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Total Number of Pages: 4

B.TECH
15BE2104

2nd Semester Regular Examination 2015-16

MECHANICS

BRANCH: ALL

Time: 3 Hours

Max Marks: 100

Q.CODE: W620

Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.

Part – A (Answer all the questions)

Q1 Answer the following questions: *multiple type or dash fill up type* **(2 x 10)**

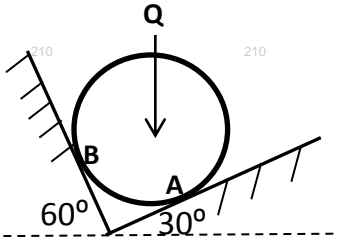
- a)** If three concurrent coplanar forces are represented by three sides of a triangle taken in order, select the condition that is satisfied.
- (i) The magnitude of the resultant is zero.
 - (ii) The third side taken in the same order is the resultant of the other two forces.
 - (iii) The magnitude of the resultant is maximum.
 - (iv) No conclusions can be drawn.
- b)** The necessary condition for equilibrium of a particle subjected to coplanar concurrent forces is
- (i) $\sum X = 0$ (ii) $\sum Y = 0$ (iii) $\sum X = 0$ and $\sum Y = 0$ (iv) None
- c)** The force of friction developed between two surfaces in contact is independent of
- (i) Roughness of surface (ii) Area of contact between the surfaces
 - (iii) Reaction of surface (iv) Force which tends to cause the motion
- d)** In the equation of virtual work, following force is neglected
- (i) Reaction of any smooth surface with which the body is in contact.
 - (ii) Reaction of a rough surface on a body which rolls on it without slipping
 - (iii) Reaction at a point or axis around which the body is constrained to turn
 - (iv) All of the above
- e)** A body of weight W is required to move up on rough inclined plane whose angle of inclination with the horizontal is α . The effort applied parallel to the plane is given by (where $\mu = \tan\phi =$ Coefficient of friction between the plane and the body.)
- (i) $P = W (\sin\alpha + \mu\cos\alpha)$ (ii) $P = W \tan\alpha$
 - (iii) $P = W \tan(\alpha + \phi)$ (iv) $P = W (\cos\alpha + \mu\sin\alpha)$
- f)** The rate of change of momentum is directly proportional to the impressed force, and takes place in the same direction in which the force acts. This statement is known as
- (i) Newton's first law of motion (ii) Newton's second law of motion
 - (iii) Newton's third law of motion (iv) None of these
- g)** The range of projectile on a downward inclined plane is _____ the range on upward inclined plane for the same velocity of projection and angle of projection.
- (i) Less than (ii) more than
 - (iii) equal to (iv) cannot be predicted
- h)** Two balls of equal mass and of perfectly elastic material are lying on the floor. One of the ball with velocity v is made to struck the second ball. Both the balls after impact will move with a velocity
- (i) v (ii) $v/2$
 - (iii) $v/4$ (iv) $v/8$
- i)** Work done is said to be zero, when
- (i) some force acts on a body, but displacement is zero
 - (ii) no force acts on a body but some displacement takes place
 - (iii) either (a) or (b)

- (iv) none of the above
- j) Given a race between a thin hoop and a uniform cylinder of same mass and radius down an incline, which will reach the bottom first?
- (i) Uniform cylinder (ii) Thin hoop
(iii) both will reach at the same time (iv) cannot be predicted

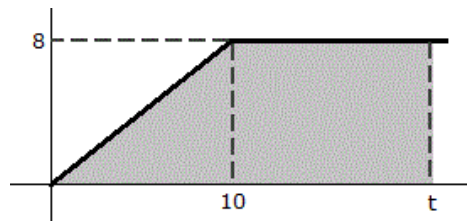
Q2 Answer the following questions: **Short answer type**

(2 x 10)

- a) State and explain theorem of transmissibility with a neat sketch.
- b) Draw the free body diagram of the following problem, showing all the active and reaction forces and their inclination with respect to vertical.



