence of positrons are doomed in nature.	
60-	The velocity of the photoelectrons increases with using a metal has a lower work function.	

WITH MY BEST WISHE

Dr. ZINAB HASSANIEN BAKR

Assiut University
Faculty of Science
Department of Physics
Second semester 2020-2021

Course: Modern Physics
Code: P215
Time: 3 Hour
Final Exam (100%)

Student name:

Academic No.:

The exam is written in fourteen (14) pages.

Direction:

1- Make sure you fill in the bubbles for your name and student number on the bubble sheet.
2- Make sure you write your name and your academic number in this test booklet.
3- There are *fifty* multiple choice questions on this test booklet. Answer all questions.
4- You may write scratch work in this test booklet itself, but only the answers on the bubble sheet.
5- Multiple choice questions have one correct answer. Mark your answer on the bubble sheet. Each correct answer will score *two* marks.
6- The exam consists of two parts, the first is the final exam "50 marks" and the second is the oral, midterm, and Quarterly Acts Exams "50 marks".
7- Take the velocity of light to be $3 \times 10^8\ m/s$.

First Part: ***(50 Marks)***

Choose the correct answer:

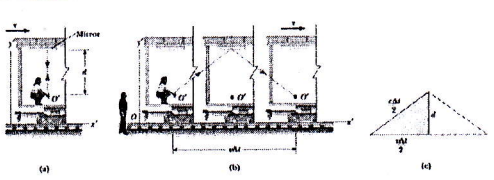
1-	A 1000-kg automobile moving with a speed of 24 m/s relative to the road collides with a 500-kg automobile initially at rest. If the two stick together, what is the velocity in m/s of the two cars after the collision according to an observer in a truck moving 10 m/s in the same direction as the moving cars?	
	(a) 9.33 m/s	
	(b) 6 m/s	
	(c) 24 m/s	
	(d) 14 m/s	
	(e) 1 m/s	
2-	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) 0.27 c	
	(b) -0.27	
	(c) -0.35 c	
	(d) 0.35 c	
	(e) -0.05 c	

3-	**A satellite moves east, taken as the positive x-axis direction, at a speed of 0.5 c and a spaceship moves toward it (to the west) at a speed of 0.8 c as measured by an observer on the Earth. The speed of the satellite measured by an observer in the spaceship is:**	
	(a) 0.93 c	
	(b) -0.93 c	
	(c) 0.21 c	
	(d) -0.21c	
	(e) 1.3 c	
4-	**Boat 1 goes directly across a stream a distance L and back taking a time t_1. Boat 2 goes down stream a distance L and back taking a time t_2. If both boats had the same speed relative to the water, which of the following statements is true?**	
	(a) $t_2 > t_1$	
	(b) $t_2 < t_1$	
	(c) $t_2 = t_1$	
	(d) $t_2 = 2\,t_1$	
	(e) $t_2 = 0.5\,t_1$	
5-	**Two fireworks explode at the same position on the 30th of June. 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 he obtain when he measures the time interval between the two explosions?**	
	(a) 4.0 s	
	(b) 3.2 s	
	(c) 6.25 s	
	(d) 7.9 s	
	(e) 4.3 s	
6-	**The half-life of a muon is 2.2 μs. How fast is it moving relative to an observer who says its half-life is 4.4 μs?**	
	(a) 0.71 c	
	(b) 1.0 c	
	(c) 1.73 c	
	(d) 0.5 c	
	(e) 0.87 c	

7-	**A spaceship moving past the Earth with a speed of 0.800 *c* signals to the Earth with pulsed laser photons emitted at 10 second intervals according to the spaceship's clock. According to observers on Earth who see the flashes, the time interval they measure is:**	
	(a) 6.0 s	
	(b) 4.47 s	
	(c) 16.7 s	
	(d) 22.4 s	
	(e) 7.8 s	
8-	**A 30-year-old woman takes a trip on a rocket, leaving her 20-year-old brother behind. She travels at a speed of 0.8 *c*, and is gone 20 years, according to the younger brother. When she returns, how many years older/younger is she than her brother?**	
	(a) 12 years older	
	(b) 2 years older	
	(c) 8 years younger	
	(d) 2 years younger	
	(e) 8 years older	
9-	**A jet plane travels around the world at 894 m/s. Two accurate atomic clocks measure the times of flight, one on board the plane and the second on Earth. If it takes 12 hours to complete the journey, what will the time difference (in μs) be?**	
	(a) $0.0\ \mu s$	
	(b) $1.0\ \mu s$	
	(c) $0.25\ \mu s$	
	(d) $0.07\ \mu s$	
	(e) $0.19\ \mu s$	
10-	**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) 1.0 m	
	(b) 0.1 m	
	(c) 10 m	
	(d) 0.44 m	
	(e) 2.29 m	

