marks):

at is the power radiated per cm² from your skin at temperature of 33 °C .
0^{-12} KCal/cm².h.K⁴)

Write short account about the work mechanism of sensory neurons, motor neurons and er-neurons of nervous system.

Sketch only the diagram for the behavior of blood velocity against cross-section area ss the aorta, capillaries and vein cava.

(10 marks):

Explain in details how the resting and acting potentials are produced inside the axon

Write only Goldman equation for the membrane potential and then calculate the Nernst potential at NPT when K^+ ions are replaced by Ca^{2+} ($(Ca^{2+})_o = 200$ and $(Ca^{2+})_i = 50)$.

Write only the most information's which can be obtained by ECG.

(10 marks):

(a) If the human ear can detect a sound in air at a periodic time of 1 ms corresponding to an intensity of 10^{1} Watt/m². Determine the pressure and displacement amplitude associated with these two limits. ($\rho = 1.3$ Kg/m³ and v = 3 0 m/s for air)

(b) With sketch the required diagrams show that Doppler effect can be used to measure the velocity of blood within the human body.

(c) Explain in detail how you can determine the velocity of acting potential in motor nerves.

11. Two bodies M and N of equal masses are suspended from two separate mass less springs of spring constants k_1 and k_2 respectively. If the two bodies oscillate vertically such that their maximum velocities are equal, the ratio of the amplitudes of M to that of N is

a. $\dfrac{k_1}{k_2}$

c. $\dfrac{k_2}{k_1}$

b. $\dfrac{\sqrt{k_1}}{k_2}$

d. $\sqrt{\dfrac{k_2}{k_1}}$

12. Tripling the weight suspended vertically from a coil spring will result in a change in the displacement of the spring's lower end by what factor?

a.   0.33

c.   3.0

b.   1.0

d.   9.0

13. A mass on a spring vibrates in simple harmonic motion at a frequency of 4.0 Hz and an amplitude of 4.0 cm. If a timer is started when its displacement is a maximum (hence $x = 4$ cm when $t = 0$), what is the speed of the mass when $t = 3$ s?

a.   zero

c.   0.015 m/s

b.   0.006 5 m/s

d.   0.024 m/s

14. An object moving in simple harmonic motion has an amplitude of 0.020 m and a maximum acceleration of 40 m/s^2. What is the frequency of the system?

a.   0.60 Hz

c.   7.1 Hz

b.   51 Hz

d.   16 Hz

15. For a system in simple harmonic motion, which of the following is the number of cycles or vibrations per unit of time?

a. amplitude

c. frequency

b. period

d. revolution

16. A 0.20-kg object is oscillating on a spring with a spring constant of $k = 15$ N/m. What is the potential energy of the system when the object displacement is 0.040 m, exactly half the maximum amplitude?

a.   zero

c.   0.012 J

b.   0.006 0 J

d.   0.018 J

17. Interference of waves have been observed with

a.   light waves

c.   water waves

b.   sound waves

d.   all

2. A series RLC circuit has components with following values: L= 20.0 mH, C= 100 nF, R= 20.0 Ω, and V_{max}= 100 V, with V= V_{max} sin ωt.

Find: **(5 Marks)**

    (a) the resonant frequency,

    (b) the amplitude of the current at the resonant frequency,

    (c) the Q (quality factor) of the circuit,

    (d) the amplitude of the voltage across the inductor at resonance, and

    (e) the average power delivered to the circuit
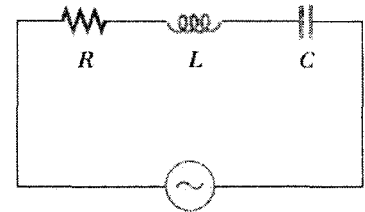
2. A spring has a spring constant of 135 N/m. How far must it be compressed so that 4.39 J of elastic potential energy is stored in the spring? **[5 marks]**

Assiut University   First term examination   Time :3 hours
Faculty of science   Thermodynamics (223 P)   Marks: 50 degree
Physics department   (2nd level Phys.)   Date: 29/12/2016

Answer the following questions

1. **a) -i-** According to the kinetic theory of ideal gas, prove that twice of average kinetic energy of gas molecules inside the gas container is equal to three times of the molecules heat energy. Derive an expression for the isothermal elastic coefficient and the expansion coefficient at constant pressure of the ideal gas.
ii- Prove that air pressure at infinite altitude measured from the ground center is not equal zero

   b)-i- Derive an expression for the total number of molecules per unit volume according to their velocity components along the three Cartesian coordinates.
ii. Prove that the root mean square velocity, average and most probable velocities of the ideal gas are proportional to the absolute temperature of this gas. Show the proportional constant in each expression and deduce the relation between these three velocities.

