Department of Mechanical and Aerospace Engineering, University of Uyo

MEE223- Engineering Mechanics II, 2021/2022 Second Semester Examination

Instruction: Attempt 4 questions.

Time allowed: 2 hours.

Question 1a: A car moves in a straight line such that for a short time its velocity is defined by $v = t(3t^2 - 9)$ m/s, where t is in seconds. Determine its position and acceleration when t = 6 s. Note: when t = 0, s = 0.

Question 1b: A v-s graph describing the motion of a motorbike is shown in fig. 1. Determine the time needed for the motorbike to reach position s = 210m.

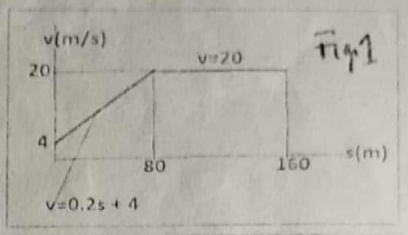


Fig1

Question 2a: A mass particle connected to an inextensible string moves with a constant velocity of 9 m/s in a circular path in a vertical plane, shown in fig. 2a. Determine the tensile force in the string when the particle is at point a and b.

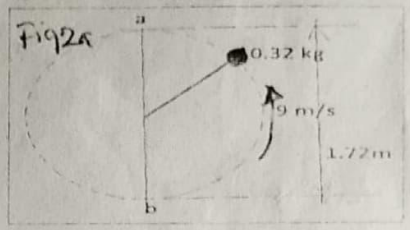


Fig2a

Question2b: Two bodies A and B are connected by a light inextensible cord as shown in figure 2b. If both bodies are released simultaneously, what distance do they move in 5 seconds? Neglect the friction between the two bodies and their inclined surfaces.

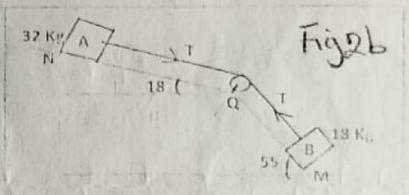


Fig2b

Question 3a: A 70-Kg block shown in figure 3 rests on a horizontal surface for which the coefficient of kinetic friction $\mu = 0.43$, if the block is subjected to a 750-N towing force as shown, determine the velocity of the block in 5 s starting from rest.

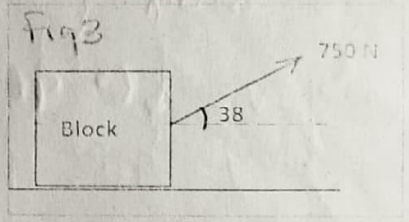


Fig3

Question 3b: A stone is allowed to fall from the top of a tower of height 300m and at the same time another stone is projected vertically upward from the ground with a velocity of 80 m/s. When and where would the two stones cross each other.

Question 4: A bag A having a mass of 3-Kg is released from rest at the position $\theta = 0^o$ as shown in figure 4. After falling to $\theta = 90^o$, it strikes a 9-Kg box B. If the coefficient of restitution between the bag and the box is e = 0.5, determine the velocities of the bag and box just after impact.

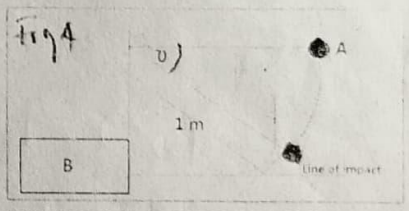


Fig4

Question 5: A 40 -Kg block L and a 135 -Kg cart C are placed as shown in figure 5. Find the acceleration of each body when (a) F = 80 N and (b) F = 53 N. Take the coefficient of static and kinetic friction between the load L and the cart C to be same at 0.38.

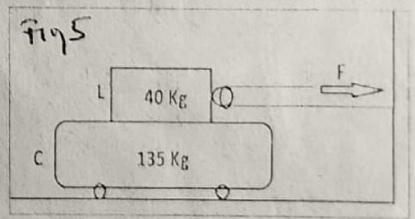


Fig5

Question 6: The smooth 2-Kg cylinder B in figure 6 has a pin P through its center which passes through the slot in arm OM. If the arm is forced to rotate in the vertical plane at a constant rate $\dot{\theta} = 0.5$ rad/s, determine the force that the arm exerts on the peg at the instant where $\theta = 60^o$.

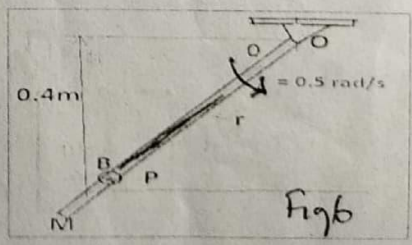


Fig6

UNIVERSITY OF UYO, NIGERIA

FACULTY OF ENGINEERING

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

Session: 2020/2021 **Semester:** Second **Date:** December 5, 2022

MEE 223: Engineering Mechanics II **Instructions:** (i) Attempt **only** 4 questions; (ii) Show **all** necessary drawings/diagrams. **Time Allowed**: 2 Hours

Question 1

(a) In rigid body mechanics, *dynamics* and *kinetics* are distinct but often confused terms. Differentiate them.

(b) Distinguish between linear motion under *uniform* and *variable* acceleration with their respective governing equations.

(c) What needs to be done in order to solve a kinetics problem using *Newton's Second Law*?

