## Answer the following questions:(10 mark for each point))

1- A. Produce the disorder number of distinguiable particle.

B. Calculate the number of macrostate and micostate for a system of 5 distinguiable particles , two energy levels (one with degenracy 2 and the other with degeneracy 3).

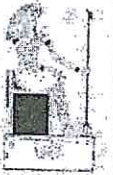C. For population inversion system , what about the temperature in this case. Prove your answer.

2- A. Quantum particles have many Schoredinger's solutions . How many meaningful solutions are there. Explain your answer with example.

B. In F-D and B-E distributions laws we introduce two constant $\alpha$ and $\beta$ . Prove that $\alpha = \mu/kT$ and $\beta = 1/kT$ where k is Boltezmann's constant and T is the temperature.

3- A. Write the first law of thermodynamic in statistical physics.

C. Produce the partition function for harmonic oscillator and calculate the total energy U at high temperature.

4- A. Black body radiation is suitable example of Boson particles but has difference distribution law, explain this difference by derivations of its distribution law.

B. Produce Planck's Radiation formula.

C. What is the suitable distribution law can be used at very high temperature for a metals. Prove your answer.

*Good luck*

## Answer the following questions:

### First question:- (25 Marks)

- Find the reflection and the transmission coefficient for a particle of a mass m incident from left, i.e, from $x \to -\infty$, the step- potential $V(x) = \begin{cases} 0 & for \ x < 0 \\ V_0 & for \ x > 0 \end{cases}$ where $V_0$ is a real positive constant, the energy of the incident particle is less than the height of the barrier $E < V_0$.

### Second question: - (25 Marks)

- Use the annihilation and a creation operators for calculating the eigenvalues of energy for a one dimensional Harmonic oscillator.

### Third question:- (25 Marks)

- A particle of mass m moves inside a potential box its walls at $x = 0$ and $x = L$. At $t = 0$ the initial state function is $\psi(x, 0) = \frac{(3\phi_1 + \phi_2 + 7\phi_5)}{\sqrt{59}}$, where $\psi_n = \sqrt{\frac{2}{L}} \sin \frac{n\pi x}{L}$

a- Prove that $\psi$ is normalized.
b- What is the probability of finding the particle in each state
c- Calculate $\langle E \rangle$ at $t = 0$
d- What is $\psi(x, t)$

### Fourth question:- (25 Marks)

- Calculate the adjoint operator of $\frac{d}{dx}$.
- Prove that the kinetic energy operator is Hermitian operator.

| EXAMINER | Prof. Dr. Nabil Elsiragy |
|---|---|
| | اطيب التمنيات بالتوفيق |

**TANTA UNIVERSITY**
**FACULTY OF SCIENCE**
**DEPARTMENT OF PHYSICS**

EXAMINATION FOR **THIRD YEAR** STUDENTS OF BIOPHYSICS (SEMESTER 1)

| COURSE TITLE: | ELECTRICAL CIRCUITS | COURSE CODE: PH3151 |
|---|---|---|
| DATE: 27 DECEMBER, 2022 | TERM: FIRST | TOTAL ASSESSMENT MARKS: 100 | TIME ALLOWED: 2 HOURS |

## Answer The Following:

### First Question (25 points):

1-(10 points) What is the difference between fuse and circuit breakers?

2-(5 points) complete and **give reason** for:

Ideal current sources have internal resistance value of……. Connected in …………….

3-(10 points) draw the waveform and phasor forms of the following equations and find their phase difference. V=20 sin(ωt+40) V. and I=10 cos(ωt-50) mA.

### Second Question (25 points):

1-(15 points) complete and **give reason** for

1) To convert between current source and voltage source there are three conditions……………

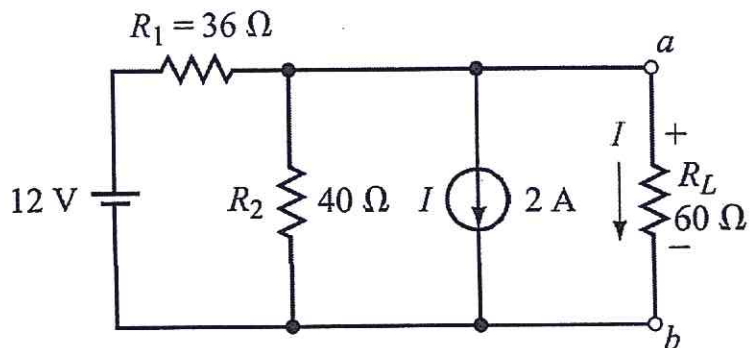2) The law of conservation of energy in electrical circuits states that …………………..