   c)-i- A gas of mass 12 gm occupies volume 4×10^{-3} meter at temperature 7 C". The gas is heated at constant pressure. The gas density after heating equals 6×10^{-4} gm cm^{-3}. Calculate the final temperature after heating.
ii- Calculate the number of oxygen gas molecules per unit volume at one atmospheric pressure and absolute temperature where the oxygen gas molecule mass is 52.8×10^{-27} Kg and Boltzmann's constant $k = 1.38 \times 10^{-23}$ J/K°

2. **a)-i-** Write an expression for the first law of thermodynamics in case of the isothermal and adiabatic variations of the ideal gas. Prove that $C_p > C_V$ and $C_p/C_V = \gamma$ for this gas
ii- Deduce the laws govern the adiabatic variation of the ideal gas.

   b)- An ideal gas of initial temperature T_1 and final temperature T_2, derive an expression for the work done during the adiabatic variations of this gas.

   c)-i- One litre of helium gas is suddenly expressed from one atmospheric pressure to ten (10) atmospheric pressure . Calculate the work done during this process where $\gamma = 1.6$. Explain the result obtained.
ii- One gm of water changes to 1671 cm^3 vapour when the water is boiling at one atmospheric pressure. If the latent heat of vaporization is $L_V = 539$ cal/gm., calculate the work done and the increase of internal energy in this case.

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Look the back page

</div>

3. **a)-i**: Drive the equations which can describe the following:

The real gas behavior of mass M and molecular weight μ

The gaseous – liquid states and the changes be ween these two states of the real gas. Indicate these states on a diagram.

ii- Write an expression for the: critical volun e - critical temperature and critical pressure of the real gas.

b)- Derive an expression for the temperature at which the real gas changes to the ideal gas

c)-i- Calculate the number of molecules per unit centimeter inside a spherical container of diameter 15 cm provided that no collisions occurrence between the molecules where the molecule diameter is $3x10^{-8}$cm Calculate the pressure of these molecules inside this container at temperature equals 27C°.

ii- Find the mean number of collisions per second (collision frequency) of a gas molecules at one atmospheric pressure and absolute temperature where the radius of molecule $2x10^{-10}$ meter and the mass is $52.4x10^{-27}$Kg. Calculate the gas viscosity in this case. (Using $k=1.38x10^{-23}$ J/K°)

4. **a)-i-** On a diagram show and explain how the heat engine can complete one cycle according to Carnot cycle

ii- Derive an expression for the total work done during Carnot cycle and the efficiency of the heat engine.

b)-i- Using a special relation to obtain an expression for the Maxwell's equations in thermodynamics. Drive an expression for entropy change in terms of C_p and C_V of the gas.

ii- In terms of both the isothermal elastic coefficient λ_T and the isothermal expansion coefficient α_P of the gas, prove that $C_p-C_V =R$ for this gas.

c)-i- Heat engine works between 450K° and 350K°. The heat quantity gained from the heat source is 1000 Cal. Calculate the following:
- The heat quantity given to the cooler
- The work done during this cycle where 1 cal.=4.18 Joule
- The efficiency of this heat engine

ii- Assume 8 gm of oxygen gas inside a container of volume (10 liter) and temperature (80 C°), is transferred to another container of volume (40 li er) and temperature (300C°). Calculate the entropy change in this case (U ing $\mu_{O2}=28$ Kg mol^{-1}, $(C_V)_{O2}=21.03$ J mol^{-1}K^{-1} and R=8.314 J mol^{-1}K^{-1})

================== With my best wishes for all of you================================

Prof. Dr. Abd-El Halim Turky

Question (3): (10 Mark)

a) Starting from equation $T = (m - m_0) c^2$, derive an expression for the relation between total energy and kinetic energy. (3 points)

b) The total energy of an electron produced in a particular nuclear reaction is measured to be 2.40 MeV. Find the electron's momentum and speed. (4 points)

c) Calculate the minimum energy and wavelength of a gamma ray photon, which can produce an electron positron pair. (3 points)

Question (4): (10 Mark)

a) Show failure of classical theory and success of Einstein's theory to explain the photoelectric effect on the following items: (6 points)

- The independence of stopping voltage on the intensity of incident radiation.
- The existence of threshold frequency.
- The dependence of stopping voltage on the energy of incident radiation.
- No time lag between the arrival of radiation the ejection of electron if the incident energy is greater or equal certain energy.