Question 2

(a) $s = 15t + 5t^2 - t^3$ represents the equation of motion of a particle moving along a rectilinear path. Given that s is the distance travelled by the particle in metres and t is the time duration of the motion in seconds. Find the following: (i) velocity and acceleration at the start; (iii) time taken to attain maximum velocity; (ii) the value of this maximum velocity.

(b) A body initially at rest, accelerates in a straight line with the equation of motion given as: $a = 13 - 0.075s^4$. If a is the body's acceleration in m/s^2 and s is the distance in m. Determine: (i) the velocity of the particle after it has moved $45\ m$; (ii) distance covered by the particle after it comes to rest.

Question 3

(a) A vintage *Boeing B-17 Flying Fortress* taking off from a private runway, has its motion described by $y = 0.0001x^2$. Given that y is in metres and the aircraft is rising with a constant velocity of $216\ km/hr$. Calculate: (i) the time it will take to reach an altitude of $10,000\ ft$; (ii) how far the aircraft is from the runway in the horizontal direction at this time; (iii) the magnitude of the velocity and acceleration at this point. [Hint: $1\ ft = 0.3048\ m$].

(b) The path of motion of a professional drag racer making a corner at a speed of $180\ km/hr$ and having a speed change of $4\ m/s$, can be represented by the equation: $y = 0.04x^2$. What is the magnitude of the acceleration of the racer at an horizontal displacement of $100\ m$?

Question 4

(a) What magnitude of force - acting at an angle of $30°$, will be required to push a block of $35\ kg$ resting on a flat horizonal surface by an acceleration of $5\ m/s^2$ to the left? Take the coefficient of static friction between the block and the incline surface as 0.25.

(b) A block of mass $m\ kg$ is sliding down an inclined plane towards the right. If the block travels a distance of $4.5\ m$ between point **M** and **N** along the incline and the velocity of the block at point **N** is $2.6\ m/s$. Using **Newton's second law**, determine its initial velocity and acceleration at point **M**. Take the coefficient of dynamic friction between the block and the inclined surface to be 0.45 and the angle of inclination as $25°$.

Question 5

(a) From *Newton's Second Law of Motion*, derive the *Impulse-Momentum Equation*.

(b) A football moving on the ground to the left with an initial velocity of $7\ m/s$, is kicked in the opposite direction with a force of $625\ N$ at an angle of $28°$ with the horizontal. If the ball makes contact with the player's foot for $0.025\ s$. Find the angle and he velocity with which the ball will travel after the force is applied. Take the mass of the ball as $430\ g$.

)uestion 6

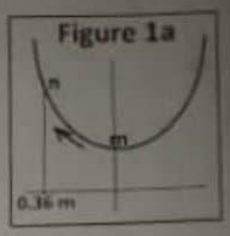
)$\frac{1}{2}mv_2^2 = \int_{s_1}^{s_2} Fds + \frac{1}{2}mv_1^2$ represents the relation for the principle of work and energy. Show how it is derived.

) A block of mass $m\ kg$ is sliding down an inclined plane towards the left. If the block travels a distance of $4.5m$ between point nd K along the incline and the velocity of the block at point B is $2.6\ m/s$. Using the **principle of work and energy**, determine nitial velocity and acceleration at point J. Take the coefficient of dynamic friction between the block and the inclined surface e 0.45 and the angle of inclination as $25°$.

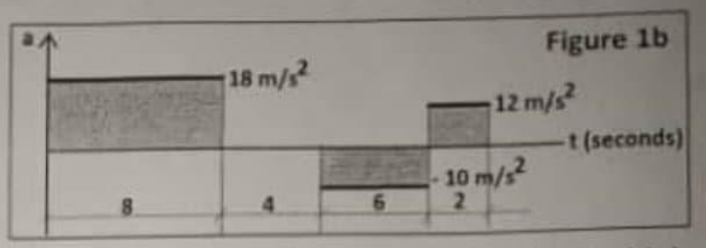
Department of Mechanical & Aerospace Engineering, University of Uyo
Second Semester Examination, 2019/2020 Session
Course Code: MEE223; Course Title: Engineering Mechanics (Dynamics)

Instruction: Attempt only Four Questions **Time allowed: 2 Hr: 30 Minutes**

Question 1a: A particle moves along a parabolic track shown in figure 1a. The particle moves with a constant speed of 80m/s. The parabolic shape is defined by the function: $y = 0.82x^2 + 0.3x^2$, where x and y are in meters. (i) Find the x and y components of the velocity at point n (ii) Find the magnitude and direction of the normal acceleration of the particle at m and n.



Question 1b: A car starts from zero velocity and moves along a straight horizontal track, the rectilinear acceleration of the car is shown in figure 1b. Using graphical methods, construct the velocity and displacement diagrams for the motion of the car.

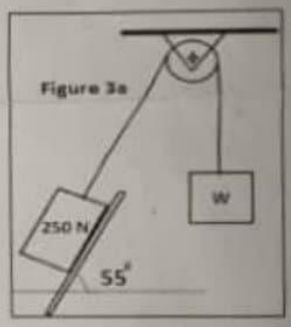


Question 2a: Find the least initial velocity which a projectile must have so that it may clear a wall 3.6 m high and 4.8 m (distance from the point of projection) and strike the horizontal plane through the foots of the wall at a distance 3.6 m beyond the wall. The point of projection is at the same level as the foot of the wall.

Question 2b: Engineering Mechanics plays a vital role in technological advancement, discuss in clear terms.

