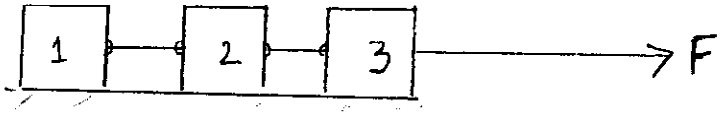
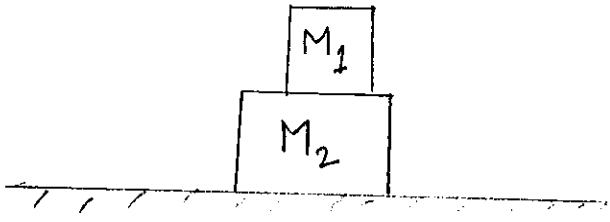
BITS PILANI DUBAI
INTERNATIONAL ACADEMIC CITY
I-SEMESTER 2008-09
Test-1

Course Name: Physics-1 Course No: PHY C 131
Max Marks:75 Weightage:25% Time: 50 Mints

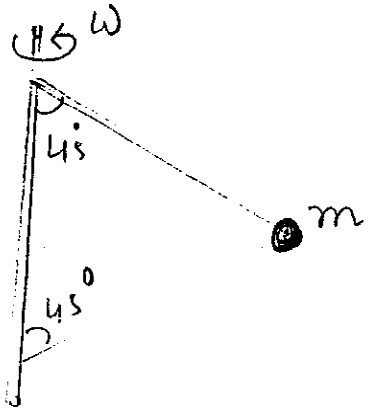
Q1. Three cars of mass M are pulled with force F by a locomotive. Friction is negligible. Find the force exerted by the second car on the third . (10)



Q2. A block of mass M_1 rests on a block of mass M_2 which lies on a frictionless table. The coefficient of friction between the blocks is μ. What is the maximum horizontal force which can be applied to the block M_2 for them to accelerate without slipping on one another. (15)



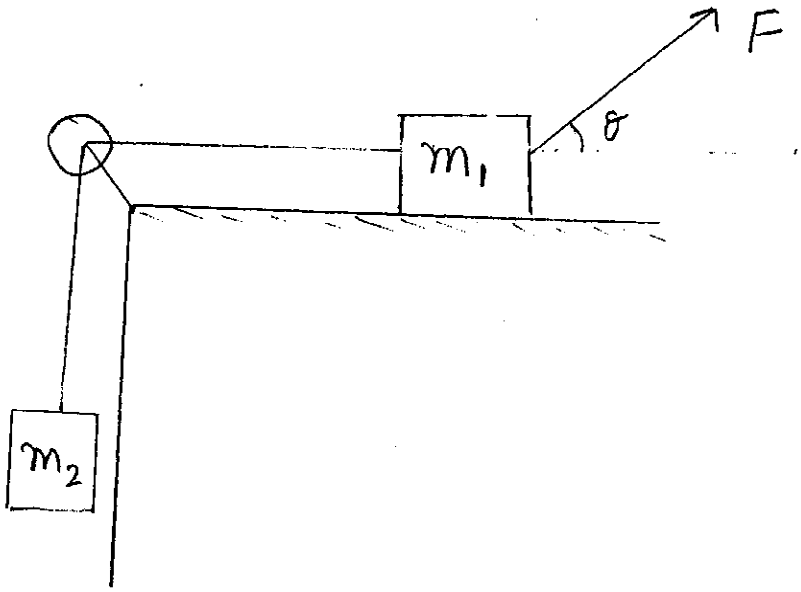
Q3.A mass m is connected to a vertical revolving axle by two strings of length l, each making an angle of 45° with the axle. Both the axle and mass are revolving with angular velocity ω. Gravity is directed downward. Find the tension in the upper string and lower string. (15)



Q4. A uniform rope of mass m and length l is attached to a block of mass M. The rope is pulled with force F. Find the tension at distance x from the end of the rope. (10)