b) Which of the following materials can be used for designing photocell works with visible light?   Tantalum (work function $\phi_0 = 4.2$ eV),   Tungsten ($\phi_0 = 4.5$ eV),

   Aluminium ($\phi_0 = 4.2$ eV),   Barium ($\phi_0 = 2.5$ eV)   (4 points)

Question (5): (10 Mark)

a) Derive the radius r_n of electron in $_2^4 He^+$ according to Bohr Model. (6 points)

b) If the Bohr radius is $a_0 = 5.32 \times 10^{-11}$, calculate the radius of second excited state in $_2^4 He^+$.
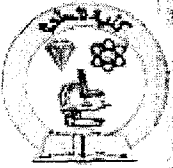
(4 point)

Question (6): (10 Mark)

a) Prove that the spacetime interval is invariant under Lorentz transformation. (5 points)

b) Prove that the speed of light is invariant under Lorentz transformation. (5 points)

Constants:

$m_0 = 9.11 \times 10^{-31}$ kg , 1 eV $\equiv 1.602 \times 10^{-19}$ J , $h = 6.6261 \times 10^{-34}$ J.s , $c = 3 \times 10^8$ m/s ,

visible light is in the range 4000 Å to 8000 Å, $e = 1.6 \times 10^{-19}$ C

3. It is possible for a constant magnetic field to alter the speed of a charged particle. ( )

4. An electric generator is a device that converts electrical energy into mechanical energy. ( )

5. The magnetic field produced in a straight wire has no poles. ( )

6. The resonance in a series RLC circuit occurs at the same frequency regardless of the value of R. ( )

7. As the bar in the following figure moves to the right, an electric field is set up directed upward in the bar. ( )

III. Choose the correct answer. Explain your answers by writing down the steps of the solution.

(16 Marks)

1. An inductor in the form of a solenoid contains 420 turns, is 16.0 cm in length, and has a cross-sectional area of 3.00 cm^2. What uniform rate of decrease of current through the inductor induces an emf of 175 μV?

(a) –0.3 A/s   (b) -0.42 A/s   (c) -0.23 A/s   (d) -0.5 A/s

2. Consider the circuit in the following figure, taking E= 6.00 V, L =8.00 mH, and R = 4.00 Ω. (a) What is the inductive time constant of the circuit?

(a) 2 ms   (b) 8.3 min   (c) 0.5 ms   (d) 2 s

4. A mass of 0.40 kg, hanging from a spring with a spring constant of 80 N/m, is set into an up-and-down simple harmonic motion. What is the speed of the mass when moving through the equilibrium point? The starting displacement from equilibrium is 0.10 m.

a.   zero
c.   2.0 m/s
b.   1.4 m/s
d.   3.4 m/s

5. A pendulum swings through a total of 28°. If the displacement is equal on each side of the equilibrium position, what is the amplitude of this vibration? (Disregard frictional forces acting on the pendulum.)

a. 28°
c. 56°
b. 14°
d. 7.0°

6. What is the maximum value of the acceleration a when
$x = A\ cos(\omega t + \varphi)$?

a. ω
c. $\omega^2 A$
b. ωt
d. $A\ \varphi$

7. Vibration of an object about an equilibrium point is called simple harmonic motion when the restoring force is proportional to

a. time.
c. a spring constant.
b. displacement.
d. mass.

8. Tripling the displacement from equilibrium of an object in simple harmonic motion will change the magnitude of the object's maximum acceleration by what factor?

a. one-third
c. 3
b. 1
d. 9

9. A mass attached to a spring vibrates back and forth. At maximum displacement, the spring force and the

a. velocity reach a maximum.
c. acceleration reach a maximum.
b. velocity reach zero.
d. acceleration reach zero

10. For a mass hanging from a spring, the maximum displacement the spring is stretched or compressed from its equilibrium position is the system's

a. amplitude.
c. frequency.
b. period.
d. acceleration.

3. An air-core solenoid with 68 turns is 8.00 cm long and has a diameter of 1.20 cm. How much energy is stored in its magnetic field when it carries a current of 0.770 A?

(a) 2.44 μJ   (b) 1.42 μJ   (c) 5.44 μJ   (d) 10.46 μJ

4. When a switch is closed in an RL series circuit, the time needed for the current to reach one half its maximum value is ……….. time constants.

(a) 0.25   (b) 0.5   (c) 0.693   (d) 1   (e) 1.44

5. A series LC circuit contains a 100 mH inductor, a 36 mF capacitor and a 12 V battery. The frequency of the electromagnetic oscillations in the circuit is

(a) 5.73×10^{-4} Hz   (b) 9.55×10^{-3} Hz   (c) 0.442 Hz   (d) 2.66 Hz   (e) 44.0 Hz

6. A motor in normal operation carries a direct current of 0.850 A when connected to a 120-V power supply. The resistance of the motor windings is 11.8 Ω. While in normal operation, the back emf generated by the motor is………….