- c) State and explain Lami's theorem with a neat sketch.
- d) State and explain Principle of virtual work with a neat sketch.
- e) While analyzing a truss by method of section, the truss is cut in two parts by an imaginary section preferably cutting not more than three members. What is the reason for this?
- f) A race car starting from rest moves along a straight track with an acceleration as shown in the graph (where for $t > 10$ s, $a = 8$ m/s²). Determine the time t for the car to reach a speed of 50 m/s.

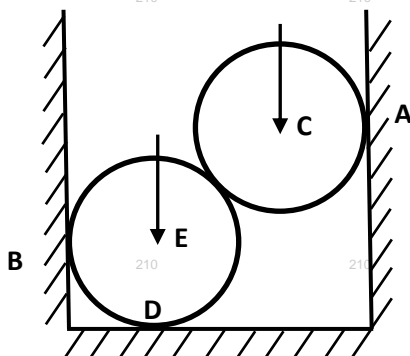


- g) Define impulse and impulsive force.
- h) Define impact and elastic impact.
- i) State principle of work and energy.
- j) A body is rotating with an angular velocity of 5 radians/sec. After 4 seconds, the angular velocity of the body becomes 13 radians/sec. Determine the angular acceleration of the body.

Part – B (Answer any four questions)

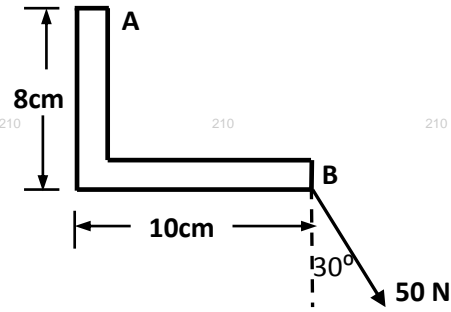
- Q3** a) Two smooth spheres of weight $Q=500$ N rest in a horizontal channel having vertical walls, the distance between them is $b = 1000$ mm and radius of each sphere is $r = 300$ mm as shown in the figure. Find the pressures exerted on the walls and floor at the points of contact A, B and D.

(10)

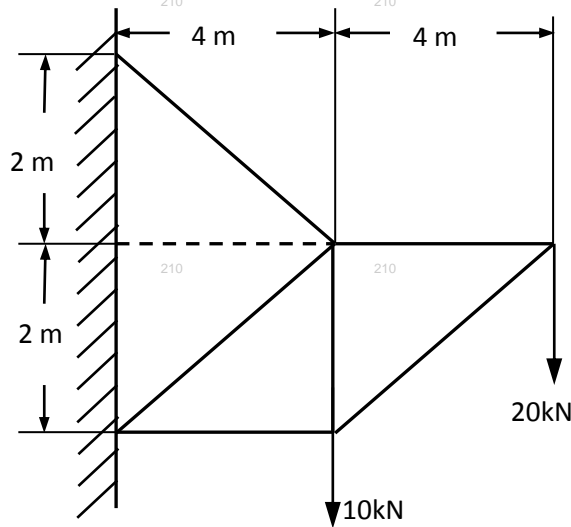


- b) A 50N force is applied to a corner plate at B as shown in the figure. Determine an equivalent force couple system acting at A.

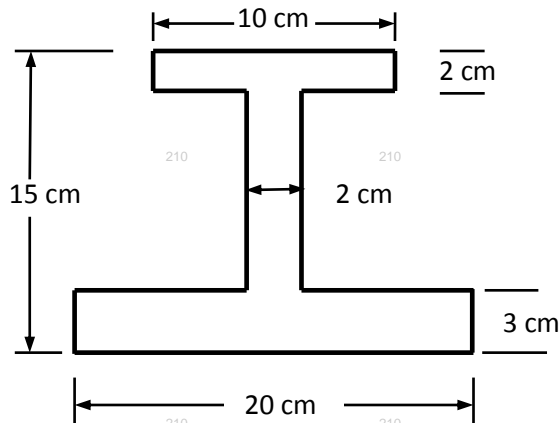
(5)



