DECEMBER 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. If the motion of one or both of colliding bodies, before impact is not directed along the line of impact, then it is known as

(A) indirect impact **(B)** direct impact
(C) direct central impact **(D)** direct oblique impact

b. Tangential component of acceleration is due to

(A) rate of change in speed **(B)** distance traversed
(C) change in acceleration **(D)** none

c. Frictional force acts _______________ to the direction of the motion at the surface of contact

(A) perpendicular **(B)** at an angle
(C) parallel **(D)** tangential

d. For principal axes, the moment of inertia will be

(A) $I_{xy} = 0$ **(B)** $I_{xy} = 1$
(C) $I_{xy} = \infty$ **(D)** none

e. A truss having 7 joints and 12 members is termed as _____________ truss.

(A) perfect **(B)** imperfect or deficient
(C) redundant **(D)** none

f. The algebraic sum of the moments of a system of forces about any point in their plane is equal to the moment of their resultant about that point is

(A) Varignon's theorem **(B)** D'Alembert's principle
(C) Lami's theorem **(D)** Merchant's theorem

g. Newton-meter/ second is the unit of

(A) force **(B)** momentum
(C) moment **(D)** deflection

h. Analysis of bodies in motion without any references to forces causing the motion is known as

(A) Dynamics **(B)** Kinetics
(C) Kinematics **(D)** none

i. The centre of gravity of solid circular cone divides the axis in the ratio

(A) 1:1 **(B)** 1:2
(C) 1:3 **(D)** 1:4

j. _______________ represents the area under velocity-time graph

(A) Acceleration **(B)** Speed
(C) Motion **(D)** Distance covered

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

Q.2 a. Define
(i) Varignon's principle
(ii) Perfect frame **(4)**

b. A body weighing 2000 N is suspended with a chain AB 2 m long. It is pulled by a horizontal force of 320 N as shown in Fig.1. Find the force in the chain and the lateral displacement (i.e. *x*) of the body. **(12)**

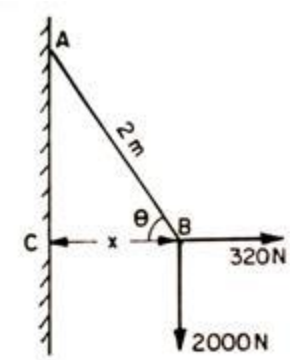
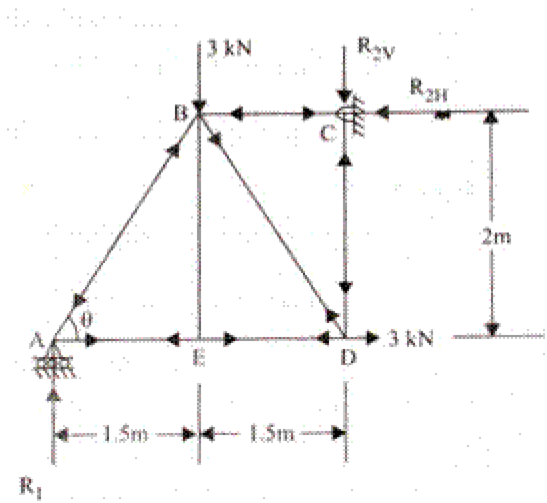


Fig. 1

Q.3 a. Give the equations of equilibrium for
(i) non-concurrent force systems
(ii) concurrent force system. **(4)**



b. Fig.2 shows a truss ABCDE , hinged at C and roller supported at A. At the point B, a vertical force of 3 kN and at D, a horizontal force of 3 kN are applied. Determine the reactions at supports and forces in the members of the truss. **(12)**

Fig. 2

Q.4 a. Define virtual work and state the propositions of virtual work **(5)**

b. A ladder AB supported as shown in Fig.3 carries a vertical load of 6000 N. Find the force P required horizontally at B to keep the ladder in equilibrium. Assume all contact surfaces as smooth. **(11)**

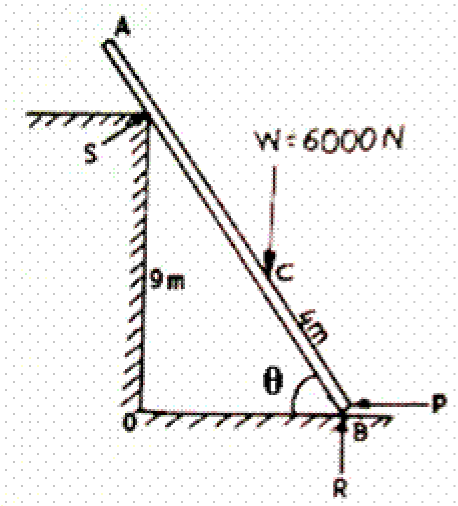


Fig.3

Q.5 a. Define (i) displacement (ii) velocity (iii) acceleration **(3)**

b. An elevator whose floor to ceiling height is 2.75 m starts ascending with constant upward acceleration of 1.2 m/sec^2. Two seconds after the start, a loose bolt drops from the ceiling towards the floor of the elevator. Calculate:

(i) time taken by the bolt to reach the elevator floor
(ii) displacement of the bolt during that time
(iii) the distance traveled by the bolt during the same time **(13)**

Q.6 a. A disk which was initially at rest executed 2.5 revolutions in 0.3 secs. Assuming that the motion is uniformly accelerated, determine (i) the angular acceleration of the disk (ii) the final angular velocity of the disk at the end of 2 secs. **(6)**

b. The frequency of free vibrations of a weight 'W' with a spring constant 'k' is 12 cycles/sec. When an extra weight of 20 N is coupled with the weight 'W', the frequency reduces to 10 cycles/sec. Find the weight 'W' and stiffness 'k' of the spring. **(10)**

Q.7 A simply supported beam is loaded as shown in Fig.4. Draw the shear force and bending moment diagrams. Determine the point of contra flexure and find the value of bending moment at that point. **(16)**

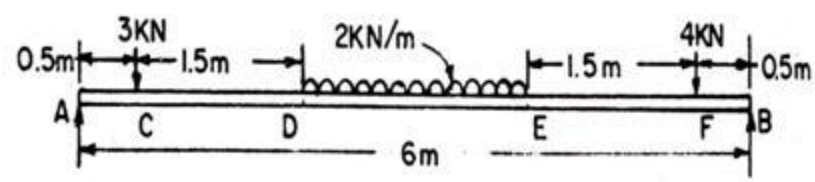


Fig. 4

Q.8 a. The two velocity components of fluid flow are given below. Find out the third component so that they satisfy continuity equation **(8)**

$$u = 3x^2 + 4y^2 + z^2$$

$$v = 5x^2 y - 3yz + 2xy$$

b. Locate the centroid of a triangle of base *b* and height *h*. **(8)**

Q.9 a. Describe the working of any turbine with the help of a sketch. **(6)**

b. A bar of uniform cross section is subjected to a uniaxial load of 148 kN. The diameter of the bar is 5 cm and the gauge length of the bar is 412 mm. Due to the load, the bar is elongated by 0.43 mm and the diameter reduces by 0.019 mm. If the material is within the elastic limit, determine (i) Poisson's ratio (ii) Modulus of elasticity. **(10)**