(a) 220 V   (b) 110 V   (c) 11 V   (d) 10 V

Q4(9 marks):

(a) By using two different methods, calculate only the wave length of accelerating electron directed onto a nickel crystal ($V = 54$ Volt, $\Theta = 65^0$, $d = 0.91$ Å and $m_0 = 9.1 \times 10^{-31}$ Kg).

(b) Explain in details how the radioactive nucleus can undergoes two types of β decay.

(c) Write the uncertainty principle, and then derive the uncertainty in the energy and time.

15. Electromagnetic induction is the
   (a) Charging of a body with a positive charge.
   (b) Production of current by relative motion between a magnet and a coil.
   (c) Rotation of the coil of an electric motor.
   (d) Generation of magnetic field due to a current carrying solenoid.

16. Consider the AC circuit in the following figure. The frequency of the AC source is adjusted while its voltage amplitude is held constant. When does the lightbulb glow the brightest?
   (a) It glows brightest at high frequencies.
   (b) It glows brightest at low frequencies.
   (c) The brightness is the same at all frequencies.
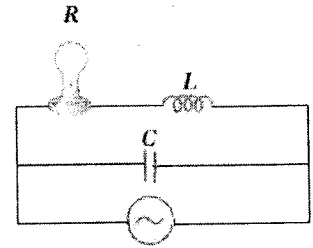
17. A metal ring is placed near a solenoid, as shown in the following figure. the direction of the induced current in the ring at the instant the switch in the circuit containing the solenoid is thrown closed is
   (a) counterclockwise
   (b) zero
   (c) clockwise
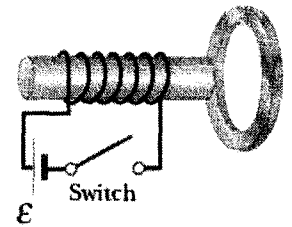
18. Which material would make a better permanent magnet?
   (a) one whose hysteresis loop looks like the right figure of the following figure.
   (b) one whose hysteresis loop looks like the left figure of the following figure.
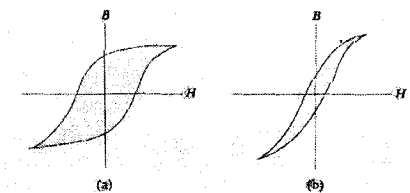
II. Are following statements true or false? Explain your answers.   **(7 Marks)**

1. The inductance of a coil depend on the current in the coil   (   )

2. The field at the centre of a long circular coil carrying current will be parallel straight lines   (   )

24. When two or more waves are at the same place at the same time, the resulting effect is called
   a.   a standing wave.   c.   a shock wave.
   b.   a Doppler wave.   d.   interference.

25. Suppose there is an object for which $F = +kx$. What will happen if the object is moved away from equilibrium ($x = 0$) and released?

   a. It will return to the equilibrium position.
   b. It will move further away with constant velocity.
   c. It will move further away with constant acceleration.
   d. It will move further away with increasing acceleration.

26. A mass M is suspended from a light spring. If the additional mass m is added, it displaces the spring by a distance x. now the combined mass will oscillate on the spring with time period equals to:

   a. $T = 2\pi \sqrt{\dfrac{mg}{x(M+m)}}$ c. $T = \dfrac{\pi}{2} \sqrt{\dfrac{mg}{x(M+m)}}$

   b. $T = 2\pi \sqrt{\dfrac{x(M+m)}{mg}}$ d. $T = 2\pi \sqrt{\dfrac{x(M+m)}{mg}}$

27. Oscillations become damped due to
   a.   normal force.   c.   tangential force.
   b.   friction.   d.   parallel force.

28. In simple harmonic motion, object's acceleration depends upon

   a. displacement from equilibrium position.
   b. magnitude of restoring force.
   c. both A and B.
   d. force exerted on it.

29. Velocity at equilibrium position is
   a.   constant.   c.   maximum.
   b.   minimum.   d.   zero.

30. Potential energy of mass attached to spring at mean position is
   a.   maximum.   c.   zero.
   b.   moderate.   d.   minimum.

