

KABARAK



UNIVERSITY

UNIVERSITY EXAMINATIONS

2010/2011 ACADEMIC YEAR

FOR THE CERTIFICATE OF PRE-UNIVERSITY PHYSICS

COURSE CODE: PPHYS 011

**COURSE TITLE: ELECTRICITY, MAGNETISM &
MODERN PHYSICS**

STREAM: SEMESTER ONE

DAY: TUESDAY

TIME: 9.00 – 11.00 A.M.

DATE: 15/03/2011

Answer QUESTION 1 and ANY OTHER TWO

You may need the following constants:

Electronic charge $e = 1.6 \times 10^{-19} \text{C}$.

$$\pi = 3.14$$

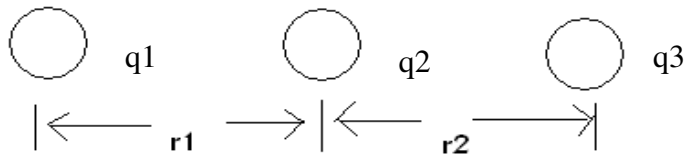
$$\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}$$

PLEASE TURN OVER

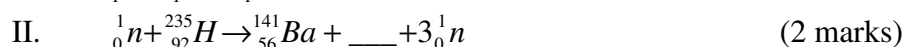
Question 1 (30 marks)

- (a) State any 4 properties of charge (4 marks)
- (b) Explain how lightning conductors discharge the clouds. (2 marks)
- (c) Three point charges, $q_1 = -4 \mu\text{C}$, $q_2 = 5 \mu\text{C}$, and $q_3 = 1 \mu\text{C}$, are placed as in Figure below.



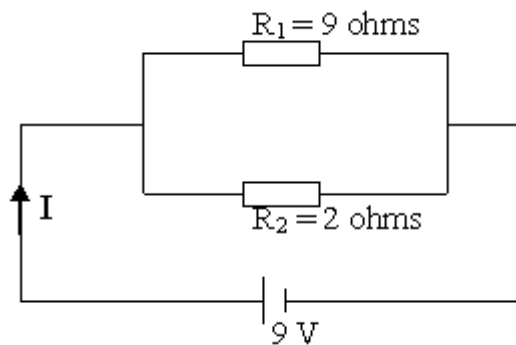
If $r_1 = 0.5 \text{ mm}$ and $r_3 = 0.8 \text{ mm}$, find the force on q_2 due to the other two charges.

- (5 marks)
- (e) Sketch a graph illustrating dependence of resistance on length l of a wire conductor keeping cross sectional area constant. (3 marks)
- (f) State three transformer losses. (3 marks)
- (h) (i) Explain the term "work function" of a metal (2 marks)
- (ii) The ^{14}C content decreases after the death of a living system with a half-life of 5739 years. If the ^{14}C content of an old piece of wood is found to be 12.5% of that of an equivalent present-day sample, how old is the piece of wood? (4 marks)
- (i) If the distance between two equal point charges is doubled, and their individual charges are also doubled, what would happen to the force between them? Show your working. (3 marks)
- (j) i. Define
I. Fusion
II. Fission
ii. Complete the following reactions (*use the periodic table where applicable*)



Question 2 (20 marks)

- (a) Define Electric current. Give its Symbol and SI unit (3 marks)
- (b) (i) State ohm's law (2 marks)
(ii) Write the general expression for the total resistance for N resistors connected in parallel. (2 marks)
- (c) For the circuit below,
i) compute the total resistance (6 marks)
ii) the current I (7 marks)



Question 3 (20 marks)

- (a) Define Capacitance (2 marks)
- (b) Sketch charging and discharging curves of a capacitor. (4 marks)
- (c) (i) Derive an expression for equivalent capacitance for a circuit with capacitors C₁, C₂, and C₃ connected in series. (5 marks)
(ii) A potential difference of 12 volts is connected to a 2 μ C and 8 μ C in parallel.
I. Calculate the charge on each capacitor (3 marks)
II. Total circuit capacitance C_{eq} (3 marks)
III. Total energy stored by the capacitors, (3 marks)

Question 4 (20 marks)

- (i) Define half life of a radioactive material (2 marks)
- (ii) Explain the three types of radioactive decay processes giving examples of each. (6 marks)
- (iii) Derive half-life (T_{1/2}) equation for radioactive material. Hence show that the decay law can be expressed as:

$$N = N_0 e^{-(\ln 2 / T_{1/2})t}$$

where N = number of nuclei present at any time t ,
 N_0 = initial number of nuclei.

- (iv) An isotope has 2.665×10^{21} particles. Its decay rate is 3.70×10^{10} particles/sec. (8 marks)
- I. Decay constant (2 marks)
- II. Half life of the isotope (2 marks)

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Period 1	1 H																		2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne	
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar	
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr	
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe	
6	55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn	
7	87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cp							

58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr