Code: D-02 **Subject: APPLIED MECHANICS**
Time: 3 Hours **June 2006**
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 A Choose the correct or best alternative in the following: **(2x10)**

a. The greatest and the least resultant of two forces are 14 N and 2 N, respectively. If the two forces were at right angles the resultant would be
(A) 6 N **(B)** 8 N
(C) 10 N **(D)** none of these

b. A simple lever is in equilibrium. The moment of all the forces acting on the lever would be zero at:
(A) fulcrum **(B)** load point
(C) effort point **(D)** about any point

c. For a triangular area, the centroid would lie at the intersection of the following lines of the triangle
(A) medians **(B)** perpendicular bisectors
(C) angle bisectors **(D)** centre of any side

d. A box of mass *m* is stationary on the floor of a train compartment moving at constant acceleration *a* on a level straight track. If the coefficient of friction is μ, the friction force on the box from the floor of the compartment is
(A) 0 **(B)** μmg
(C) ma **(D)** μg

e. In a simple wheel and axle machine, the diameter of the wheel is 40 cm and that of the axle 8 cm. The velocity ratio would be
(A) 8/40 **(B)** 40/8
(C) 8×40 **(D)** $40/(2\times 8)$

f. A body starts from rest and travels with a constant acceleration for 8 seconds. The ratio of the distance travelled in the first 4 seconds to the distance travelled in the next 4 seconds would be
(A) 1/4 **(B)** $1/2$
(C) 1 **(D)** $1/8$

g. A ball A of mass *m* moving with velocity *V* on a smooth horizontal surface hits another identical stationary ball B. If the impact is perfectly plastic, The velocity of the ball A just after impact would be

(A) 0 **(B)** *V*/2

(C) *V* **(D)** V/4

h. In a uniaxial tension test for a specimen, the yield stress would change due to change in

(A) gauge length **(B)** diameter

(C) material **(D)** rate of loading

i. The strain energy in a linear spring subjected to a force P is E. If the force is further increased by P the strain energy would be

(A) 2E **(B)** 4E

(C) 8E **(D)** 6E

j. At a point of contraflexure in a beam, the following quantity changes sign

(A) bending moment **(B)** shear force

(C) axial force **(D)** none of these

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

Q.2 A uniform cylinder of weight *W* and radius *R* begins to roll over the obstruction A of height *h* due to the application of the force **P** at B as shown. Draw the free body diagram as it begins to roll and find the minimum force **P** required for the same. **(16)**

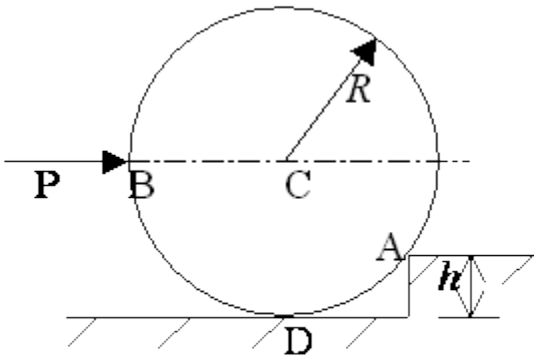

Fig.Q2

Q.3 Determine the force in each member of the truss shown. **(16)**

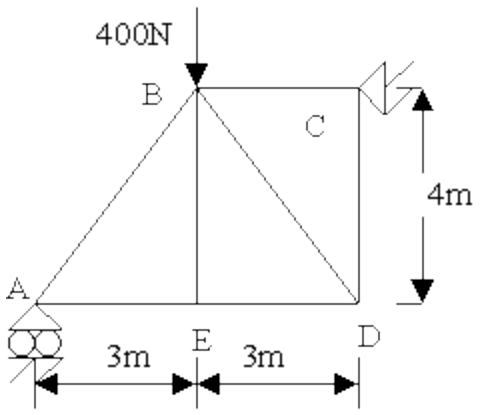

Fig.Q3

Q.4 Determine the centroid of the beam section shown. Find the area moment of inertia I_{xx} about the x axis. **(16)**

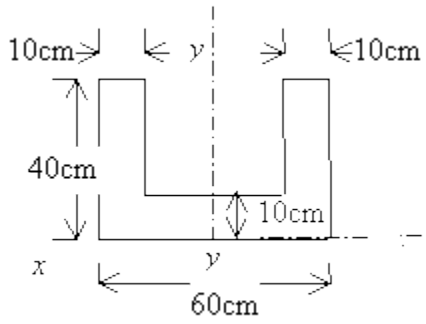

Fig.Q4

Q.5 Derive an expression for the torque T required for lifting a load W on a screw jack having single square thread of mean diameter d, pitch p and coefficient of friction μ. Hence, obtain an expression for the efficiency of the screw jack. Obtain the condition for self locking. **(16)**

Q.6 A boat of mass 40 Kg is pushed and receives an initial velocity V_0 = 0.5 m/s. Assume that the water resistance $R = 9.24V$ N where V is the boat velocity in m/s. Determine the time in which the velocity will be $V_0/2$ and the distance the boat will travel in that time. Also find the distance the boat will travel till it stops.
(16)

Q.7 Draw the shear force and bending moment diagrams for the beam shown in Fig.Q7. Indicate the numerical value at all important sections in the diagrams. **(16)**

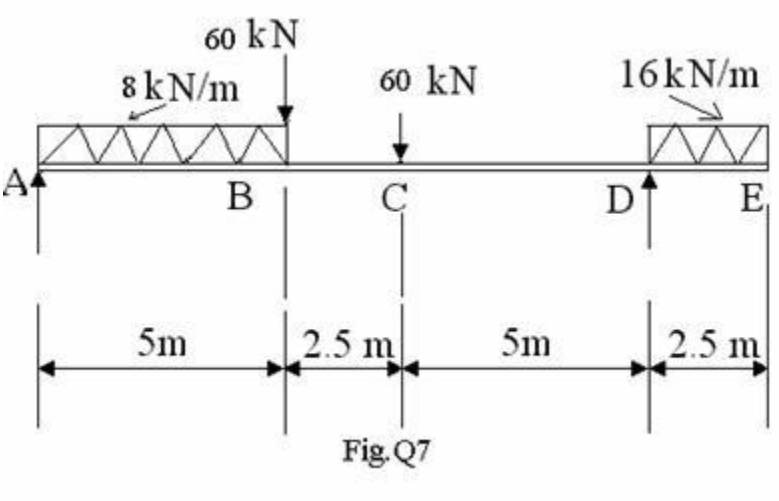

Fig.Q7

Q.8 A hollow steel shaft has to transmit 5 MW at 200 rpm. If the outside diameter is 30 cm, find its inside diameter and torsional rigidity. Take the modulus of rigidity for steel as 80 GPa and the allowable shear stress as 60 MPa. **(16)**

Q.9 An overhanging beam of length L = 5m is subjected to a uniformly distributed load w = 2kN/m and is simply supported at a distance d = 1m from each end. Draw the S.F. and B.M. diagrams. Locate the maximum bending moment and the points of contraflexure. **(16)**