2-(10 points) using the mesh loop technique find the current in each loop of the following circuit when the load resistance is set to 5KΩ
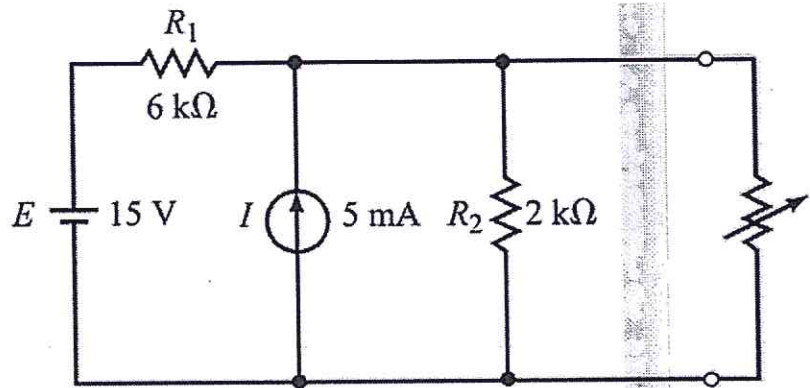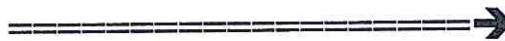


### Third Question (25 points):

1- (5 points) Define: integrator circuit.

2- (10 points) using the superposition theorem, find the voltage across the load resistance
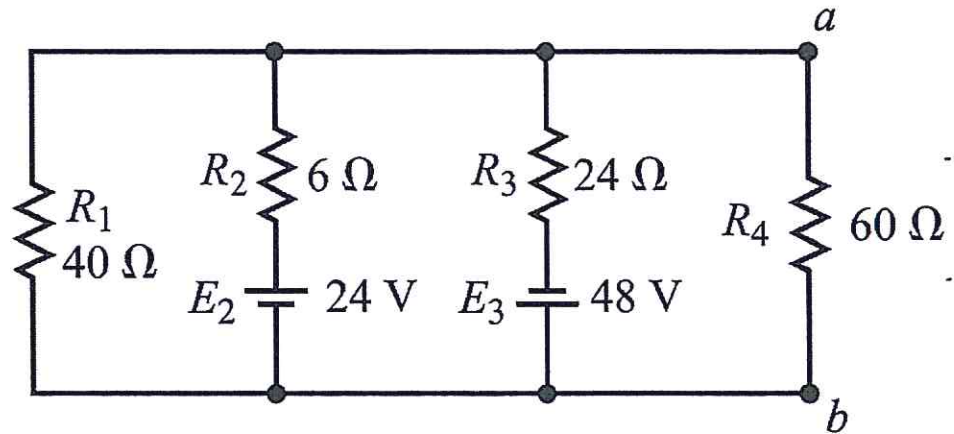


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<div dir="rtl">لاحظ ان الأسئلة على وجهين</div>

3- (10 points)
Find the Norton equivalent circuit between points a and b.



**Fourth Question (25 points):**

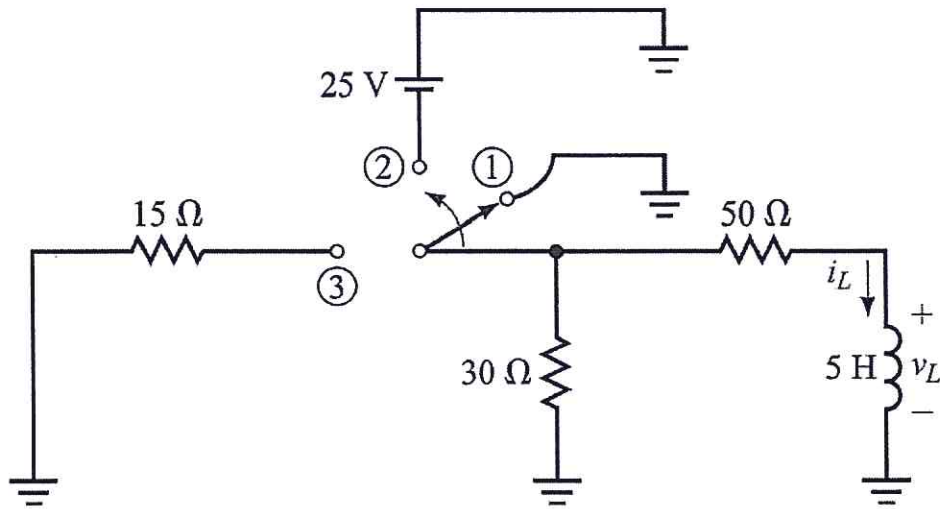1-(15 points) define:

Steady state

Kirchhoff's current law

Stray capacitance

2-(10 points) In the following circuit, when the switch is set to position 2 the circuit is energizing the inductor with energy. When the circuit reaches steady state find:

-The currents in all the branches.