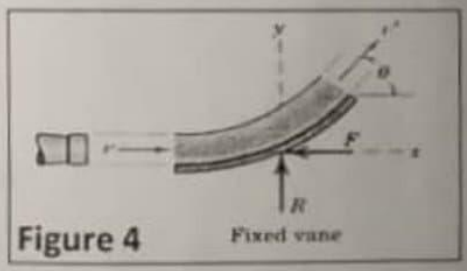
Question 2c: Idealization is quite useful in mechanics analysis, how would you compensate for this in real life design?

Question 3a: Find the magnitude and sense of the acceleration of the two blocks in figure 3a, if W =100 N. The coefficient of kinetic friction between the block and the plane is 0.3.

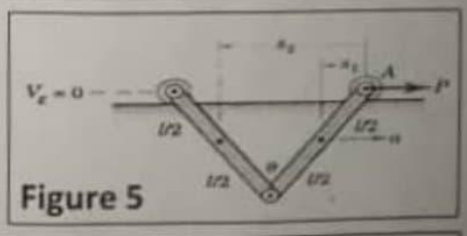


Question3b: A light-weight passenger elevator has a mass of 500 Kg. A passenger of mass 70 Kg rides in the elevator. When the elevator moves upward with constant acceleration, the cable tensile force is 6500 N. Find (i) the value of the acceleration of the elevator (ii) the apparent weight of the passenger as the elevator accelerates.

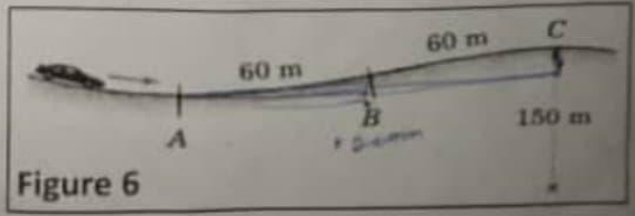
Question 4: The smooth vane shown in figure 4 diverts the open stream of fluid of cross-sectional area A, mass density ρ, and velocity v. (i) Determine the force components R and F required to hold the vane in a fixed position. (ii) Find the forces when the vane is given a constant velocity u less than v and in the direction of v.



Question 5: A constant force P is applied to end A of the two identical and uniform links and causes them to move to the right in their vertical plane with a horizontal acceleration a. Determine the steady-state angle θ made by the bars with one another.



Question 6: To anticipate the dip and hump in the road figure 6, the driver of a car applies her brakes to produce a uniform deceleration. Her speed is 100Km/h at the bottom A of the dip and 50Km/h at the top C of the hump, which is 120 m along the road from A. If the passengers experience a total acceleration of 3 m/s² at A and if the radius of curvature of the hump at C is 150 m, calculate: (i) the acceleration at the inflection point B, (ii) and the total acceleration at C.



UNIVERSITY OF UYO, UYO

FACULTY OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

Second Semester Examination 2013/2014 Session

Course Title: Engineering Mechanics II **Course Code:** MEE 223

Instruction: Answer all Questions in Section A and 1 Question from Section B.

Time: 2 ½ Hrs.

SECTION A

1. A ball dropped from the top of a tower reaches the ground in 6 seconds. The height of the tower is .....
2. A body is projected horizontally from the top of a building 30m high. The time taken by it to reach the ground is .....
3. A particle starts from rest and moves in a straight line whose equation of motion is $x = 2t^3 - t^2 - 1$. The acceleration after 2 seconds is .....
4. Two balls of masses m_A, m_B are dropped from towers of different heights h_A and h_B. The ratio of time taken by the two to fall those distances is .....
5. A body dropped from a height $'H'$ reaches the ground after $'t'$ seconds. It would have reached a height of 0.5 H at a time .....0.5t..... seconds.
6. A car travels between two stations which are 15km apart in 20minutes. If the car accelerates for a part of journey uniformly followed by uniform retardation, the maximum speed attained by the car during the journey is .....
7. If $x = \propto cost$ where x = displacement and t = time then acceleration is .....
8. If the motion of a particle is defined by $(2t - t^2)i + (3t - 15t^2)j$, its path is .....
9. A particle is travelling in a circle at constant speed; it has ..... acceleration directed towards the .....
10. An aeroplane is moving horizontally with a velocity v_0. It drops a packet from a height $'h'$. The time taken by the packet to reach the ground is .....
11. A ball is thrown upwards returns to the ground describing a parabolic path ..... of the velocity of the ball is constant.
12. The height $'y'$ and the distance $'x'$ along the horizontal plane of a projectile are given by $y = (12t - 6t^2)$ and $x = 8t$, where x, y are in metre and $'t'$ is in seconds. The initial velocity of projection is ...
13. Equations of motion in Cartesian co-ordinate system in $x - y$ plane are ....., ...
14. Equations of motion in tangential and normal directions are ....., ...
15. Magnitude of inertial force is ..... and its direction is .....
16. A particle is considered to be in ..... under the given forces and inertia vector.
17. Newton's second law expresses the relationship between ....., ... and .....
18. If two bodies of masses m_A and $m_B (m_A > m_B)$ are connected by a light inextensible string passing over a smooth pulley, the tension in the string is .....
19. If two bodies of masses m_A and $m_B (m_A > m_B)$ are connected by a light inextensible string passing over a smooth pulley, and when m_B lies on horizontal plane and $'m_A'$ is suspended freely, the tension in the string is .....
20. When a body slides down an inclined surface, the acceleration of the body is .....
21. The property of the body by virtue of which the body is unable to change by itself the state of rest or of uniform linear motion is known as .....
22. A block of mass 10km slides down a smooth inclined plane of inclination $'\theta'$ with horizontal when released from the top in 30seconds. Another block falls freely from the same point and strikes the ground in 15 seconds. The value of $'\theta'$ is .....