Q5. An automobile whose speed is increasing at a rate of 0.600 m/s^2 travels along a circular road of radius 20.0 m. When the instantaneous speed of the automobile is 4.00 m/s, find (a) the tangential acceleration component, (b) the centripetal acceleration component, and (c) the magnitude and direction of the total acceleration. (10)

6. A block of mass m_1 on a rough, horizontal surface is connected to a ball of mass m_2 by a lightweight cord over a lightweight, frictionless pulley, as shown in Figure below. A force of magnitude F at an angle θ with the horizontal is applied to the block as shown. The coefficient of kinetic friction between the block and surface is μ_k. Determine the magnitude of the acceleration of the two objects . (15)

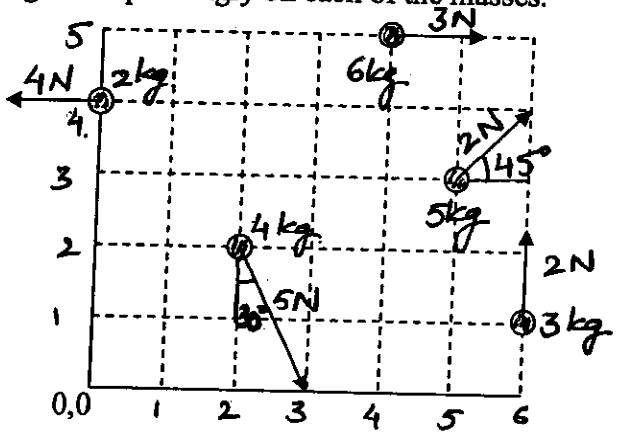


BITS PILANI DUBAI
INTERNATIONAL ACADEMIC CITY
I-SEMESTER 2008-09
Test-2 (Open Book)

Course Name: Physics-1 Course No: PHY C 131
Max Marks: 60 Weightage: 20% Time: 50 Mints

NOTE: Only the prescribed Text Book and the Handwritten Class Notes are allowed.

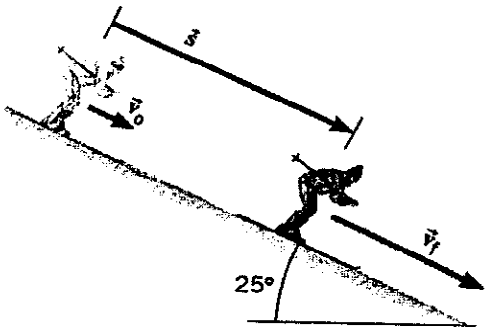
Q1. Calculate the location of the center of mass of the system shown below. Also calculate the acceleration of the center of mass where the arrows represent the forces acting correspondingly on each of the masses. **[5+5]**



Q2. A rocket reaches a position in outer atmosphere with a mass of 3000 Kg traveling at a speed of 650 m/s. The gravitational acceleration at this point is 9.20 m/s^2. Fuel is being consumed at a rate of 130 kg/s, and the exhaust velocity relative to the rocket is 600 m/s. (a) Calculate the initial acceleration of the rocket. (b) What is the final velocity of the rocket after the fuel has been burning for 1.8 mins? **[5+5]**

Q3. A 58kg skier is coasting down a 25° slope, as shown in figure. Near the top of the slope, her speed is 3.6 m/s. She accelerates down the slope because of the gravitational force, even though a kinetic frictional force of magnitude 71N opposes her motion. Ignoring air resistance, determine the speed at a point that is displaced 57m downhill using **Work and Energy Theorem.** **[10]**

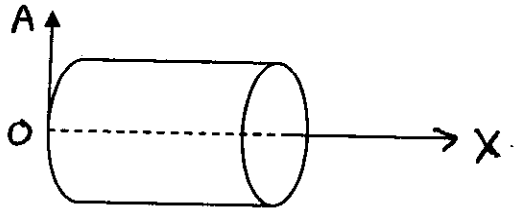
(Picture on the next page)



Q4. A ball of mass m with a velocity u undergoes an elastic collision with another ball of the same mass m but at rest. After the collision, if the two balls move with the same speeds, what is the angle between their directions of motion? **[10]**

Q5. Derive an expression for the moment of inertia of a hollow cylinder (mass M, length L and radius R) about an axis OA passing through one end of the cylinder and perpendicular to it.

