Mechanics L.O.6

Qena Student Club

- Concepts
- Resultant of forces.
- Resolution of a force.
- Lamis rule.
- Triangle of force.
- Equilibrium of co-planar forces act at a point.

The force is defined as the effect of a natural body upon another one by pushing, attraction, pressure or repulsion.

The natural body is a body consisting of materials (mass) and volume not equal to zero.

The natural body can be classified into two kinds:

1- rigid bodies (solid bodies)

_they are the bodies whose shapes do not change whatever the forces which are acting on them as solid metals, rocks , etc.….

2-deformable bodies.

_they are the bodies whose shapes can be disfigured as strings, liquids, gases, rubber and clay and our study in this unit will be contained to rigid bodies only.

There are different kinds of forces ,as:

1-Tension force.

_as the force in the string when carrying a body at it.

2-pressure force.

_as the force that appears when a body stabilized on a surface.

3-reaction force.

_as the reaction of a smooth surface on a body stabilized on it.

4-attraction force and repulsion forces.

_as the forces which formed between magnetic poles and electric charges.

5-gravitational forces (weight).

_if we let a body in the air , then it will drop down towards the earth because the attraction force of the earth attracts any body towards it.

The force is a vector quantity so it can be represented by the same way as the vectors.

The force can be expressed as following

1-cartesien form:

F=(x,y)

2-in terms of fundamental unit vectors:

F=xi +yj

3-polar form:

F=(IIFII , O)

Determination of the force.

The force is a vector which passes through a fixed point.

The force is determined by:

1-the magnitude of the force.

2-the direction of the force.

3-the point of action of the force.

Finding the resultant of two forces meeting at a point analytically.

R=(f1)2 + (f2)2 +2f1f2 cos a

Tan Ceta= f2 sin a over f1 +f2 cos a

The conditions of equilibrium of a rigid body under the action of two forces.

The rigid body is in equilibrium under the action of two forces only, if the two forces:

1-are in equal magnitude.

2-are opposite in direction.

3-their lines of action are on the same straight line.

Examples on the equilibrium of a body under the action of two forces:

(1) A body suspended by a light string:

If a weight is suspended by a light string. It balance under the action of two forces which are : weight acting vertically downwards and the tension in the string acting vertically upwards therefore, T=W

(2) A body of weight placed on horizontal smooth plane:

If a body of weight is placed on smooth horizontal plane. It balances under the action of two forces which are ,weight acting vertically downwards and the reaction of the horizontal smooth plane acting vertically upwards .

We deduce that, r=W

Note

If the rigid body is in equilibrium under the action of three forces actingAt a point and a triangle is drawn whose sides are parallel to the lines of action of the forces and taken in the same cyclic order, then the lengths of the sides of the triangle are proportional to the magnitudes of the corresponding forces.

Lamis rules

If three coplanar forces meeting at a point and and acting up on a particle are in equilibrium , then the magnitude of each force is proportional to the sine of the angle between the two other forces.

Questions

(1) The least number of coplanar unequal in magnitude forces could be in equilibrium is …….

(a)1 (b)2 (c)3 (d)4

(2) If f1 , f2 and f3 are three forces meeting at a point and they are in equilibrium , then the magnitude of the resultant of f1 and f2 =……

(a)f1 (b)f1 + f2 (c) f3 (d) zero

(3) Three equal forces in magnitude meeting at a point and they are in equilibrium , then the measure of the angle between each two forces =…….

(a)60 (b)90 (c)120 (d)150

(4)If f is in equilibrium with two perpendicular forces of magnitudes 8 newton and 15 newton , then f=……

(a)7 (b)17 (c)23 (d)15

(5)Three coplanar forces not on the same straight line meeting at a point are in equilibrium, the magnitude of two forces of them are 7 and 3 newton , then the magnitude of the third could be ……..

(a)10 (b)4 (c)5 (d)3