23. Two masses 10kg and 15kg are attached to the end of the string passing over a pulley fixed at the top. The tension and acceleration are ..... and ..... respectively.
24. A boat of mass 5000kg initially at rest is pulled by a force of 30kN through a distance of 4m. Assuming that the resistance due to water is negligible, the velocity of the boat is .....
25. According to Newton's law of gravitation, $F =$ ..... and $g =$ .....
26. The external forces acting on the system of particles are equivalent to the effective forces of the various particles of the system because the sum of ..... is equal to zero.
27. If $\vec{F}$ is the force vector and $\vec{r}$ is the displacement vector of the particle, then work done is .....
28. If the magnitude of $\vec{F}$ varies but it's direction is constant along x-$axis$, the work done in moving the particle from $x_1 to\ x_2, is\ U_{1\text{-}2} =$ .....
29. If the magnitude and direction of the particle changes and moves along x-axis from $x_1 to\ x_2$, then work done is $U_{1\text{-}2}$ .....
30. The area of (F - x) curve between the limits $x = x_2$ represents .....
31. Work done by the force of gravity is positive when a body .....
32. Work done by spring force is positive when .....
33. Work done by gravitational force $\vec{F}$ during displacement from $r = r_1 to\ r = r_2$ is $U_{1\text{-}2} =$ .....
34. Work done by reaction at a smooth surface when the body in contact moves along the surface is .....
35. If $\vec{F}$ is the force and $\vec{r}$ is the displacement, the work done = ...; Power = ...
36. Work done in moving a 80kg block through a horizontal distance of 12m by applying a force of 150N which makes an angle of 40^0 with the horizontal is .....
37. Determine the work done by a 20kN force on 150kg body in order to pull it along a smooth floor by a distance of 8m.
38. A force is said to be conservative if the work done by it is .....
39. A car weighting 49050N climbs up a hill that rises 1 in 25m of its length at the rate of 72km/hr. Neglecting friction, minimum power developed is .....
40. A body of mass 2.5kg is moving with a constant velocity of 5m/s. In order to bring it to rest at a distance of 4m, the work done is ..... and force required is .....
41. The integral $\int_{t_1}^{t_2} \vec{F} dt$ is known as .....
42. Impulsive force is a .....
43. Motion produced due to impulsive force is an .....
44. An automobile of mass 250kg is moving with a uniform velocity of 120km/hr. The force required to stop the vehicle is 15 seconds is .....
45. Two masses of 2kg and 5kg are moving with kinetic energies. The ratio of magnitudes of respective linear momenta is .....
46. A particle of mass 'm' moving with a velocity u is subjected to an impulse I, which produces a final velocity 'v', $then\ I =$ .....
47. If two bodies with masses, m_A, m_B move with equal kinetic energy, their linear momenta will be in the ratio .....
48. A ball of weight 1N falls from a height of 4m and rebounds to a height of 3m. If the time of contact between the ball and floor is 0.2 second, its impulse is ..... and the average force is given by .....
49. Large force acting on a particle for a very short duration which produces a definite change in momentum of particles is known as .....
50. A collision between two bodies which occurs in a very small interval of time, and during which they exert a relatively large force on each other is called .....
51. Line of impact is a .....
52. In a one dimensional elastic collision, the relative velocity of approach before collision is ..... times the relative velocity of separation after collision.

53. A spherical ball of mass 5kg moving with a velocity 'u' hits another spherical ball of the same mass which is stationary. If the coefficient of resolution is e, the ratio of velocities of two spheres after collision is .....

54. Time from the instant of initial contact to the instant of maximum deformation is called .....; time from the instant of maximum deformation to the instant of just separation is called .....

55. Coefficient of restitution (e) is the ratio of impulses given by .....; in terms of velocity, it is given by .....

56. A ball is rolled on a smooth floor of a room to hit a wall. If the time taken by the ball in returning to the point of projection is twice the time in reaching the wall, $e =$ .....

57. A glass marble is dropped from a height of 3.5m upon a horizontal floor. If $e = 0.8$, it will rebound to a height of .....

58. Efficiency of an engine in terms of indicated power and break power is .....

59. Indicated power is defined as .....

60. Break power is defined as .....

SECTION B

(1)a. A locomotive and train together has mass of 200t. The tractive resistance is 1% of the train mass. On a grade of 1 in 120, the train can go with a maximum speed of 30km per hour. Determine (i) the power of the locomotive (ii) The maximum speed it can attain on straight level track with the tractive resistance remaining same.

b. Find the spherical coordinates of a point whose Cartesian coordinate are (3,4,5).

40 marks

(2)a. The 250N box shown below is acted upon by a force having a variable magnitude $P = (100t)$ N, where t is in seconds. Determine the box's velocity 2s after P has been applied. The initial velocity is $v_1 = 1m/s$ down the plane and the coefficient of kinetic friction between the box and the plane is = $\mu_k = 0.3$.

b. A 5kg riffle bullet has a velocity of 30m/s as it if enters a large fixed block of wood. It comes to rest 2s after entering the block. Determine the average force that acts on the bullet and distance perpetrated by the bullet. 40 marks

3. A body moves along a straight line and its acceleration (a) which varies with time (t) is given by $a = 2 - 3t$. After 5 seconds from start of observations, its velocity is observed to be 20m/sec. After 10 seconds from start of observation, the body was at 85metres from origin.