11-	**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) 1.0 m	
	(b) 0.1 m	
	(c) 10 m	
	(d) 0.44 m	
	(e) 2.29 m	
12-	**A spaceship from another galaxy passes over the solar system directly above a radial line from the sun to the Earth. (We measure that distance to be 1.5×10^{11} m.) On Earth, the spaceship is observed to be traveling at a speed of 0.8 c. As measured on Earth it takes the spaceship 625 seconds to travel from the sun to Earth. When a scientist in the spaceship measures the Earth-sun distance, she finds that:**	
	(a) $9 \times 10^{10}\ m$	
	(b) $9 \times 10^{11}\ m$	
	(c) $2.5 \times 10^{11}\ m$	
	(d) $2.5 \times 10^{10}\ m$	
	(e) $7 \times 10^{10}\ m$	
13-	**A spaceship from another galaxy passes over the solar system directly above a radial line from the sun to the Earth. (We measure that distance to be 1.5×10^{11} m.) On Earth, the spaceship is observed to be traveling at a speed of 0.8 c. As measured on Earth it takes the spaceship 625 seconds to travel from the sun to Earth. When a scientist in the spaceship measures the time, it takes her to travel that distance, she finds that:**	
	(a) 250 s	
	(b) 375 s	
	(c) 450 s	
	(d) 625 s	
	(e) 750 s	

14-	**Fireworks go off at the same time according to Earth clocks in two cities, Alum and Boron, that are 300 km apart. The people in a spaceship that is flying in a straight line from Alum to Boron at 0.8 *c* also observe the fireworks. Do they see the fireworks in the two cities simultaneously?**	
	(a) No	
	(b) Yes	
	(c) impossible to determine.	
	(d) all the above.	
	(e) none of the above.	
15-	**As a spaceship heads directly to Earth at a velocity of 0.8*c*, 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) c	
	(c) 0.2 c	
	(d) 0.8 c	
	(e) none of the above.	
16-	**In a classroom on the first spaceship to an extrasolar planet – there are children because the trip will take 200 years – a teacher is showing charge Q uniformly distributed along a conducting rod of length L_o to produce linear charge density λ_o. As observed on Pluto when the spaceship passes it at 0.80 *c*, the linear charge λ' is**	
	(a) $0.6\,\lambda_o$	
	(b) λ_o	
	(c) $0.3\,\lambda_o$	
	(d) $0.8\,\lambda_o$	
	(e) $1.67\,\lambda_o$	
17-	**A spaceship leaves Earth and maintains a constant force by means of a nuclear engine. As the speed of the spaceship increases, an observer on Earth finds that relative to her the magnitude of the spaceship's acceleration is**	
	(a) zero.	
	(b) decreasing.	
	(c) constant.	
	(d) increasing.	
	(e) proportional to the kinetic energy of the spaceship.	

18-	**The period of a pendulum is 2.0 s in a stationary inertial frame of reference. What is its period when measured by an observer moving at a speed of 0.6 *c* with respect to the inertial frame of reference?**	
	(a) 2.0 s	
	(b) 0.6 s	
	(c) 1.0 s	
	(d) 2.5 s	
	(e) 4.0 s	
19-	**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) *O'*	
	(b) *O*	
	(c) both observers	
	(d) neither observer	
	(e) all the above	
20-	**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.	
	(e) none of the above.	

21-	**You are driving on a freeway at a relativistic speed. Straight ahead of you, a technician standing on the ground turns on a searchlight and a beam of light moves exactly vertically upward, as seen by the technician. As you observe the beam of light, you measure the magnitude of the vertical component of its velocity as**	
	(a) equal to *c*	
	(b) greater than *c*	
	(c) less than *c*	
	(d) equal to 0.5 *c*	
	(e) none of the above	
22-	**You are driving on a freeway at a relativistic speed. Straight ahead of you, a technician standing on the ground turns on a searchlight and a beam of light moves exactly toward you, as seen by the technician. As you observe the beam of light, you measure the magnitude of its velocity as**	
	(a) equal to *c*	
	(b) greater than *c*	
	(c) less than *c*	
	(d) equal to 0.5 *c*	
	(e) none of the above	
23-	**You are driving on a freeway at a relativistic speed. Straight ahead of you, a technician standing on the ground turns on a searchlight. If the technician aims the searchlight directly at you, you measure the magnitude of the horizontal component of its velocity as**	
	(a) equal to *c*	
	(b) greater than *c*	
	(c) less than *c*	
	(d) equal to 0.5 *c*	
	(e) none of the above	
24-	**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	
	(e) none of the above	

25-	**Which of these is an inertial reference frame (or a very good approximation)?**	
	(a) A car rolling down a steep hill	
	(b) A rocket being launched	
	(c) A roller coaster going over the top of a hill	
	(d) A sky diver falling at terminal speed	
	(e) None of the above	

Second Part: ***(50 Marks)***

26-	**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) at the same time as event 2	
	(b) before event 2	
	(c) after event 2	
	(d) impossible to measure	
	(e) none of the above	
27-	**Molly flies her rocket past Nick at constant velocity v. Molly and Nick both measure the time it takes the rocket, from nose to tail, to pass Nick. Which of the following is true?**	
	(a) Both Molly and Nick measure the same amount of time.	
	(b) Nick measures a shorter time interval than Molly.	
	(c) Molly measures a shorter time interval than Nick.	
	(d) impossible to measure.	
	(e) none of the above.	
28-	***Proper time* is**	
	(a) the time measured by an observer moving along with the clock.	
	(b) the time interval between two events as measured by an observer who sees the events occur at the same point in space.	
	(c) a time interval that can be measured by a single clock.	
	(d) the time between ticks of a clock measured by an observer who is at rest with respect to the clock.	
	(e) all the above.	

29-	proper length is	
	(a) the length of the object measured by someone who is at rest with respect to the object.	
	(b) the length of an object measured by someone in a reference frame that is moving relative to the object.	
	(c) the shortest possible length of an object.	
	(d) the length measured by the light year.	
	(e) all the above.	
30-	A high-speed train passes a train platform. Anthony is a passenger on the train, Miguel is standing on the train platform, and Carolyn is riding a bicycle toward the platform in the same direction as the train is traveling. Choose the proper order of how long each of these observers measures the train to be, from longest to shortest.	
	(a) Carolyn, Miguel, Anthony.	
	(b) Miguel, Carolyn, Anthony.	
	(c) Miguel, Anthony, Carolyn.	
	(d) Anthony, Carolyn, Miguel.	
	(e) Anthony, Miguel, Carolyn.	
31-	For a material object, such as a rocket ship, the possible range of γ is	
	(a) $0 \leq \gamma \leq 1$	
	(b) $1 \leq \gamma$	
	(c) $0 < \gamma < \infty$	
	(d) $-\infty < \gamma < \infty$	
	(e) none of the above	
32-	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.	
	(e) none of the above.	

33-	**A rocket is traveling toward the earth at 0.5 c, when it ejects a missile forward at 0.5 c relative to the rocket. According to *Galilean* velocity addition, the speed of this missile as measured by an observer on earth would be**	
	(a) 0	
	(b) 0.5 c	
	(c) 0.8 c	
	(d) c	
	(e) none of the above.	
34-	**For the missile in the previous question, the *correct* value for its speed measured by an observer on earth would be**	
	(a) 0	
	(b) 0.5 c	
	(c) 0.8 c	
	(d) c	
	(e) none of the above.	
35-	**Suppose a rocket traveling at 99.99% of the speed of light measured relative to the earth makes a trip to a star 100 light years from earth (meaning that it would take light 100 years to make the trip). During this rocket trip**	
	(a) People on earth would age essentially 100 years.	
	(b) People on earth would age more than 100 years.	
	(c) The astronauts in the rocket would age more than 100 years.	
	(d) The astronauts in the rocket would age essentially 100 years.	
	(e) The astronauts in the rocket would age the same as the people on earth.	
36-	**Suppose a rocket traveling at 99.99% of the speed of light measured relative to the earth makes a trip to a star 100 light years from earth (meaning that it would take light 100 years to make the trip). During this rocket trip**	
	(a) People on earth would age essentially 100 years.	
	(b) People on earth would age more than 100 years.	
	(c) The astronauts in the rocket would age less than 100 years.	
	(d) The astronauts in the rocket would age essentially 100 years.	
	(e) The astronauts in the rocket would age the same as the people on earth.	

37-	A rocket ship is moving toward earth at $\frac{2}{3}$ c. The crew is using a telescope to watch a Cubs baseball game in Chicago. The batter hits the ball (event A), which is soon caught (event B) by a player 175 ft away, as measured in the ballpark. Which one of the following is the proper length of the distance the ball traveled?	
	(a) the $175\ ft$ measured in the ballpark.	
	(b) the distance measured by the rocket's crew.	
	(c) Both distances are equal, and hence both are the proper length.	
	(d) the $\frac{2}{3} \times 175\ ft$ measured in the ballpark.	
	(e) none of the above.	
38-	A large constant force is used to accelerate an object from rest to a high speed. In which form of Newton's second law—relativistic or classical nonrelativistic—does the object take a longer time to reach a speed of $0.9c$?	
	(a) Relativistic.	
	(b) Nonrelativistic.	
	(c) Same for both.	
	(d) impossible to measure.	
	(e) none of the above.	
39-	Observer O fires a particle at velocity v in the positive y direction. Observer O′, who is moving relative to O with velocity u in the x direction, measures the y component of the velocity of the same particle and obtains v′. How does the y component measured by O′ compare with the y component measured by O?	
	(a) $v' > v$	
	(b) $v' = v$	
	(c) $v' < v$	
	(d) $v' = 0$	
	(e) none of the above.	
40-	Two clocks in the reference frame of observer 1 are exactly synchronized. For other observers in motion relative to observer 1, the clocks are:	
	(a) synchronized for all observers.	
	(b) not synchronized, but all observers will agree which of the two clocks is ahead.	
	(c) not synchronized, but different observers may not agree which of the clocks is ahead.	
	(d) either synchronized or not synchronized, depending on the locations of the observers.	
	(e) none of the above.	