4. A capacitor of capacitance C in an LRC circuit (see the figure) is initially charged and the switch is open; the charge on the plates of the capacitor is q_o. At time $t = 0$ the switch is closed and the capacitor is discharged.
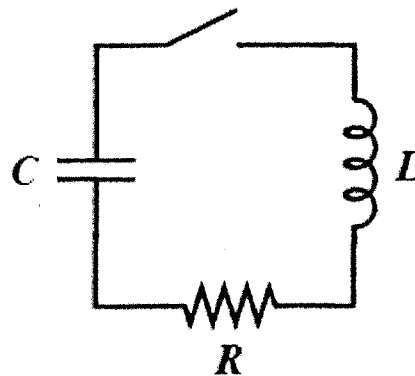
a) Write down the differential equation for the charge $q(t)$ during the discharge. **[1 mark]**

b) What are the initial conditions for the discharge? **[1 mark]**

c) What should the value of the resistor R be to obtain critical damping? **[1 mark]**

d) Write down the analytic expression of the charge $q(t)$ in terms of q_o, L, and R for the case of critical damping. **[1 mark]**

e) Make a sketch of $q(t)$ for the case of critical damping. Mark your time axis in units of T, where T is the period of undamped oscillations (i.e., in the case that $R = 0$). **[1 mark]**
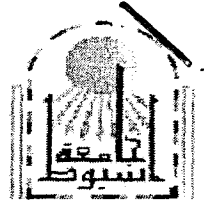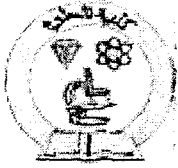
Final Exam – Second Term: (2016/2017) - Course Title: Principle of Modern Physics , P- 225 , Time: 2 h , Prof. Dr. Ahmed Sedky

Answer the following questions:

Q1(16 marks):

1. The expected shift of the fringes by M-M experiment is given by _____ , and it is really equal _____, when they rotated the apparatus by 90°.

2. Consider an object moves with $v = c$, then its proper length equal _____, and its proper time equal _____

3. The relativistic expression between E and P for an electron is given by _____ , and it is given by_____for a photon

4. The stopping voltage for photoelectric effect occurs when _____ ,and it is related to the kinetic energy by the relation _____

5. The λ_{min} (Å) of the x-ray photons is given by _____, and it is equal _____Å at V = 6.2 KV.

6. If the energy of γ-rays equal 5.022 MeV in pair production, the kinetic energy of the pairs is given by _____, and it is equal _____MeV

7. The $x_{1/2}$ of photon absorption in metals is given by_____ , and its equal _____ when $\mu_{\ell} = 78$ cm^{-1}.

8. R-G formula focused on the ultraviolet catastrophe because _____ , and it is agree with Planks formula at _____
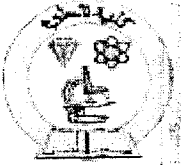
Q3(9 marks):

(a) Calculate the power emitted per m^2 from the surface of the sun if the minimum frequency at which the intensity peak occurs is 6.045×10^{14} Hz ($\sigma = 5.67 \times 10^{-8}$ W m^{-2} K^{-4}).

(b) Calculate E_b for $_2^4He$ ($M_{He} = 4.012$ amu, $m_p = 1.0073$ amu and $m_n = 1.0087$ amu).

(c) Calculate the minimum and maximum shift of the x-ray wave length by Å obtained by Compton effect.

B. Problems: Answer the following questions. [5 marks]

1. A spring stretches by 25.0 cm when a 0.500-kg mass is suspended from its end.

   a. Determine the spring constant. **[2.5 marks]**

   b. How much elastic potential energy is stored in the spring when it is stretched this far? **[2.5 marks]**

7. An incandescent lightbulb is rated at 100 Watt when plugged into a 220 V-rms household outlet. What is the resistance of the filament of this lightbulb?

(a) 48.4 Ω   (b) 2.2 Ω   (c) 484 Ω   (d) 121 Ω

8. A solenoid 2.50 cm in diameter and 30.0 cm long has 300 turns and carries 12.0 A. Calculate the flux through the surface of a disk of radius 5.00 cm that is positioned perpendicular to and centered on the axis of the solenoid, as shown in the following figure.

(a) 7.4 μWb   (b) 52 μWb   (c) 3.8 μWb   (d) 14 μWb
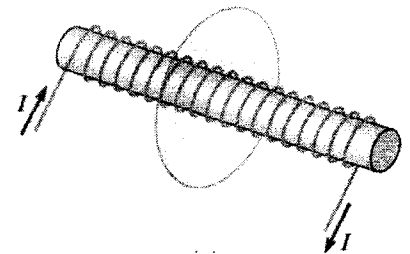
IV. Solve the following problems:

1. Consider the arrangement shown in the following figure. Assume that R=6.00 Ω, l=1.20 m, and a uniform 2.50 T magnetic field is directed into the page. At what speed should the bar be moved to produce a current of 0.500 A in the resistor?   **(4 Marks)**
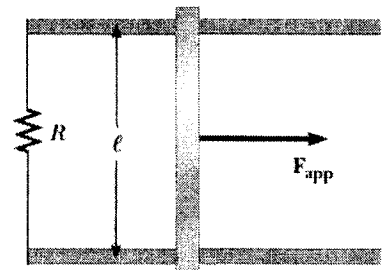
10. The magnetic field inside a long straight solenoid-carrying current:
   (a) is zero.
   (b) decrease as we move towards its end.
   (c) increase as we move towards its end.
   (d) is the same at all point.

