PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)
BSc DEGREE EXAMINATION MAY 2022
(Fourth Semester)
Branch – MATHEMATICS WITH COMPUTER APPLICATIONS

DYNAMICS

Time: Three Hours   Maximum: 75 Marks

SECTION-A (10 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks   (10 x 1 = 10)

1   A bus travels the 100km between A and B at 50km/h and then another 100km between B and C at 70km/h. The average speed of the bus for the entire 200km trip is _____
(i)   More than 60km/h   (ii) Less than 60km/h
(iii) equal to 60km/h   (iv) None of these

2   Two particles A and B are moving along the same straight line. then the relative acceleration of B with respect to A is _____
(i) $v_B = v_A + v_{B/A}$ (ii) $v_A = v_B + v_{A/B}$
(iii) $a_B = a_A + a_{B/A}$ (iv) $a_A = a_B + a_{A/B}$

3   1 pound-mass = _____ kg.
(i)   0.3048   (ii) 0.4536
(iii) 14.59   (iv) 0.4936

4   When a particle moves under a central force, its areal velocity is _____
(i)   Constant   (ii) Zero
(iii) Varying   (iv) no areal velocity

5   The mechanical efficiency of a machine is _____.
(i)   always equal to 1   (ii) always equal to 0
(iii) always greater than 1   (iv) always less than 1

6   The sum T+V is called _____ of the particle.
(i)   Total potential energy   (ii) Total Kinetic energy
(iii) Total mechanical energy   (iv) Total thermal energy

7   The coefficient of restitution (e) for perfectly elastic impact is _____
(i)   e=1   (ii) e=0
(iii) e<0   (iv) e>1

8   The momentum of an object depends upon the objects _____
(i)   Size and shape   (ii) mass and velocity
(iii) mass and speed   (iv) mass and energy

9   The maximum acceleration of a particle moving with simple harmonic motion is _____
(i) ω (ii) $x\omega$
(iii) ωx^2 (iv) $\omega^2 x$

10 The frequency of ascillation for the simple pendulum is _____
(i) $2\pi\sqrt{\dfrac{l}{g}}$ (ii) $2\pi\sqrt{\dfrac{g}{l}}$
(iii) $\dfrac{1}{2\pi}\sqrt{\dfrac{l}{g}}$ (iv) $\dfrac{1}{2\pi}\sqrt{\dfrac{g}{l}}$

SECTION - B (25 Marks)
Answer ALL questions
ALL questions carry EQUAL Marks   (5 x 5 = 25)

11 a The motion of a particle is defined by the relation $x = 2t^3 - 9t^2 + 12t + 10$, where x and t are expressed in meters and seconds, respectively. Determine the time, the position and the acceleration f the particle when $v = 0$.

OR

 b A projectile is fired from the edge of 150 m cliff with an initial velocity f 180 m/s at an angle of 30^0 with the horizontal. Neglecting air resistance find the horizontal distance from the gun to the point where the projectile strikes the ground.

12 a Determine the rated speed of a highway curve with a radius of $\int = 120m$ banked through an angle $\theta = 18^0$. The rated speed of a banked highway curve is the sped at which car should travel to hane no lateral frictin force exerted on its wheels

OR

 b A satellite is launched in a direction parallel to the surface of the earth with a velocity of 30,000 km/h from an attitude of 400 km. determine the velocity of the satellite as it reaches its maximum attitude of 400 km. the earth's radius is 6370 km.

13 a A 400 kg satellite is placed in a circular orbit 6394 km above the surface of the earth. At this elevation, the acceleration of gravity is 4.09 m/s². Knowing that its orbital speed is 20,000 km/h determine the kinetic energy of the satellite.

OR

 b A 1000 kg roller coaster car starts form rest at point 1 and moves without friction down the track as shown. Determine the force earted by the track on the car at point 2 where the radius of curveted of the track is 6m.
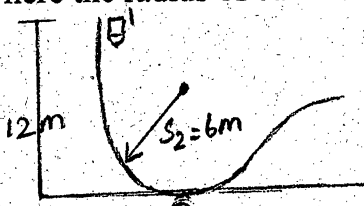
14 a An automobile weighing 1800 kg is moving down a 5^0 incline at a speed of 100 km/h when the brakes are applied, causing a constant total braking force (applied by the road on the tires) of 7000 N. Determine the time required for the automobile to come to a stop.

OR

 b A ball is thrown against a frictions, vertical wall. Immediately before the ball strikes the wall, its velocity has a magnitude of v and forms an angle of 30^0 with the horizontal. Knowing that e=0.90, determine the magnitude and direction of the velocity of the ball as it rebounds from the wall.

15 a A particle moves in simple harmonic motion. knowing that the amplitude is 300 mm and the maximum acceleration is 5m/s², determine the maximum velocity of the particle and the frequency of its motion.

OR

b A 50 Kg block moves between vertical guides as shown the block is pulled 40 mm down from its equilibrium position and released. Determine the period of vibration, the maximum velocity of the black and maximum acceleration of the block for the spring arrangement.

$K_1 = 4\ KN/m$

$K_2 = 6\ KN/m$
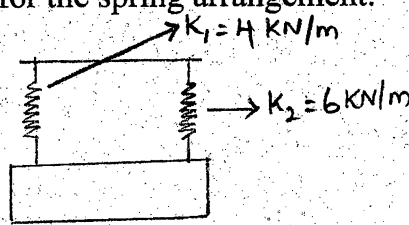
SECTION -C (40 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** Marks   (5 x 8 = 40)

16 a Car A is traveling at a constant 135 km/h when she passes a parked police officer B, who gives chase when the car passes her. The officer accelerates at a constant rate until she reaches the speed of 150 km/h. Thereafter here speed remains constant. The police officer catches the car 4.5 km from her starting point. Determine the initial acceleration of the police officer.

OR

b Airplane B, which is traveling at a constant 560 km/h is pursuing airplane A, which is traveling northeast at a constant 800 km/hr. At time t=0, airplane A is 640 km east of airplance B. Determine (i) The direction of the course airplane B should fellow (measured from east) to intercept plane A, (ii) the rate of which the distance between the airplane is decreasing (iii) how long it takes for airplane B to catch airplane A.

17 a The 6 kg block B starts from rest and slides on the 15 kg wedge A, which is supported by a horizontal surface. Neglecting friction, determine (i) the acceleration of the wedge, (ii) the acceleration of the block relative to the wedge.
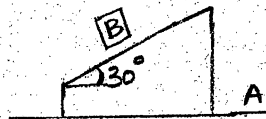
OR

b A 0.5 kg fragile glass vase is dropped onto a thick pad that has a force deflection relationship as shown. knowing that the vase has a speed of 3m/s when it first contacts the pad, determine the maximum downward displacement of the vase.
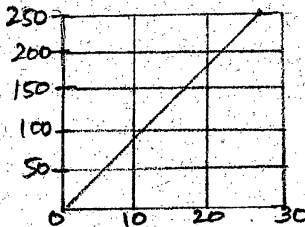

18 a The 650 Kg hammer of a drop hammer file driver falls onto the top of a 140 kg file. After the impact, the hammer and the file stick together and have a velocity of 3m/s. The vertical force exerted on the file by the ground after the impact is given by $F=0.2\ x^2$ where x and f are expressed in mm and KN, respectively. Determine the velocity of the system after it has penetracted 80 mm into the ground.

OR

b A sphere of mass m=0.6 kg is attached to an elastic cord of constant k=100 N/m, which is under formed when the sphere is located at the origin 0. the sphere may slide without friction on the horizontal surface and in the position shown its velocity v_A has a magnitude of 20m/s. Determine (i) the maximum and minimum distances from the sphere to the origin 0, (ii) the corresponding values its speed.
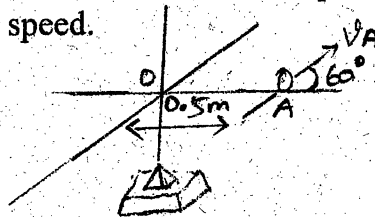
19 a A 10 kg package drops from a chute into a 25 kg cart with a velocity of 3m/s. the cart is initially a rest and can roll freely. Determine (i) the final velocity of the cart, (ii) the impulse exerted by the cart on the package, (iii) the fraction of the initial energy lost in the impact.

OR
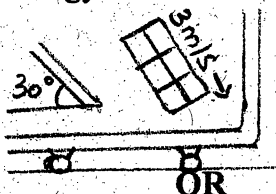
b Ball B is hanging from an inextensible cord BC. an identical ball a is released from rest when it is just touching the cord and acquires a velocity v_0 before striking ball B. Assuming a perfectly elastic impact (e=1) and no friction, determine the velocity of each ball immediately after impact.
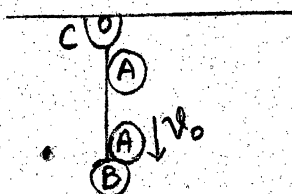
20 a A cylinder with weight W and radius r is suspended from a looped cord as shown. One end of the cord is attached directly to a rigid support, and the other end is attached to a spring with a constant K. determine the period and natural frequency of the vibrations of the cylinder.

OR
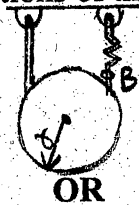
b Determine the period of small, oscillations of a cylinder with radius 'r' that rolls without slipping inside a curved surface with radius R.

Z-Z-Z   END