Important Formulae (University Physics Mechanics)

- $v_x = v_{0x} + a_x t$
- $x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$
- $v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$
- $v_x = v_{0x} + \int_0^t a_x dt$
- $x = x_0 + \int_0^t v_x dt$
- $x = (v_0 \cos \alpha_0)t$
- $y = (v_0 \sin \alpha_0)t - \frac{1}{2}gt^2$
- $a_{rad} = \frac{v^2}{r}$
- $v_{P/A-x} = v_{P/B-x} + v_{B/A-x}$
- $\vec{v}_{P/A} = \vec{v}_{P/B} + \vec{v}_{B/A}$
- $\sum \vec{F} = m\vec{a}$
- $f_s \leq \mu_s n$
- $f_k = \mu_k n$
- $v_{max} = \sqrt{\mu_s g R}$
- $tan\beta = \frac{v^2}{gR}$
- $W = \vec{F} \cdot \vec{s} = Fs\cos\phi$
- $W_{tot} = K_2 - K_1 = \Delta K$
- $P = \frac{dW}{dt}$
- $P = \vec{F} \cdot \vec{v}$
- $W_{grav} = U_{grav,1} - U_{grav,2} = -\Delta U_{grav}$
- $\Delta K + \Delta U + \Delta U_{int} = 0$
- $\vec{F} = -(\frac{\partial U}{\partial x}\hat{i} + \frac{\partial U}{\partial y}\hat{j} + \frac{\partial U}{\partial z}\hat{k})$

UPM

MID SEMESTER EXAMINATION, October-2016
University Physics_ Mechanics (PHY 1001)

Programme: B. Tech
Full Marks: 30

Semester- 1st
Time: 2 Hours

Subject/ Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
UPM/A,E	L2,L3	1	6
UPM/A,E,G	L2,L3,L4	2	6
UPM/A,E	L2,L3	3	6
UPM/A,E	L2,L3	4	6
UPM/A,E	L2,L3	5	6

*Bloom's taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

1. (a) Define scalar product of two vectors $\vec{A}$ and $\vec{B}$ and express it in their components form. 2

   (b) Two vectors A and B both lie in the xy-plane. (a) Is it possible for A to have the same magnitude as B but different components? (b) Is it possible for A to have the same components as B but a different magnitude? Justify your answer. 2

   (c) An antelope moving with constant acceleration covers the distance between two points 70.0 m apart in 7.00 s. Its speed as it passes the second point is 15.0 m/s. (a) What is its speed at the first point? (b) What is its acceleration? 2

2. (a) Define average velocity, $v_{av\text{-}x}$ and instantaneous velocity, v_x. Show how $v_{av\text{-}x}$ and v_x can be obtained from x-t graph. 2

   (b) If the x-acceleration a_x is increasing with time, will the v_x-t graph be (i) a straight line (ii) concave (i.e., with an upward curvature), or (iii)concave down (i.e., with a downward curvature)? 2

(c) A batter hits a base ball so that it leaves the bat at speed v_0=37 m/s at an angle 53.1^0 with horizontal. Find the position of the ball and its velocity (magnitude and direction) at time t = 2 s. 2

3. (a) Find magnitude of radial acceleration of a particle moving with uniform speed in a circular path in terms of its speed 'v' and radius 'R' of the circular path. 2

(b) Suppose the nose of an airplane is pointed due east and the airplane has an airspeed of 150 km/h. Due to the wind, the airplane is moving due north relative to the ground and its speed relative to the ground is 150 km/h. What is the velocity of the air relative to the earth? 2

(c) You want to move a 500-N crate across a level floor. To start the crate moving, you have to pull with a 230-N horizontal force. Once the crate "breaks loose" and starts to move, you can keep it moving at constant velocity with only 200 N. What are the coefficients of static and kinetic friction? 2

4. (a) State Newton's second law of motion both in vector and component forms. 2

(b) An astronaut landed on a planet with acceleration due to gravity 19.6 m/s^2. Compare his weight and mass on the planet with his weight and mass on earth. 2

(c) A passenger on a carnival Ferris wheel moves in a vertical circle of radius R with constant speed v. The seat remains upright during the motion. Find expressions for the force the seat exerts on the passenger at the top of the circle and at the bottom. 2

5. (a) A particle of mass 'm' is moving along x-axis under the action of a constant net force of magnitude F along +ve x-axis. Find the work done on the particle for a displacement 's' and hence establish work-energy theorem. 2

(b) In a hydroelectric generating station, falling water is used to drive turbines ("water wheels"), which in turn run electric generators. Compared to the amount of gravitational potential energy released by the falling water, how much electrical energy is produced? (i) the same; (ii) more; (iii) less. 2

(c) A force of 800N stretches a certain spring a distance of 0.200m. (a) What is the potential energy of the spring when it is stretched 0.200m? (b) What is its potential energy when it is compressed 5.00cm? 2

End of Questions

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