(a) Determine its acceleration, velocity and distance from the origin at the start of observation.

(b) Determine the time after start of observation in which the velocity becomes zero and its distance from the origin. 40 marks

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UNIVERSITY OF UYO, UYO

FACULTY OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

Second Semester Examination 2013/2014 Session

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5. A body dropped from a height 'H' reaches the ground after 't' seconds. It would have reached a height of 0.5 H at a time ..... seconds.
6. A car travels between two stations which are 15km apart in 20minutes. If the car accelerates for a part of journey uniformly followed by uniform retardation, the maximum speed attained by the car during the journey is .....
7. If $x = \propto cost$ where x = displacement and t = time then acceleration is .....
8. If the motion of a particle is defined by $(2t - t^2)i + (3t - 15t^2)j$, its path is .....
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$F = \frac{G m_1 m_2}{r^2}$ mg $mg = \frac{G M_1 M_2}{R^2}$ $g = \frac{GM}{r^2}$

23. Two masses 10kg and 15kg are attached to the end of the string passing over a pulley fixed at the top. The tension and acceleration are ..... and ..... respectively.
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36. Work done in moving a 80kg block through a horizontal distance of 12m by applying a force of 150N which makes an angle of 40^0 with the horizontal is .....
37. Determine the work done by a 20kN force on 150kg body in order to pull it along a smooth floor by a distance of 8m.
38. A force is said to be conservative if the work done by it is ..... WDE Fxb
39. A car weighting 49050N climbs up a hill that rises 1 in 25m of its length at the rate of 72km/hr. Neglecting friction, minimum power developed is .....
40. A body of mass 2.5kg is moving with a constant velocity of 5m/s. In order to bring it to rest at a distance of 4m, the work done is ..... and force required is .....
41. The integral $\int_{t_1}^{t_2} \vec{F} dt$ is known as .....Impulse.....
42. Impulsive force is a .....
43. Motion produced due to impulsive force is an .....
44. An automobile of mass 250kg is moving with a uniform velocity of 120km/hr. The force required to stop the vehicle is 15 seconds is .....
45. Two masses of 2kg and 5kg are moving with kinetic energies. The ratio of magnitudes of respective linear momenta is .....
46. A particle of mass 'm' moving with a velocity u is subjected to an impulse I, which produces a final velocity 'v', $then\ I =$ .....
47. If two bodies with masses, m_A, m_B move with equal kinetic energy, their linear momenta will be in the ratio .....
48. A ball of weight 1N falls from a height of 4m and rebounds to a height of 3m. If the time of contact between the ball and floor is 0.2 second, its impulse is ..... and the average force is given by .....
49. Large force acting on a particle for a very short duration which produces a definite change in momentum of particles is known as .....
50. A collision between two bodies which occurs in a very small interval of time, and during which they exert a relatively large force on each other is called .....
51. Line of impact is a .....
52. In a one dimensional elastic collision, the relative velocity of approach before collision is ..... times the relative velocity of separation after collision.

53. A spherical ball of mass 5kg moving with a velocity 'u' hits another spherical ball of the same mass which is stationary. If the coefficient of resolution is e, the ratio of velocities of two spheres after collision is .....

54. Time from the instant of initial contact to the instant of maximum deformation is called .....; time from the instant of maximum deformation to the instant of just separation is called .....

55. Coefficient of restitution (e) is the ratio of impulses given by .....; in terms of velocity, it is given by .....

56. A ball is rolled on a smooth floor of a room to hit a wall. If the time taken by the ball in returning to the point of projection is twice the time in reaching the wall, e = ...

57. A glass marble is dropped from a height of 3.6m upon a horizontal floor. If $e = 0.8$, it will rebound to a height of .....

58. Efficiency of an engine in terms of indicated power and break power is .....

59. Indicated power is defined as .....

60. Break power is defined as .....

SECTION B

1a. A locomotive and train together has mass of 200t. The tractive resistance is 1% of the train mass. On a grade of 1 in 120, the train can go with a maximum speed of 30km per hour. Determine (i) the power of the locomotive (ii) The maximum speed it can attain on straight level track with the tractive resistance remaining same.

b. Find the spherical coordinates of a point whose Cartesian coordinate are (3,4,5).

40 marks

2a. The 250N box shown below is acted upon by a force having a variable magnitude $P = (100t)$ N, where t is in seconds. Determine the box's velocity 2s after P has been applied. The initial velocity is $v_1 = 1m/s$ down the plane and the coefficient of kinetic friction between the box and the plane is = $\mu_k = 0.3$.

b. A 5kg riffle bullet has a velocity of 30m/s as it if enters a large fixed block of wood. It comes to rest 2s after entering the block. Determine the average force that acts on the bullet and distance perpetrated by the bullet.

40 marks

3. A body moves along a straight line and its acceleration (a) which varies with time (t) is given by $a = 2 - 3t$. After 5 seconds from start of observations, its velocity is observed to be 20m/sec. After 10 seconds from start of observation, the body was at 85metres from origin.

(a) Determine its acceleration, velocity and distance from the origin at the start of observation.

(b) Determine the time after start of observation in which the velocity becomes zero and its distance from the origin.

40 marks

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DEPARTMENT OF MECHANICAL ENGINEERING

MEE 223: ENGINEERING MECHANICS II
SECOND SEMESTER EXAMINATION 2012/2013

ANSWER FOUR (4) QUESTIONS ONLY **TIME: 2HOURS**

Q 1a A body weighing 350N is pushed up a 30° plane by a 400N force acting Parallel to the plane. If the initial velocity of the body is 2m/sec. and the coefficient of Kinetic friction is 0.3, what velocity will the body have after moving 5m?

