KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2009/2010 ACADEMIC YEAR

FOR THE CERTIFICATE OF PRE-UNIVERSITY PHYSICS

COURSE CODE: PPHYS 011

COURSE TITLE: ELECTRICITY, MAGNETISM & MODERN PHYSICS

STREAM: SEMESTER ONE

DAY: MONDAY

TIME: 9.00 – 11.00 A.M.

DATE: 02/08/2010

INSTRUCTIONS:

1. *Answer question 1 and any other two questions*
2. *Question 1 carries 40 marks and is compulsory*
3. *All other questions carry 15 marks each.*

Use the following constants where necessary;

Plank's constant $h = 6.6 \times 10^{-34} Js$

$g = 9.8 ms^{-2}$

Speed of light $C = 3.0 \times 10^{8} ms^{-1}$

$1\ eV = 1.6 \times 10^{-19} J$

Mass of electron $M_e = 9.1 \times 10^{-31} kg$

$1\ a.m.u. = 1.66 \times 10^{-27} kg$

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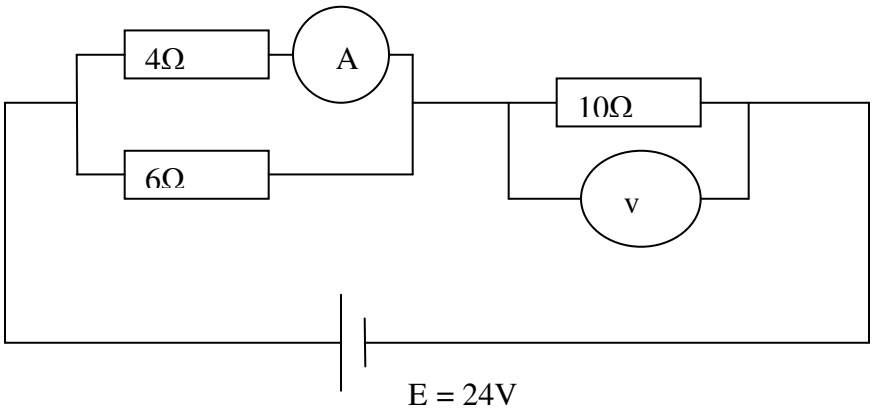
QUESTION 1 (40 MARKS)

a.) Give two uses of x-ray radiations. (2 marks)
b.) State Ohm's law. (1 mark)
c.) How should voltmeters have as high a resistance as possible but ammeters as low a resistance as possible? (2 marks)
d.) The maximum power dissipated in a 10Ω resistor is 22W. Calculate its maximum current. (2 marks)
e.) Calculate the readings of the voltmeter V and ammeter A in the below circuit. Also find the power taken from battery. (4 marks)



f.) Give one element that can be used to give p-type property of a semiconductor when used as a doping element. (1 mark)
g.) State two ways of producing an emf in a wire. (2 marks)
h.) Describe Bohr model of an atom. (3 marks)
i.) Give the difference between emission spectra and absorption spectra. (2 marks)
j.) Explain the use of oil in x-ray tube. (1 mark)
k.) A 2A electric current flows through a conductor. Calculate;
    1. How many Coulombs of charge pass through the conductor per second (2 marks)
    2. How many coulombs of charge per every 2 minutes? (1marks)
l.) A lamp rated 240V, 60W is used by a student for 4 hours every day. Find
    1. The power consumption for a week (3 marks)
    2. The resistance of the lamp (1 mark)
m.) Express Plank's constant in eV.s (1 mark)
n.) Light from the 253.7nm UV line in the mercury spectrum ejects electrons from the surface of metallic sodium.
    1. what is the maximum kinetic energy of these photoelectrons (3marks)
    2. Can photoelectrons be ejected from sodium by the green light (wavelength λ = 546nm) in the mercury spectrum? (2 marks)
o.) State Faraday's law. (2 marks)
p.) A battery of e.m.f of 24V and internal resistance (r) is connected to a circuit having two parallel resistors of 3Ω and 6Ω in series with an 8Ω. The current in the 3Ω resistor is 0.8A. Find
    i.) The current in the 6Ω resistor (2 marks)
    ii.) Internal resistance (r) (2 marks)
    iii.) The terminal p.d. of the battery (1mark)

QUESTION 2 (15 MARKS)

a.) Define resistivity (1 mark)

b.) A copper wire of resistance 10 ohms at room temperature is used in a circuit. If the diameter of this wire is 0.14mm and 16m of it is used in the wiring of the house; find

i.) its resistivity (2 marks)

ii.) the conductivity of the wire (2 marks)

iii.) The current in the wire when a 110V power supply is connected across it. (2 marks)

c.) Calculate the drift velocity if a current of 5A pass through a cross-section of a wire of $1mm^2$ during which 10^{28} electrons are allowed through it. (3 marks)

d.) An electric heating element dissipating 480W on 240V mains is to be made from a steel wire of thickness 1mm. Calculate the length of the ribbon needed if the resistivity of tungsten $5.65x10^{-8}\Omega.m$. (3 marks)

e.) Give two factors that affect induced e.m.f in a coil. (2 marks)

QUESTION 3 (15 MARKS)

a.) What do you understand by the term doping as used in semiconductor physics? (2 marks)

b.) Draw a forward biased p-n junction diode and a reversed biased diode. (4 marks)

c.) Briefly describe the causes of breakdown voltage of the junction in a reversed biased characteristics. (4 marks)

d.) Calculate current gain of a transistor that has an output current of 6mA and the input current of 210μA. (3 marks)

e.) Sodium particle decays by emission of beta particle to produce magnesium. Complete the radiation equation below;

$$^{24}_{11}Na \rightarrow Mg + \beta$$ (2 marks)

QUESTION 4 (15 MARKS)

a.) What is the meaning of wave particle duality? (1 mark)

b.) i) From decay law, rate of decay of a number of particles is proportional to the number of particles, $-\frac{dN}{dt} \alpha N$. Show that $\lambda = \frac{0.693}{t_{1/2}}$. (5 marks)

ii) Give two applications of radioactivity. (2 marks)

c.) Why does the electrical conductivity of an intrinsic semiconductor increase as temperature rises? (2 marks)

d.) An x-ray photon has a wavelength of $3.4x10^{-9}m$. Calculate the momentum, mass and energy of the particle associated with the photon which moves with a velocity C. (4 marks)

e.) Explain what you understand by the term induced current. (1 mark)