**JUNE 2008**

**Code: AE03** **Subject: APPLIED MECHANICS**
**Time: 3 Hours** **Max. Marks: 100**

**NOTE: There are 9 Questions in all.**

- **Question 1 is compulsory and carries 20 marks. Answer to Q. 1. A must be written in the space provided for it in the answer book supplied and nowhere else.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

**Q.1 Choose the correct or best alternative in the following: (2x10)**

a. The rod connected to the ceiling fan is under _______________ strain

**(A)** shear **(B)** compressive
**(C)** tensile **(D)** compression and shear

b. The position of centre of pressure of a plane surface immersed in a static fluid is

**(A)** at the centroid of the immersed surface
**(B)** always above centroid
**(C)** always below centroid
**(D)** none of these

c. The energy developed by a force acting through a distance against resistance is known as

**(A)** Power **(B)** work
**(C)** moment **(D)** torque

d. Maximum value of frictional force acting on a body, when the body is just about to start is called

**(A)** limiting friction **(B)** static friction
**(C)** dynamic friction **(D)** coefficient of friction

e. The value of coefficient of restitution for perfectly elastic body is

**(A)** 0 **(B)** > 1
**(C)** < 1 **(D)** 1

f. Compressibility of a liquid is expressed by its

**(A)** density **(B)** pressure
**(C)** volume **(D)** bulk modulus of elasticity

g. The angular distortion in a tangent at any point of the elastic curve of a beam due to deflection is called____

**(A)** distortion **(B)** angular deviation
**(C)** slope **(D)** deflection

h. The acceleration, in a simple harmonic motion, is proportional to

**(A)** Linear velocity **(B)** angular velocity
**(C)** displacement **(D)** rate of change of angular velocity

i. ______________ have the same units

**(A)** Work and K.E. **(B)** momentum and impulse
**(C)** K.E and P.E. **(D)** all the above

j. If the momentum of a body is doubled, its kinetic energy will

**(A)** get halved **(B)** remains same
**(C)** increased by four times **(D)** none

**Answer any FIVE Questions out of EIGHT Questions.**
**Each question carries 16 marks.**

**Q.2** a. Define vector and scalar with examples. **(2)**

b. For the system of Beam AB shown in Fig. 1 find the tension T in the cable and the horizontal and vertical components of the reaction at A. Neglect the weight of the beam and the pulley.

What will be the tension T in the cable and the reaction components at A, if the cable pulls the boom AB in to a position at which it is inclined upward at a slope of 4 vertical to 3 horizontal? The load remains vertical. **(14)**

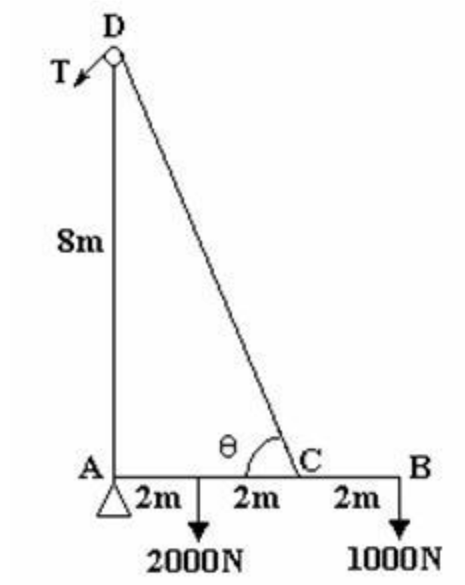


**Fig.1**

**Q.3** Determine the position of centroid and moment of inertia of the shaded area 1 shown in Fig.3, about the centroidal vertical and horizontal axes. **(16)**

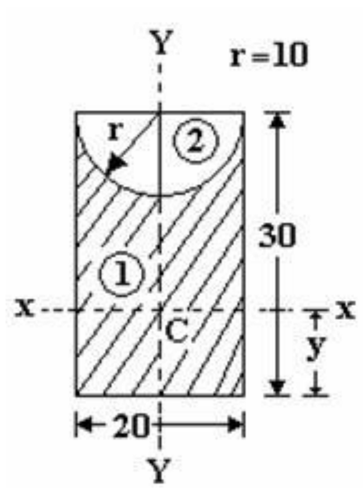


**Fig.3**

**Q.4** a. State laws of dry friction. **(4)**

b. Driver of a car traveling at 72 km/hr observes the light 300 m ahead of him turning green. The traffic light is timed to remain green for 20 secs. before it turns red. If the motorist wishes to pass the lights without stopping to wait for it to turn red, determine

(i) The required uniform acceleration of the car.

(ii) The speed with which the motorist crosses the traffic light. **(12)**

**Q.5** a. Derive the expression for coefficient of restitution. **(6)**

b. The coefficient of restitution between two spheres of mass, 1 kg and 6 kg is 0.75. The sphere of mass 1 kg, moving with a velocity of 3 m/sec, strikes the sphere of mass 6 kg moving in the same direction with a velocity of 0.6 m/sec. Find the velocity of the two spheres after impact and also the loss of K.E. during impact. **(10)**

**Q.6** a. State the laws of rotary motion. **(4)**

b. Two bodies weighing 300 N and 450 N are hung at the ends of a rope passing over an ideal pulley. With what acceleration would the heavier body come down? What is the tension in the rope?

Give the solutions by using (i) principle of work and energy (ii) principle of impulse and momentum. **(12)**

**Q.7** Derive the expressions for shear force and bending moment at any point on a cantilever beam carrying

(i) A point load 'P' at its free end

(ii) A point load 'P' at its free end and a uniformly distributed load W/unit length on the entire length of the beam.

Draw shear force diagram and bending moment diagram for both the cases. **(16)**

**Q.8** A sluice gate is 2 m wide and 1.2 m high. It is hinged at the bottom. On the upstream side, there is sea water extending to a height of 1.6 m above the top of the gate, and on the downstream side, there is fresh water up to the top of the gate. Find

(i) The resultant pressure force acting on the gate

(ii) The position of the centre of pressure

(iii) The least force required at the top of the gate which will open the gate.

Fresh water and sea water weigh 9810 $N/m^3$ and 10055 $N/m^3$ respectively. **(16)**

**Q.9** If for a two dimensional flow the stream function is given by $\Psi = 2xy$ , calculate the velocity at the point (3, 6) . Show that the potential $\Psi$ exists for this case and deduce it. **(16)**