1b If $X = 3 \sin t$ and $Y = 4 \cos t$, where X and Y are in metres and t is in seconds, determine the X and Y components of velocity and acceleration.

Q 2a A train car weighs 120KN, the tractive resistance being 5N/KN. What power will be required to propel the car at a uniform speed of 25kmph? If (a) On level surface (b) up an incline of 1 in 300 and (c) down an inline of 1 in 300? Take efficiency of motor as 80%.

Q 3a A glass marble, whose weight is 0.3N, falls from a height of 10m. Find the impulse and the average force between the marble and the floor, if the time during which they are in contact is 1/10 of a second.

3b If $X = 1 - t$ and $y = t^2$ where x and y are in metres and t is measured in seconds, determine the x and y components of velocity and acceleration

Q 4a A hammer weighing 5N is used to drive a nail of weight 0.2N with a velocity of 5m/sec. horizontally into a fixed wooded block. If the nail penetrates by 20mm per blow, calculate the resistance of the block which may be assumed uniform.

4b A ball is dropped from a height of 1m on a smooth floor. The height of first rebounce is 0.31m. Determine (a) Coefficient of the Restitution (b) Expected height of second bounce.

Q 5a At any instant the horizontal position of the weather ballon in fig. 5a below is defined by $X = (9t)$ Metres, where t is given in seconds. If the equation of the path is $y = x^2/30$, determine (a) the distance of the ballon from the station at A when t= 2 seconds and (b) the magnitude and direction of velocity and acceleration when t= 2 seconds.

5b Explain the following terms (a) Coefficient of Restitution (b) Period of Deformation and (c) Period of Restitution.

Q 6 The 10kg block shown in fig. 6a below rests on the smooth incline. If the spring is originally stretched 0.5m, determine the total work done by all the forces acting on the block when a horizontal force P = 400N pushed the block up the plane S =2m.

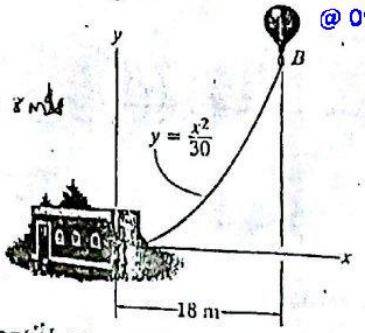

Fig. 5(a)

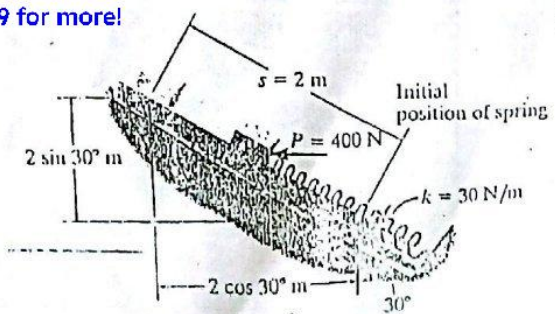

Fig. 6

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SECOND SEMESTER EXAMINATION 2011/2012 SESSION
MEE 223: ENGINEERING MECHANICS II

INSTRUCTION: ATTEMPT ANY FOUR (4) QUESTIONS ONLY. TIME ALLOWED: 2 HOURS

1a. A body moves along a straight line and its acceleration a which varies with time is given by a=4-6t. Five seconds after start of the observations, its velocity is found to be 20m/sec. Ten seconds after start of observations, the body is at 80m from the origin. Determine; (i) its acceleration, velocity and distance from the origin (ii) the time in which the velocity becomes zero and the corresponding distance from the origin (iii) describe the motion diagrammatically for values of t ranging from 0 to 8secs. 17marks

1b. A force $F= F_{xi} + F_{yj} + F_{zk}$ is exerted on a free mass m located at (X_o, y_o, Z_o) at time t = 0. Its velocity at t= o is $V = V_{oxi} + V_{oyj} + V_{ozk}$ find (i) The acceleration of the mass t second later (ii) the position of the mass t second later

2a. Two weights 800N and 200N are connected by a thread and they move along a rough horizontal plane under the action of a force of 400N applied to the 800N weight as shown in fig 2 below. The coefficient of friction between the sliding surface of the weights and the plane is 0.3. Using D'Alembert's principle determine, the acceleration of the weight and tension in the thread.
12marks

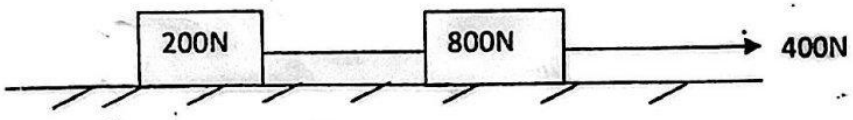

Fig 2a

2b. A body weighing 250N is pushed up a 30° plane by a 450N force acting parallel to the plane. If the initial velocity of the body is 1.6 m/sec. and coefficient of kinetic friction is $\mu = 0.2$. Using the work energy equation determine, the velocity of the body after moving 6m? 13marks

3a. A body weighing 130N is on an incline, as shown in figure 3a below, whose slope is 5 vertical to 12 horizontal. Its initial velocity down the incline is 24m/sec. What will be its velocity 5sec later? Take coefficient of friction at contact surface= 0.3 10marks