[10]



Q6. A uniform disc of mass M and radius R and a uniform hoop of mass M and radius R are released simultaneously from rest at the top of an inclined plane. Which body reaches the bottom first if they both roll without slipping? Justify your answer with detailed calculation. **[10]**

BITS PILANI DUBAI
INTERNATIONAL ACADEMIC CITY
I-SEMESTER 2008-09
Comprehensive Examination

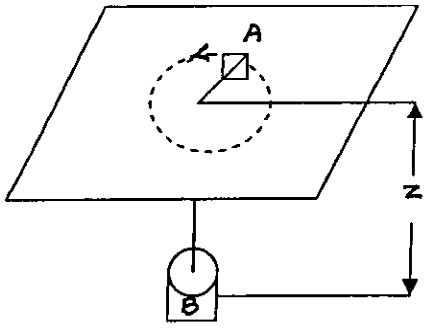
Course Name: Physics-1 Course No: PHY C 131
Max Marks:120 Weightage:40% Time: 3 Hrs Date: 8.1.09

Note: There are three sections A,B and C. Each section has to be answered on a separate answer sheet. All questions are compulsory.

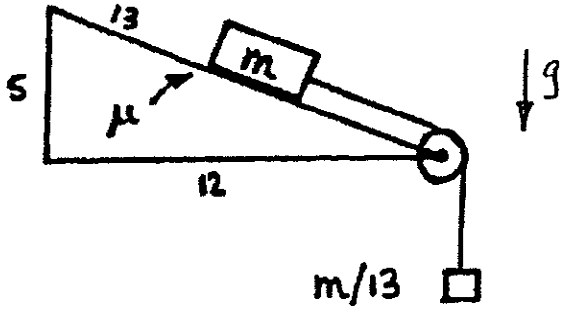
SECTION A

Q1. A horizontal frictionless table has a small hole in its center. Block A of mass M_A on the table is connected to block B of mass M_B hanging beneath by a string of negligible mass which passes through the hole. Initially, B is held stationary and A rotates at constant radius r_o with steady angular velocity ω_o. If B is released at t = 0, what is its acceleration immediately afterward? Given that $M_B > M_A$.

(10)



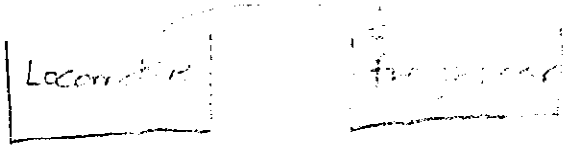
Q2. A block of mass *m* slides on an inclined plane with length of sides as shown in the figure. A massless rope, guided by a massless pulley, connects the block to a second block of mass *m*/13.



The two-block system is observed to be moving with a constant velocity v_o. What is the coefficient μ of sliding friction between block and plane? **(10)**

Q3. Find the center of mass of a thin rectangular plate with sides of length **a** and **b**, whose mass per unit area σ varies in the following fashion $\sigma = \sigma_o (xy/ab)$, where σ_o is a constant. (10)

Q4. A sand spraying locomotive sprays sand horizontally into a freight car. The locomotive and freight car are not attached. The engineer in the locomotive maintains his speed so that the distance to the freight car is constant. The sand is transferred at a rate dm/dt = 10kg/s with a velocity of 5m/s relative to the locomotive. The car starts from rest with an initial mass of 2000kg. Find its speed after 100s. Neglect the external forces. (10)



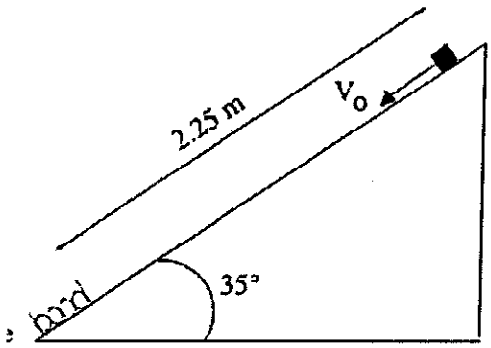
SECTION B

Q5. In this system the block, whose mass is given, is launched with an initial velocity Vo, as shown. The coefficient of friction is given. The spring has a force constant k. The distance shown is from the initial position (where the block has V = Vo) to the end of the spring when the spring is neither squeezed nor stretched.

