ENGINEERING MECHANICS

Time Allowed 3 Hours   *Full Marks 60*

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer. However, no marks will be given for wrong explanation of the answer of each MCQ type question.

Answer any Five (05) Questions from Group-B.

GROUP-A

1 Choose the correct answer from the given alternatives and explain your answer (any ten)   2x10=20

i) A force can be represented by---
   a) Direction b) magnitude c) direction and magnitude d) any one of the above

ii) Lami's theorem deals with the equilibrium of a body under the action of three----
   a) Coplanar forces b) non- coplanar forces c) coplanar non-concurrent forces d) coplanar concurrent forces

iii) The algebraic sum of moments of forces about any point in their plane is equal to the moment of their resultant about the same point- this is the statement according to------
   a) Varignon's theorem b) lami's theorem c) coplanar force theorem d) triangular theorem

iv) For conditions of equilibrium, Lami's theorem is applicable when the number of forces acting at a point is---a) two b) three c) four d) any number

v) Newton's which law is known as inertia law   a) first law b) second law c) third law d) fourth law

vi) When two forces of magnitude 3N and 4N acts at right angles to each other their resultant is
   a) 14N   b) 10N   c) 2N   d) 5N

vii) Unit of moment in S.I system is   a) kg-mm b) N-mm c) kg-m d) N-m

viii)   The point, through which the whole weight of the body acts, irrespective of its position, is known as
   (a) Moment of inertia (b) Center of gravity (c) Center of percussion (d) Center of mass.

ix) The magnitude of frictional force depends upon—a) area b) shape c) nature of the contacting surfaces d) none of these

x) Efficiency of a lifting machine is the ratio of –a) P. W b) V R / M.A. c) M A / V R d) M.A. x V R

xi) An ideal machine is one whose efficiency is   a) 50% b) 50% to 70% c) < 50% d) 100%

xii) The maximum mechanical advantage of a lifting machine is given by   a) 1 - m b) 1-m c) m / VR d) 1/m

xiii)   The distance travelled by a body moving with an uniform acceleration in the nth second is equal to---

   a) 2u + a (2n -1) b) u + a/2(2n - 1) c) un + ½ an² d) none of these

xiv) The energy which a body possesses by virtue of its position or configuration is called—
   a) Kinetic Energy b) Potential Energy c) Heat Energy d) Chemical Energy

xv) For maximum range of a projectile, the angle of projection should be--- a) 90° b) 60° c) 30° d) 45°

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GROUP-B

Answer any Five (05) questions   5x8 =40

2. State and explain Lami's Theorem. Find the Forces (tension) developed in the wire AB & CB, supporting an electric fixture as shown in the adjacent Fig [3+5]
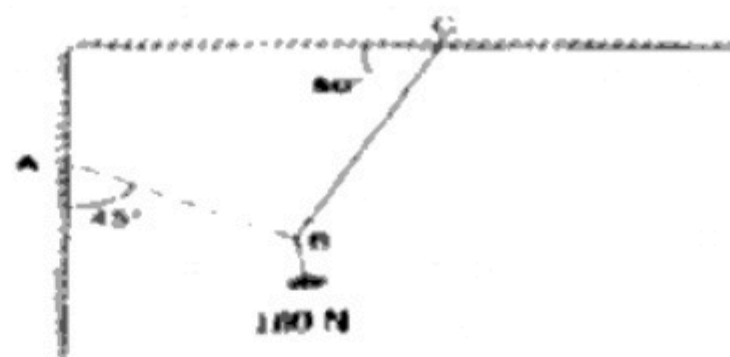
3. The following forces act a point --- i) 20N inclined at 30° towards north of east ii) 25N towards north iii) 30 N towards north of west and iv) 35N inclined at 40° towards south of west. Find the magnitude and direction of the resultant of the force system [8]

4. Write the general expression of Mechanical Advantage (MA) & Velocity Ratio (VR) of simple lifting machine. Deduce the condition of reversibility of a machine. What do you mean by non-reversible or self-locking machine [3+3+2]

5. What is Friction? Define Coefficient of Friction and Angle of Repose. A body is resting on rough horizontal plane. It requires a pull of 170 Newtons inclined plane at 27°, to the plane just to move it, while a push of 190 Newtons inclined at 27° to the plane just to move it. Determine weight of the body and the coefficient of friction [3+5]

6. Write the mathematical expression of potential and kinetic energy. A particle is projected at an angle 45° with the horizontal with velocity of projection 150 m/s. Determine i) the maximum height attained by the projectile, ii) the horizontal range of projectile, iii) time of flight [3+5]

7. State the unit of angular velocity, angular acceleration and angular displacement. A body moving with uniform acceleration covers 20 m in 4th second and 30 m in 8th second. find i) the initial velocity and ii) the acceleration of the body [3+5]

8. What are the advantages of a lifting machine? Define work, power and energy. Mention the S.I units of them [2+3+3]

9. Draw the sketches of the types of support in beam. Determine the reactions of the support A & B in the adjacent Fig [2+6]
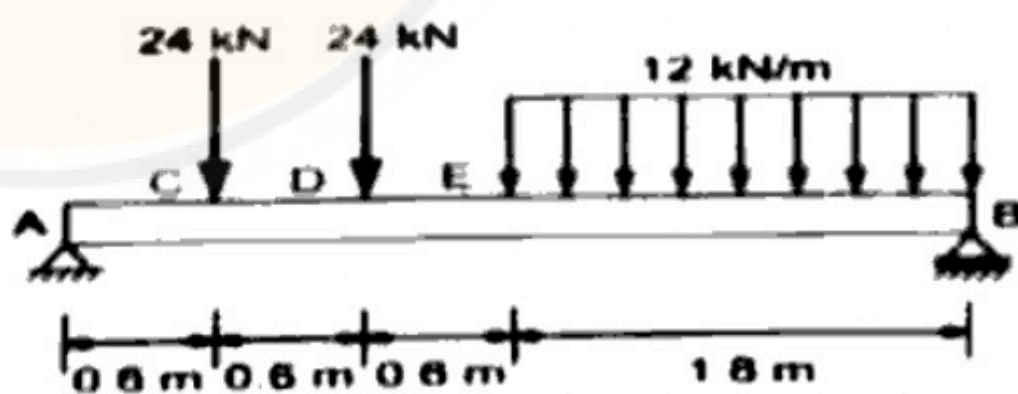
10. Write the expression of VR of a simple screw jack. The efficiency of a lifting machine is 80% when an effort 50 N is required to lift a load of 1 kN. Find the mechanical advantage and velocity ratio of the machine [2+6]

11. Differentiate between centroid and C.G. locate the centroid of the I-section shown in figure [2+6]