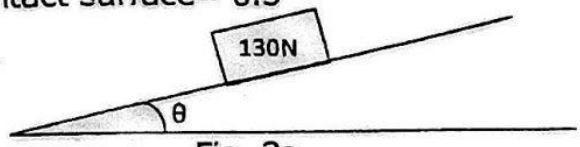

Fig. 3a

3b. A pile hammer, weighing 15kN drops from a height of 600mm on a pile of 7.5 kN. How deep does a single blow of hammer drive the pile if the resistance of the ground to pile is 140KN? Assume that ground resistance is constant.
15marks

4a. A ball is dropped from a height of 1.5m on a smooth floor. The height of the first bounce is 0.95m. Determine; (i). Coefficient of the restitution (ii) Expected height of second bounce.
13marks

4b. If kinetic energy is conserved, show that the coefficient of restitution e = 1
12marks

5a A train car weighs 120KN, the tractive resistance being 5KN. What power will be required to propel the car at a uniform speed of 20km/h? if,

i. On level surface
ii. Up an incline of 1 in 300 and
iii. Down an inclination of 1 in 3000?
Take efficiency of motor as 80%

16marks

5b. Explain the following terms
i. indicated power ; (ii) Brake power (iii) Efficiency of an engine

5c. What apparatus is used in measuring the brake power of an engine? Mention two (2) types of the apparatus.
3marks

6a. A sphere of weight 10N moving at 3m/sec collides with another sphere of weight 50N moving in the same line at 0.6m/sec. Find the loss of kinetic energy during impact and show that the direction of motion of the first sphere is reversed after the impact.
15marks

6b. A point initially at X = 0, moves with initial velocity and acceleration of +320m/s and – 16m/s along the X-axis. Determine the position of the point at the time when V = 0.
5marks

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SECOND SEMESTER EXAMINATION 2011/2012 SESSION
MEE 223: ENGINEERING MECHANICS 11

INSTRUCTION: ATTEMPT ANY FOUR (4) QUESTIONS ONLY. TIME ALLOWED: 2 HOURS

1a. A body moves along a straight line and its acceleration a which varies with time is given by a=4-6t. Five seconds after start of the observations, its velocity is found to be 20m/sec. Ten seconds after start of observations, the body is at 80m from the origin. Determine; (i) its acceleration, velocity and distance from the origin (ii) the time in which the velocity becomes zero and the corresponding distance from the origin (iii) describe the motion diagrammatically for values of t ranging from 0 to 8secs. 17marks

1b. A force $F= F_{xi} + F_{yj} + F_{zk}$ is exerted on a free mass m located at (X_o, y_o, Z_o) at time t = 0. Its velocity at t= o is $V = V_{oxi} + V_{oyj} + V_{ozk}$ find (i) The acceleration of the mass t second later (ii) the position of the mass t second later

2a. Two weights 800N and 200N are connected by a thread and they move along a rough horizontal plane under the action of a force of 400N applied to the 800N weight as shown in fig 2 below. The coefficient of friction between the sliding surface of the weights and the plane is 0.3. Using D'Alembert's principle determine, the acceleration of the weight and tension in the thread.
12marks

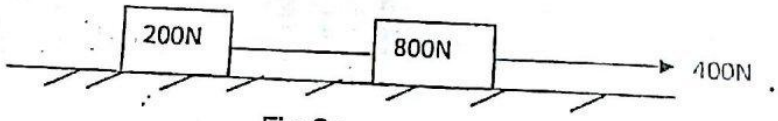

Fig 2a

2b. A body weighing 250N is pushed up a 30° plane by a 450N force acting parallel to the plane. If the initial velocity of the body is 1.6 m/sec. and coefficient of kinetic friction is μ = 0.2. Using the work energy equation determine, the velocity of the body after moving 6m?
13marks

3a. A body weighing 130N is on an incline, as shown in figure 3a below, whose slope is 5 vertical to 12 horizontal. Its initial velocity down the incline is 24m/sec. What will be its velocity 5sec later? Take coefficient of friction at contact surface= 0.3
10marks

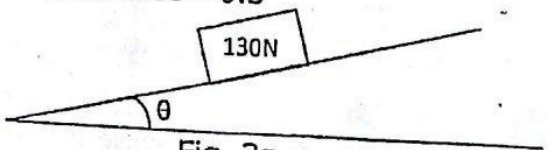

Fig. 3a

A pile hammer, weighing 15KN drops from a height of 600mm on a pile. How deep does a single blow of hammer drive the pile if the resistance of the ground to pile is 140KN? Assume that ground resistance is constant. 15marks

1a. A ball is dropped from a height of 1.5m on a smooth floor. The height of the first bounce is 0.95m. Determine; (i). Coefficient of the restitution (ii) Expected height of second bounce. 13marks

1b. If kinetic energy is conserved, show that the coefficient of restitution e = 1 12marks

5a. A train car weighs 120KN, the tractive resistance being 5KN. What power will be required to propel the car at a uniform speed of 20km/h? if,

i. On level surface
ii. Up an incline of 1 in 300 and
iii. Down an inclination of 1 in 3000?