Vo = 4.70 m/s, m = 1.25 kg, μ = 0.40, k = 350 N/m. **Using energy methods**

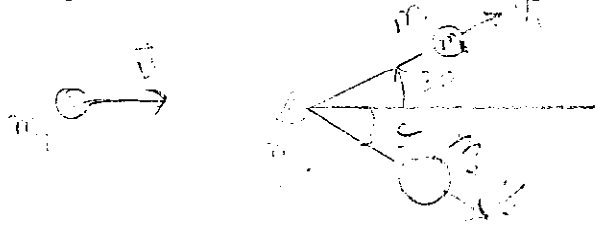
(a) Calculate the magnitude of the velocity of the mass just before it first touches the spring.

(b) Calculate the total distance the mass travels before its velocity first becomes zero.

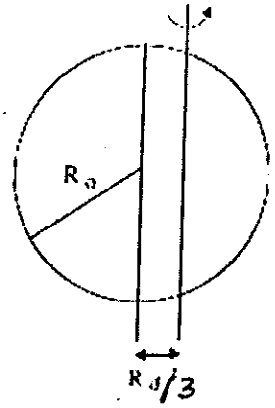


(5+5)

Q6. A particle of mass m_1 = 1.00 kg is moving with velocity v = 8 m/s î collides with a particle at rest of mass m_2=2.0kg. There are no net external forces. Find velocities of both the particle after the collision and the angle θ. (10)



Q7. (a) Calculate the moment of inertia of a sphere of mass 7.35 kg and diameter 0.123 m about (a) an axis passing through center of mass (b) an axis parallel to the diameter at a distance $R_o/3$ from the center. (5+5)



Q8. (a) A wheel in the shape of a disc, starting from rest accelerates uniformly. If it undergoes 475 complete revolutions in 6 min 35 s, what is the angular acceleration? Calculate the torque about the an axis passing through center of mass and perpendicular to the plane, if the wheel above has a mass 0.75 Kg and radius 30 cm.
(b) A sphere of mass 8.00 kg and diameter 15.0 cm, is rolling without sliding. If its translational velocity is 17.0 m/s, find its rotational kinetic energy, total kinetic energy and its angular momentum about an axis passing through the center of mass. (5+5)

SECTION C

Q9. In a lightly damped harmonic oscillator (mass spring system), the block has a mass of 1.52 Kg , the force constant is 8.13N/m and the damping constant b=227g/s. Suppose that the block is pulled aside a distance 12.5cm and released.

(a) Calculate the time interval required for the amplitude to fall to one third of its initial value?
(b) How many oscillations are made by the block in this time and what is the Q factor
(5+5=10)

Q10. The equation of a transverse wave traveling along a very long string is given by $Y=(6.90\text{cm})\sin[(2\pi\ \text{rad/m})x + (4\pi\ \text{rad/s})t]$. The string is under a tension of 16.3N. Calculate (a) the wavelength (b) the frequency (c) the maximum transverse speed of a particle in the string (d) the linear mass density of the string (2x5=10)

Q11. In a Newton's ring experiment the radius of curvature of the lens is 5m and its diameter of the ring is 20mm. (a) How many rings are produced? (b) How many rings would be seen if the arrangement were immersed in water(n=1.33). Assume that wavelength of light is 589nm. (5+5)

Q12. A diffraction grating 2.86cm wide produces a deviation of 33.2^0 in the second order with light of wavelength 612nm. Find the total number of rulings on the grating. (10)