fomenky's

UNIVERSITY OF BUEA
COLLEGE OF TECHNOLOGY
FIRST SEMESTER Examinations 2017/2018

MONTH: ~~February~~ March
YEAR: 2018
DATE: 08/02/2018
TIME ALLOWED: Three Hours

COURSE INSTRUCTOR: MIH T./Nkongho A.
COURSE CODE & NUMBER: EEC 211
COURSE TITLE: PHYSICS 1
TIME: 15:00-18:00
CREDIT VALUE: 3

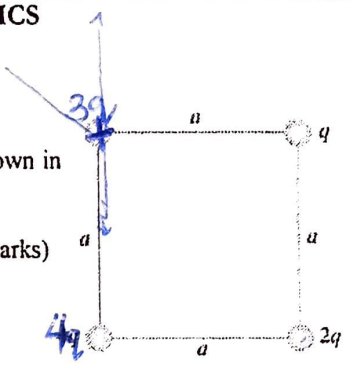
INSTRUCTIONS: Answer ALL questions. Begin each section on a new page. Where necessary, take m_p to be 1.67×10^{-27} kg, m_e to be 9.11×10^{-31} kg, $k_e = 9.0 \times 10^9$ N.m^2/C^2, G = 6.67×10^{-11} N.m^2/ kg^2.

SECTION I: ELECTROSTATICS

1. (13 marks)

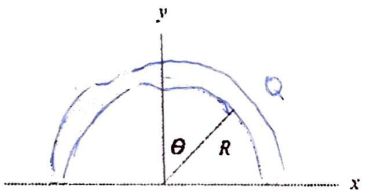
(a) State Coulomb's law. (2 marks)

(b) Four point charges are placed at the corners of a square of sides a as shown in the figure to the right.



i. What is the electric field at the location of charge 3q? (3 marks)

ii. Determine is the net force on the charge 2q? (3 marks)



(c) A positively charged wire is bent into a semicircle of radius R as shown in the figure to the left. The total charge on the wire is Q. However the charge per unit length on the semicircle is non uniform and is given by $\lambda = \lambda_0 \cos\theta$.

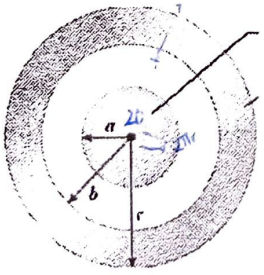
i. Establish the relationship between λ_0, R and Q. (2 marks)

ii. What would be the total force on a charge q place at the origin? (3 marks)

2. (22 marks)

(a) State Gauss's law. (2 marks)

(b) The diagram below shows a solid spherical conductor of radius a = 2cm located at the centre of a conducting shell of inner radius b = 6cm and outer radius c = 8cm. A total charge of 20μC is placed on the centre conductor.



i. Determine the charge densities on the on the inner and outer surfaces of the conducting shell and on the surface of the solid sphere. (3 marks)

ii. Compute the magnitude and direction of the electric field everywhere (i.e., at $r < a$, $a < r < b$, $b < r < c$ and at $r > c$.). (5 marks)

iii. The outer shell is now grounded by connecting a wire from the shell to earth. What would be the electric field a distance 12 cm from the centre of the sphere? Justify your answer. (2 marks)

iv. The inner sphere is now replaced by an insulating one with the same amount of charge uniformly distributed in it. Compute its charge density and determine the electric field everywhere. (6 marks)

v. Sketch the curves to show the variation of E everywhere for the two situations. (4 marks)

20×10^{-6} E q

$E = \Phi = \frac{q_{enc}}{A}$

SECTION 2: MECHANICS

Q1a. State Newton's laws of motion. **(3 marks)**

b. An object moves along the x axis according to the equation $x(t) = (3t^3 - 2t^2 + 3)$ m. Determine between $t = 2$s and $t = 3$s **(i)** the average speed, **(ii)** the instantaneous speed, **(iii)** the average acceleration, and **(iv)** the instantaneous acceleration. **(7 marks)**

c. A crate of weight F_g is pushed by a force **P** on a horizontal floor. **(i)** If the coefficient of static friction is μ_s and **P** is directed at angle θ below the horizontal, show that the minimum value of P that will move the crate is given by $P = \frac{\mu_s F_g \sec\theta}{1-\mu_s \tan\theta}$. **(ii)** Find the minimum value of P that can produce motion when $\mu_s = 0.4$, $F_g = 100$ N, and $\theta = 0°$, 15.0°. **(5 marks)**

d. A disk 8cm in radius rotates at a constant rate of 1200rev/min about its central axis. Determine

(i) its angular speed **(ii)** the tangential speed at a point 3cm from its center

(iii) the radial acceleration of a point on the rim and

(iv) the total distance a point on the rim moves in 2s. **(4 marks)**

Q2a) State the following:

(i) The principle of conservation of linear momentum. **(ii)** Newton's law of Gravitation. **(2 marks)**

bi) The mass of the Earth is 5.98 x 10^{24} kg, and the mass of the Moon is 7.36 x 10^{22} kg. The distance of separation, measured between their centers, is 3.84 x 10^8 m. Locate the center of mass of the Earth–Moon system as measured from the center of the Earth. **(2 marks)**

(ii) A billiard ball moving at 6 m/s strikes a stationary ball of the same mass. After the collision, the first ball moves, at 4.5 m/s, at an angle of 30.0° with respect to the original line of motion. Assuming an elastic collision (and ignoring friction and rotational motion), find the struck ball's velocity after the collision.

(3 marks)

ci. A projectile is fired up an incline (incline angle ϕ) with an initial speed v_i at an angle θ_i with respect to the horizontal ($\theta_i > \phi$), as shown in Figure Q2c. **(i)** Show that the projectile travels a distance d up the incline, where $d = \frac{2v_i^2 \cos\theta_i \sin(\theta_i - \phi)}{g\cos^2\phi}$

(ii) For what value of 'i is d a maximum, and what is that maximum value? **(5 marks)**

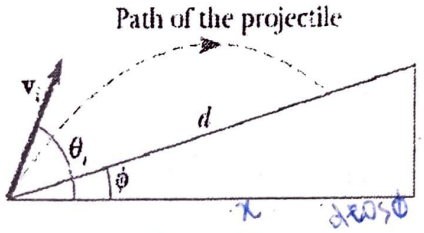


Figure Q2c

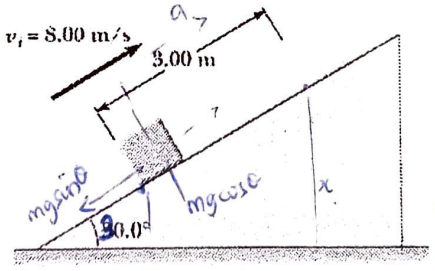


Figure Q2d

d. A 8-kg block is set into motion up an inclined plane with an initial speed of 8 m/s (Fig. Q2d). The block comes to rest after traveling 3m along the plane, which is inclined at an angle of 30.0° to the horizontal. For this motion determine **(i)** the change in the block's kinetic energy, **(ii)** the change in the potential energy of the block–Earth system, and **(iii)** the friction force exerted on the block (assumed to be constant). **(iv)** What is the coefficient of kinetic friction? **(4 marks)**

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