Take efficiency of motor as 80% 16marks

5b. Explain the following terms

i. indicated power ; (ii) Brake power (iii) Efficiency of an engine

5c. What apparatus is used in measuring the brake power of an engine? Mention two (2) types of the apparatus. 3marks

6a. A sphere of weight 10N moving at 3m/sec collides with another sphere of weight 50N moving in the same line at 0.6m/sec. Find the loss of kinetic energy during impact and show that the direction of motion of the first sphere is reversed after the impact. 15marks

6b. A point initially at X = 0, moves with initial velocity and acceleration of +320m/s and − 16m/s along the X-axis. Determine the position of the point at the time when V = 0. 5marks

$W = mg$

$m = \frac{W}{g}$

$u = 0$

$S = 600 = 0.6m$

$v^2 = u^2 + 2gs$

$m = \frac{15}{9.8} = 1.53kg$

$V^2 = +2 \times 9.8 \times 0.6$

$v^2 = 11.76$

$v = 3.43 m/s$

$V = 0$

$u = 3.43 m/s$

$V^2 = u^2 - 2as$

$0 = (3.43)^2 - 2as$

but $f = ma$

$140 = 1.53a$

$a = \frac{140}{1.53}$

$a = 91.5 m/s^2$

$0 = 11.76 - 2 \times 91.5 s$

$-11.76 = -183s$

$S = \frac{11.76}{183}$

$S = 0.064m$

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SECOND SEMESTER EXAMINATIONS **SESSION: 2010/2011**

COURSE TITLE: ENGINEERING MECHANICS II **COURSE CODE: MEE 223**

INSTRUCTION: ATTEMPT ANY FOUR (4) QUESTIONS **TIME ALLOWED: 2 HOURS**

CREDIT HOUR: 2 UNITS

Question 1 (a) Two cars traveling towards each other on a single lane road at the velocities of 12m/sec and 9m/sec respectively. When 100m a part, both drivers realize the situation and apply their brakes. They succeed in stopping simultaneously and just short of colliding. Assume constant deceleration for each and determine:

(a) time required for the cars to stop
(b) deceleration of each car
(c) the distance traveled by each car while slowing down. **(17 marks)**

Question 1 (b) State four (4) important points regarding initial and final velocity in the case of rectilinear motion. **(8 marks)**

Question 2 (a) A car weighing 11,000N running at 10m/sec holds three men each weighing 700N. The men jump off from the back end gaining a relative velocity of 5m/sec with the car. Find the speed of the car if the three men jump off (i) in succession (ii) all together. **(18 marks)**

Question 2 (b) A bullet weighs 0.5N and moving with a velocity of 400m/sec. hits centrally a 30N block of wood moving away at 15m/sec. and gets embedded in it. Find the velocity of the bullet after the impact and the amount of kinetic energy lost. **(7 marks)**

Question 3 (a) A ball impinges directly on a similar ball at rest. The first ball is reduced to rest by the impact. Find the coefficient of restitution, if half of the initial kinetic energy is lost by impact. **(10 marks)**

Question 3 (b) A sphere of mass 1kg moving at 3m/sec. overtakes another sphere of mass 5 kg moving in the same line at 0.6m/sec. Find the lost of kinetic energy during impact, and show that the direction of motion of the first sphere is reversed. Take coefficient of restitution as 0.75. **(15 marks)**

Question 4 (a) A 10N ball traverses a frictionless tube as shown in fig a below, falling through a height of 2m. It then strikes a 20N ball hung from a rope 1.2m long. Determine the height to which the hanging ball will rise
(i) if the collision is perfectly elastic
(ii) if the coefficient of restitution is 0.7. **(17 marks)**

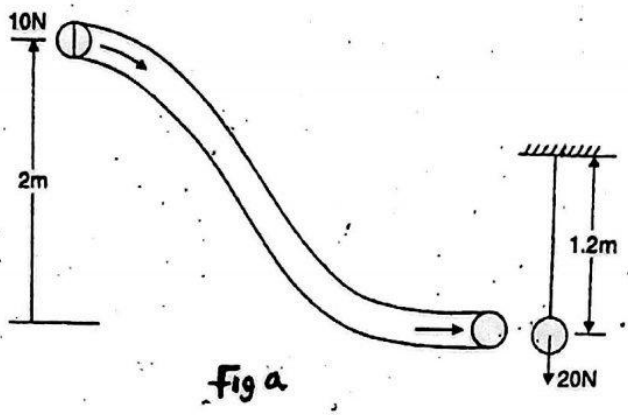

Fig a

Question 4 (b) Write short notes on the following terms:
(i) Line of Impact (ii) Direct Impact (iii) Oblique Impact
(iv) Central Impact (v) Eccentric Impact (vi) Period of Deformation
(vii) Period of Restitution (viii) Restitution **(8 marks)**

Question 5 (a) A block weighing 2500N rests on a level horizontal plane for which coefficient of friction is 0.20. This block is pulled by a force of 1000N acting at an angle of 30° to the horizontal. Find the velocity of the block after it moves 30m starting from rest. If the force of 1000N is then removed, how much further will it move?
Use work energy method. **(17 marks)**

Question 5 (b) Write short notes on the following:
(i) Indicated power
(ii) Brake power
(iii) Efficiency of an engine
(iv) Dynamometer **(8 marks)**

Question 6 (a) In a police investigation of tyre marks, it was concluded that a car while in motion along a straight level road skidded for a total of 60metres after the brake were applied. If the coefficient of friction between the tyre and the pavement is estimated as 0.5, what was the probable speed of the car just before the brakes were applied?
(15 marks)

Question 6 (b) A glass marble whose weight is 0.3N, falls from a height of 10m and rebounds to a height of 8metres. Find the impulse and the average force between the marble and the floor, if the time during which they are in contact is 1/5 of a second. **(10 marks)**