11. Which of the following property of a proton can change while it moves freely in a magnetic field?
   (a) mass
   (b) Speed
   (c) Velocity.

11. A rectangular coil of copper wires is rotated in a magnetic field. The direction of the induced current changes once in each
   (a) two revolutions
   (b) one revolution
   (c) half revolution
   (d) one-fourth revolution

12. which of the following correctly describes the magnetic field near a long straight wire?
   (a) The field consists of straight lines perpendicular to the wire.
   (b) The field consists of straight lines parallel to the wire.
   (c) The field consists of radia lines originating from the wire.
   (d) The field consists of concentric circles centred on the wire.

13. The magnetic field produces due to the current passing through a conductor is proportional to the ………
   (a) Electric current.
   (b) Conducting material.
   (c) Length of conductor.
   (d) Diameter of conductor.

14. A soft iron bar is introduced inside a current-carrying solenoid. The magnetic field inside the solenoid
   (a) will become zero.
   (b) will decrease.
   (c) will increase.
   (d) Will remain unaffected.

Assiut University
Faculty of Science – Physics Department
Final Exam, Jan. 12, 2017
Course: Physical Optics & Optical Fibers (271P)
Programs: Physics and Physics/Chemistry
Time: Three hours - Total mark: 50 marks

Note: Define all symbols used in your answer. (Questions are presented in two pages)

The speed of light in free space $c = 3 \times 10^8$ m/sec and Planck's constant $h = 6.626 \times 10^{-34}$ J.sec

PART I: (14 marks, 2 marks for each item)

Answer the following questions as shown between brackets:

1- The intensity of the wave motion described by the equation $y = 4 \sin(2x - 10t)$, where t is time in sec and x and y are in m is I_1, then the intensity of the wave motion described by the equation $y = 2 \sin(4x - 10t)$ travelling in the same medium equals:

   a) I_1 b) $2I_1$ c) $4I_1$ d) $8I_1$ e) $16I_1$ (Choose the correct answer)

2- For a light wave travelling in empty space the general differential equation is defined as ……………………………………………………………………………..…… . (Fill in spaces)

3- The electromagnetic wave is described by two sinusoidal components. (Define these components and the relation between their amplitudes)

4- In standing waves, if λ is the wavelength, we get nodes at distances x where

   a) $x = n\lambda/2$ b) $x = (2n+1)\lambda$ c) $x = (2n+1)\lambda/2$ d) $x = (2n+1)\lambda/4$ e) $x = (2n+1)\lambda/3$

   ($n = 0, 1, 2, …$)   (Choose the correct answer)

5- The phasor addition can be used to obtain the resultant of combination of four electromagnetic waves with constant path difference δ.

         (Draw this addition and extract the resultant wave when $\delta = \lambda/8$)

6- In Newton's rings experiment if a light of wavelength 580 nm is used and the radius of the lens is 30 cm, the radius of the third bright fringe equals ………..…(Fill in spaces).

7- The wavelength of light emitted from LED electronic source is inversely proportional to the bandgap energy. (Verify the statement and find the wavelength if the bandgap energy equals to 1 eV)

4. Two straight wires that are parallel to each other are carrying currents in opposite directions. What happens to the wires?
    (a) They stop carrying current because the current directions cancel each other out.
    (b) Nothing happens.
    (c) They repel each other.
    (d) They attract each other.

5. A magnetic field exerts a force on ....
   (a) only electrons
    (b) all charged particles, regardless of size
    (c) only protons
    (d) only small particles

6. A magnetic field is generated .... the direction of current in a wire.
    (a) in the same direction as
    (b) opposite of
    (c) parallel to
    (d) perpendicular to

7. In the following figure, if the magnetic poles were reversed, what would the direction of the magnetic force be?
    (a) right
    (b) down
    (c) up
    (d) left
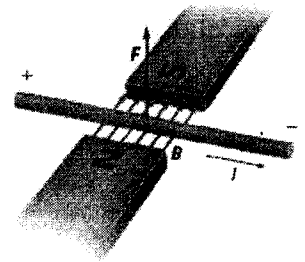
8. An increase in which of the following would result in the increase of magnetic flux density (B) in a solenoid?
    (a) core permeability
    (b) number of coil turns
    (c) current in the coil
    (d) all of the above

9. Why are eddy current coils not made using iron wire?
    (a) to avoid hysteresis effects
    (b) to make mathematical calculations easier
    (c) to prevent excessive heat build-up
    (d) for cathodic breakdown considerations

First Term -Final Exam (2016/2017) Biophysics
P-323 - Time: 3h -Teaching Staff: Prof. Dr. Ahmed Sedky

Answer the following questions:
Q1a(5 marks), Complete the following sentences:

1- Systolic pressure =_____ Dyne/cm^2 for young person at rest ($\rho = 1.05$ g/cm^3).

2- The average periodic time interval of the bats chirps' =_____

3- Cryo surgery is made by freezing the tip of the probe at a temperature of_____ k.

4- A good ear normally needs about _____ more intensity to detect a sound at

100 Hz than that of_____

5- The brain acoustic impedance = _____ ($\rho = 1.02$ g/cm^3, $v = 1530$ m/s).

Q1b (5 marks): Put √ or X in the following :

1. The energy released per one gram of fuel equal **10000 J**   (   )

2. The time interval for short spike of the axon potential is **32 ms**   (   )

3. Presbyopia occurs when the refractive index of the outer layer decreases.   (   )

4. The bats emit sound waves and also detect the echoes in **50 ms**.   (   )

5. Astigmatism occurs due to lack of symmetry in the curvature of the retina   (   )
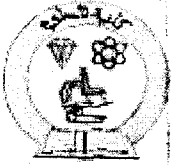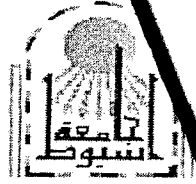
Q2(9 marks):

(a) Explain with drawing how you can determine Planck's constant from photoelectric effect.

(b) Derive an expression for time dilation in special relativity.

(c) An electron's speed is increased from 0.2c to 0.8c. By what ratio does its momentum increase in terms of $m_0 c$.

## PART II: (36 marks, 9 marks for each question)

Answer <u>only four questions</u> from the following:

1- a) Describe how the Fresnel mirrors are used as an interferometer to determine the wavelength of light.   (4 marks)

   b) Show how the Nicol prism is used as a polarizer.   (5 marks)

2- a) Prove that the bright and dark fringes obtained by Young's double-slit experiment have equal widths.   (4 marks)

   b) Deduce the characteristic curve of the electronic LED optical source.   (5 marks)

3- a) Determine the principal components of the communication system. Sketch a diagram showing the main constituents of each component.   (4 marks)

   b) Explain the physical concept of the population inversion required to produce the laser beam.   (5 marks)

4- a) Draw the profile of a GRIN optical fiber.   (5 marks)

   b) A monochromatic light of wavelength equals to **600 nm** is incident normally on a diffraction grating containing **5000** grooves per centimeter. Find the angles at observed fringes.   (4 marks)

5- a) Light of wavelength **600** nm is incident on a slit having a width of **0.25** mm. The viewing screen is **3.0** m from the slit. Find the positions of the first dark fringes and the width of the central bright fringe. What if the slit width is increased by an order of magnitude to **2.5** mm? What happens to the diffraction pattern?   (5 marks)

   b) Derive an expression of the numerical aperture of an optical fiber in terms of the refractive indices of the core and cladding.   (4 marks)

<u>Good Luck</u>

Prof. Dr. Mohamed El-Azab Farid

Physics Department
Assiut University
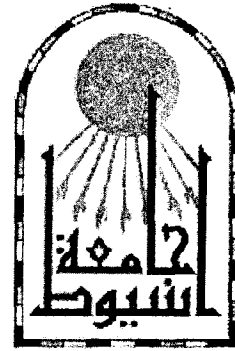
Physics 212F – Oscillations and Waves

THIS TEST HAS TEN PAGES

DURATION OF TEST: 3 HOURS

Date: 29th December 2016.

Examiner: Dr. Ahmed Mostafa Amry

Answer ONLY 25 question from section A.

Answer ALL questions in section B.

