QUAID-I-AZAM UNIVERSITY
ISLAMABAD

B.Sc. Annual Examinations--2013
(PART-I)

Roll No: _____

Subject: **Physics** Paper: **A (Mechanics)**

Time Allowed: **3 Hours** **June 26, 2013** Max Marks: **50**

Note: **Attempt total FIVE questions. All questions carry equal marks. Only simple scientific calculator is allowed.**

Q. No.1

(a) What is the banked curve? Show that angle of banking depends on speed of car and radius of curvature of the road. **(4)**

(b) A 10,700 N car traveling at 13.4 m/sec attempts to round an unbanked curve with radius of 61m.

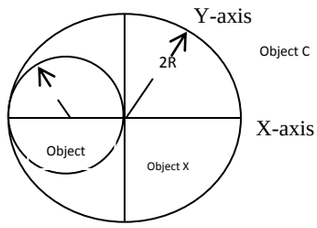
i. What force of friction is required to keep the car on its circular path?

ii. What minimum coefficient of static friction between the tyres and road is required? **(4)**

(c) Why it is that racing drives actually speed up when traversing a curve? **(2)**

Q. No.2

(a) A circular metal plate of radius 2R form which a disk of radius R has been removed. Let us call it object X. its center of mass is shown as a dot on the x-axis. Locate this point. **(4)**



(b) Show that ratio of the distances x_1 and x_2 of two particles from their centers of mass is the inverse ratio of their masses that is $x_1/x_2 = m_2/m_1$ **(4)**

(c) Where is the center of mass of Earth's atmosphere? **(2)**

Q. No.3

(a) What is an inelastic collision? Discuss inelastic collision in one dimension. **(4)**

(b) Two skaters collide and embrace in a completely inelastic collision that is, they stick together after impact. Alfred, whose mass m_A = 83 kg, is originally moving eastwards with a speed v_A = 6.4 km/h. Barbara, whose mass m_B = 55 kg, is originally moving northwards with a speed v_B=8.8 km/hr. What is the velocity **V** of the couple after the impact? **(4)**

(c) How would you design a recoilless gun? **(2)**

Q. No.4

(a) Calculate the rotational inertia of a rod about an axis through center and perpendicular to its length. **(4)**

(b) Calculate the rotational inertia of a 'meter stick', with mass 0.56 kg, about an axis perpendicular to the stick and located at the 20 cm mark. **(4)**

(c) About what axis would a uniform cube have its minimum rotational inertia? **(2)**

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Q. No.5

(a) Which is greater, the angular momentum of the Earth associated with its rotation on its axis or the angular momentum of the Earth associated with its orbital motion around the sun? **(4)**

(b) Show that $\mathbf{L} = I\cdot\boldsymbol{\omega}$ for two particle system of the following Fig: **(4)**

(c) A helicopter flies off, its propellers rotating. Why doesn't the body of the helicopter rotate in the opposite direction? **(2)**

Q. No.6

(a) State and prove Kepler's:

i. law of areas.

ii. law of periods of planetary motion. **(4)**

(b) Sun's center is at one focus of Earth's orbit. How far is it from the other focus? Express your answer in terms of the radius of the Sun $R_s = 6.96 \times 10^8$ m. The eccentricity of Earth's orbit is 0.0167 and semi major axis is 1.50×10^{11} m. **(4)**

(c) How could you determine mass of the Moon? **(2)**

Q. No.7

(a) Show that speed of flow of fluid in a pipe is given by:

$$v_a = \sqrt{2gh\rho'/\rho}$$

Also explain to measure the flow speed of gas by using the Pitot tube. **(4)**

(b) A Pitot tube is mounted on an airplane wing to determine the speed of the plane relative to the air, which has a density of 1.03 kg/m^3. The tube contains alcohol and indicates a level difference of 26.2 cm. What is the plane's speed relative to the air? The density of alcohol is 810 kg/m^3. **(4)**

(c) Why does a stream of water from a faucet become narrower as it falls? **(2)**

Q. No.8

(a) Discuss some consequences of the Lorentz Transformation. **(4)**

(b) A clock moves along the x-axis at a speed of 0.622xc and reads zero as it passes the origin: ($c=3.0\times10^8$ m/sec).

i. Calculate the Lorentz factor.

ii. What time does the clock read as it passes x = 183 m? **(4)**

(c) "The mass of electron is 0.511 MeV". What does this statement exactly mean? **(2)**