-The voltage across the inductor VL.



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# Answer the following

## First question:

Write short notes about:

A) Crystal systems and fourteen Bravais lattices.

B) Diffraction of x-ray and deduce Bragg's law.

## Second question:

A) In a cubic unit cell draw the planes (134), (111), (101) and (200). Calculate the inter planer distances for these planes if a = 3.4 A°

B) Derive an expression for the determination of unit cell dimensions of a rectangular unit cell.

## Third question:

A) Explain only powder photograph **or** single crystal rotation photograph.

B) Discuss in detail the interatomic forces in solids.

## Fourth question:

Explain in detail the free electron model in a metal and derive an expression for the energy level in three dimensions.

Good luck

Examiner: Prop Dr. Abd El Razik Abdeen

## Please Answer the Following:

**Q1)** a) Put True or false: [12 Marks]

1- All physical problems could be solved analytically:

2- Computational and numerical methods always produce exact solutions.

3- There is no difference between true errors and relative true errors.

4- The error propagation in measurements and calculations is the algebraic summation of true error of all quantities.

b) Compare between Bisection method and Newton's method: The algorithm, advantages, and disadvantages. [13 Marks]

**Q2)** a) The strain in an axial member of a square cross-section is given by $\epsilon = F/(h^2 E)$, where the axial force in the member is $F = 72 \pm 0.9$ N, the length or the width of the cross section is $h = 4 \pm 0.1$ N, and Young's modulus is $E = 70 \pm 1.5$ GPa. Find the maximum possible error in the measured strain. [12 Marks]

b) The velocity of an object is given by

$$v(t) = 2000 \, ln(\frac{14 \times 10^4}{14 \times 10^4 - 2100\, t}) - 9.8t$$

Use the backward, forward, and difference approximation to calculate the force affect that object if its mass is 1000 Kg at t=16 s and a time step of $\Delta t = 2 \, Sec.$ [13 Marks]

**Q3)** a) Find solutions of the equation x²-7x+10=0 by using Newton's method. For the starting point, use (a) x=1 and (b) x=7. Five iterations are enough and show the relative approximate error for each. [13 Marks]

b) Explain sources of numerical errors with examples. [12 Marks]

**Q4)** a) An object moves from rest with a velocity v(t)= 5 t² m/sec. Find the exact distance that the object can move in 5 sec. Use trapezoidal method to estimate the distance covered by the object, assume 5 intervals and find the true error. [12 Marks]

b) Prove that the second order derivative could be approximated as

$$f''(x_i) \approx \frac{f(x_{i+2}) - 2\,f(x_{i+1}) + f(x_i)}{\Delta x^2}$$

[13 Marks]

☺ ☺ Best Wishes ☺ ☺

A. Prof. Dr. Mohammed Shihab

## ANSWER ALL THE QUESTIONS:

### Question (1)

1. Describe the Classification of radiation in details and discuss the interaction of radiation in matter?
2. Defined: 1-energy fluence, 2-Kerma, Cema, 3-absorbed dose, 4-exposure, 5-equivalent dose, 6-Effective dose?

### Question (2)

1. Describe the stopping power, Cavity theory and Spencer–Attix cavity theory?
2. Discuss the method of radioactive decay and give an example for each method?
3. What is the advantage and disadvantage of power tower design?

### Question (3)

1. What are the general principles for the establishment of nuclear radiation detectors and describe each in details?
2. Energy resources can be classified into A renewable and non-renewable resource, give an example for every resource and descript it in details?

### Question (4)

1. Describe the regions for structure and composition of the atmosphere?
2. Defined: 1-Solar Radiation, 2-Diffused Solar Radiation, 3-Direct Solar Radiation, 4-Solar thermal energy (STE), 5-Low-temperature collectors, 6-Medium-temperature collectors, 7-High-temperature collectors, 8-Parabolic trough designs, 9-Boiling water reactor, 10-Pressurized Water Reactors.

**Good Luck**

Dr. Ahmed Elmekawy