Q4 Determine the force in each member of the truss as shown in the figure. **(15)**

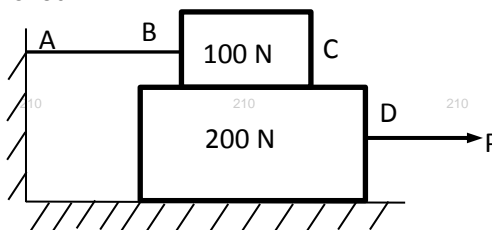


Q5 a) Find the moment inertia of the I section as shown in the figure. **(10)**



b) State and prove perpendicular axis theorem. **(5)**

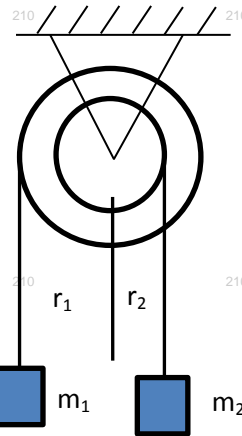
Q6 a) The coefficient of friction between all surfaces is 0.25. Determine the smallest force P required to start the block D moving if (i) the block C is restrained by the cable AB as shown (ii) cable AB is removed. **(10)**



b) A ladder AB of length l and weight Q rests in a vertical plane and supported by a smooth wall and a smooth floor. The inclination of the ladder with the horizontal is θ . **(5)**

Using the principle of virtual work find the magnitude of force P required to be applied at the bottom of the ladder to keep it in equilibrium.

- Q7 a)** Considering the inertial and frictional effect absent in the pulley system as shown, determine the downward acceleration of mass m_1 , Take $m_1 = 8\text{kg}$, $m_2 = 12\text{kg}$, $r_1 = r_2 = 20\text{cm}$.

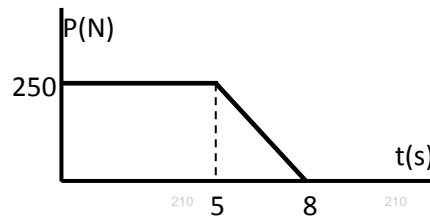


(10)

- b)** A rocket is released from a jet fighter flying horizontally at 1200 kmph at an altitude of 3000m above the target. The rocket thrust gives it a constant horizontal acceleration of 6m/sec^2 . At what angle below the horizontal should pilot see the target at the instant of releasing the rocket in order to score a hit?

(5)

- Q8 a)** A 50kg block placed on a horizontal rough surface and initially at rest is acted upon by a force P which varies as shown in the figure. The kinematic friction is 0.20. Determine the velocity of the block after (i) $t = 5\text{s}$ and (ii) $t = 8\text{s}$

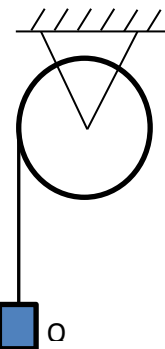


(10)

- b)** A 2000 kg rail car moving at a speed of 0.5m/s to the right collides with a 3500 kg car which is at rest. If after the collision the 3500 kg car is observed to move to the right at a speed of 0.3 m/s, determine the coefficient of restitution.

(5)

- Q9 a)** A solid right circular drum of radius $r = 0.5\text{m}$ and weight $W = 200\text{N}$ is free to rotate about its geometric axis as shown in the figure. Wound around the circumference of the drum is a flexible cord carrying at its free end a weight $Q = 50\text{N}$. If the weight Q is released from rest, find the time t required to fall a height of $h = 2\text{m}$.



(10)

- b)** An automobile weighing 2000N is driven down 5° incline at a speed of 90kmph when the brakes are applied causing a total braking force of 750N. Determine the distance travelled by the automobile as it comes to a stop.

(5)