A. **Multiple Choice:** Identify the choice that best completes the statement or answers the question. **[25 marks]**

1. A particle executes SHM with a frequency f. The frequency with which it's KE oscillates is

    a. $f/2$ c. $2f$

    b. f d. $4f$

2. A mass of 0.40 kg, attached to a spring with a spring constant of 80 N/m, is set into simple harmonic motion. What is the magnitude of the acceleration of the mass when at its maximum displacement of 0.10 m from the equilibrium position?

    a. zero   c. 10 m/s^2

    b. 5 m/s^2 d. 20 m/s^2

3. The process of waves appearing with different intensity at a point when a number of waves pass through a point in a medium is known as

    a. interference   c. polarization

    b. diffraction   d. all
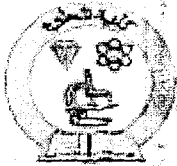
Q5(7 marks):

(a) Calculate by Å the shorter wave length of Ballmer series for the hydrogen atom $(R_h = 1.097 \times 10^{-3} \text{ Å}^{-1})$.

(b) According to De Broglie hypothesis Calculate the wave length related to the electron moves with $v = 0.55c$ $(m_o = 9.1 \times 10^{-31} \text{ Kg})$.

(c) In terms of the required reactions and diagrams write short account about nuclear fission.

I. Choose the correct answer. You must give reasons for your answers (using figures, equations or statements). **(18 Marks)**

1. Initially, an inductor with no resistance carries a constant current. Then the current is brought to a new constant value twice as large. After this change, what has happened to the emf in the inductor?
   (a) It is larger than before the change by a factor of 4.
   (b) It is larger by a factor of 2.
   (c) It has the same nonzero value.
   (d) It continues to be zero.
   (e) It has decreased.

2. A long fine wire is wound into a coil with inductance 5 mH. The coil is connected across the terminals of a battery, and the current is measured a few seconds after the connection is made. The wire is unwound and wound again into a different coil with L=10 mH. This second coil is connected across the same battery, and the current is measured in the same way. Compared with the current in the first coil, is the current in the second coil
   (a) four times as large?
   (b) twice as large?
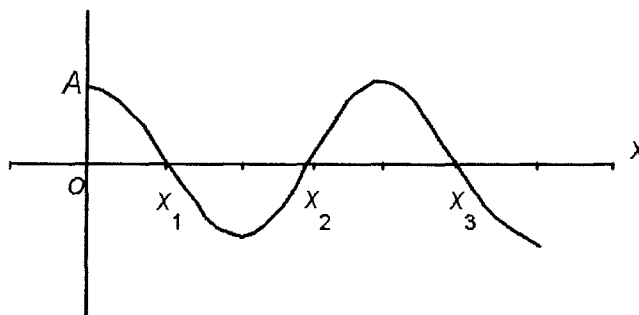   (c) unchanged?
   (d) half as large?
   (e) one-fourth as large?

3. If the current in an inductor is doubled, by what factor is the stored energy multiplied?
   (a) 4
   (b) 2
   (c) 1
   (d) 0.5
   (e) 0.25

18. A large spring requires a force of 150 N to compress it only 0.010 m. What is the spring constant of the spring?
    a.   125 000 N/m   c.   15 N/m
    b.   15 000 N/m   d.   1.5 N/m

19. Consider the curve $f(x) = A\ cos(2\pi x/\lambda)$. The wavelength of the wave will be:

    a.   the distance 0 to A.   c.   the distance x_2 to x_3.
    b.   twice the distance 0 to A.   d.   twice the distance x_2 to x_3.

20. Two water waves meet at the same point, one having a displacement above equilibrium of 60 cm and the other having a displacement above equilibrium of 80 cm. At this moment, what is the resulting displacement above equilibrium?
    a.   140 cm   c.   70 cm
    b.   100 cm   d.   50 cm

21. A simple pendulum on the Earth has a period of one second. What would be its period in s on the moon where the acceleration due to gravity is 1/6 that of Earth?
    a. 6.00s   c. 1.00s
    b. 2.45s   d. 0.408s

22. The lowest A on a piano has a frequency of 27.5 Hz. If the tension in the 2.0 meter string is 308 N, and one-half wavelength occupies the wire, what is the mass of the wire in kg?
    a. 0.025 kg   c. 0.72kg
    b. 0.051kg   d. 0.81kg

23. The length of a simple pendulum executing simple harmonic motion is increased by 21%. The percentage increase in the time period of the pendulum of increased length is:
    a. 11%   c. 42%
    b. 21%   d. 10%

5. The differential equation that describes a damped oscillator can be written as

$$\ddot{x} + \gamma\dot{x} + \omega_o^2 x = 0$$

where x is the displacement from equilibrium. Define the following terms using the parameters in the differential equation, and describe the motion in each case:

i) Under damped oscillator . **[2 marks]**

ii) Over damped oscillator . **[2 marks]**

iii) Critically damped oscillator. **[1 mark]**