41-	**Rockets A and C move with identical speeds in opposite directions relative to B, who is at rest in this frame of reference. A, B, and C all carry identical clocks. According to A:** 	
	(a) B's clock and C's clock run at identical slow rates.	
	(b) B's clock runs fast, and C's clock runs slow.	
	(c) B's clock runs slow, and C's clock runs even slower.	
	(d) B's clock runs fast, and C's clock runs even faster.	
	(e) B's clock runs slow, and C's clock runs fast.	
42-	**Rockets A and C move with identical speeds v = 0.8c in opposite directions relative to B, who is at rest in this frame of reference. A stick of length L_o carried by A. What is the length of the stick according to C?** 	
	(a) L_o	
	(b) 0.6 L_o	
	(c) 0.36 L_o	
	(d) 0.22 L_o	
	(e) 0.45 L_o	
43-	**A star (assumed to be at rest relative to the Earth) is 100 light-years from Earth. (A light-year is the distance light travels in one year.) An astronaut sets out from Earth on a journey to the star at a constant speed of 0.98c. How long does it take for a light signal from Earth to reach the star, according to an observer on Earth?**	
	(a) 100 y	
	(b) 100 L y	
	(c) 102 y	
	(d) 20 L y	
	(e) 20.4 y	
44-	**A star (assumed to be at rest relative to the Earth) is 100 light-years from Earth. (A light-year is the distance light travels in one year.) An astronaut sets out from Earth on a journey to the star at a constant speed of 0.98c. How long does it take for the astronaut to travel from Earth to the star, according to an observer on Earth?**	
	(a) 100 y	
	(b) 100 L y	
	(c) 102 y	
	(d) 102 L y	
	(e) 20.4 y	

45-	**A star (assumed to be at rest relative to the Earth) is 100 light-years from Earth. (A light-year is the distance light travels in one year.) An astronaut sets out from Earth on a journey to the star at a constant speed of 0.98*c*. According to the astronaut, what is the distance from Earth to the star?**	
	(a) 100 y	
	(b) 100 L y	
	(c) 102 y	
	(d) 20 L y	
	(e) 20.4 y	
46-	**A star (assumed to be at rest relative to the Earth) is 100 light-years from Earth. (A light-year is the distance light travels in one year.) An astronaut sets out from Earth on a journey to the star at a constant speed of 0.98*c*. According to the astronaut, how long does it take for the astronaut to travel from Earth to the star?**	
	(a) 100 y	
	(b) 100 L y	
	(c) 102 y	
	(d) 20 L y	
	(e) 20.4 y	
47-	**A newly created particle is moving through the laboratory at a speed of 0.765*c*. It is observed to live for a time of 0.231 μs before decaying. What would be the lifetime of this particle according to someone who is moving along with the particle at a speed of 0.765*c*?**	
	(a) 0.358 μs	
	(b) 0.149 μs	
	(c) 0.096 μs	
	(d) 0.557 μs	
	(e) none of the above.	
48-	**Sitting in a chair in his laboratory, Albert observes a particle to be created at one instant moving at a speed of 0.65*c* and to decay after a time interval of 5.75 ns. Betty is moving along with the particle at a speed of 0.65*c*. What is the time between the creation and decay of the particle according to Betty?**	
	(a) 2.43 ns	
	(b) 4.37 ns	
	(c) 5.75 ns	
	(d) 7.57 ns	
	(e) 9.64 ns	

49-	An unstable particle moving through the laboratory leaves a track of length 3.52 mm. The particle is moving at a speed of 0.943*c*. How long would the particle's track appear to someone moving with the particle?	
	(a) 1.17 mm	
	(b) 10.6 mm	
	(c) 3.52 mm	
	(d) 0.390 mm	
	(e) None of these	
50-	A certain particle has a proper lifetime of $1.00 \times 10^{-8}\ s$. It is moving through the laboratory at a speed of $0.85\ c$. What distance does the particle travel in the laboratory?	
	(a) 2.55 m	
	(b) 4.84 m	
	(c) 1.34 m	
	(d) 9.19 m	
	(e) none of the above.	