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GRADE 13

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II

**m<uq jk jdr mÍCIKh - 2024**

**First Term Examination - 2024**

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**COMBINED MATHEMATICS – II**

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* **Answer all the questions from Part A and only five questions from Part B.**

**Part A**

01. Given that two vectors and , where and . If and are perpendicular then show that

02. Two forces and have a resultant and the resolved part of in the direction is magnitude . Show that the angle between the forces is

03. Two cars and are travelling along two parallel paths, with accelerations and and velocity at a point is and respectively. If after sometime two cars at a point , then show that .

04. Velocity of a particle relative to earth is and velocity of particle relative to earth is . If the velocity of relative to is . Find the values of and .

05. One end of a light inextensible string which passes over

a smooth fixed pulley , carries a particle of mass .

The string passes under a smooth light pulley which, carries

a particle of mass . The other end of string is attached to

a ceiling as shown in the figure. The system moves freely

under gravity. If the tension in the string is ,

then find the value of .

06. Two uniform smooth spheres each of radius and weight , are at rest touching each other inside a fixed smooth hemispherical bowl of radius . Show that the reaction between two spheres is .

07. A wind is blowing due east with a speed and plane has a constand speed in still air files to a point at a distance in the north-east direction in time and flies back in time . Show that  .

08. A particle is projected vertically upward under gravity. It passes a point at a height above the ground at and in ascending and descending for the first time. Show that.

09. Three forces , and act on a particle where , and . Given that the particle is in equilibrium, then find the values of and .

10. A uniform ladder of length and weight is leaning against a smooth vertical wall a rough ground of coefficient of friction . If the ladder is point of sliding, then show that

. Where is the inclination of the ladder, to the horizontal.

**Part B**

11. a). At a Car starts from rest at a point on a straight path and moves with a constant acceleration . When its velocity is , a second Car is meter behind , is starting with the velocity and uniform retardation and follows Car .

Sketch graph in the same diagram for the motion of Car and .

Hence show that if , Car and meet together, twice or once or will not meet.

b). A person travelling eastward with a velocity finds the wind to blow from north, on doubling his speed he finds it to come from north-east. Show that if he trebles his speed the wind would appear to him to come from a direction making an angle. .

i). Find the true velocity of the wind.

ii). Show that

12. a). A particle is projected with a velocity and an angle to the horizontal, where

. Find in terms and the height of the particle when its speed is and the direction in which the particle is moving at this height. If the velocity of the particle makes an angle of with the horizontal at time and , where after the projection, then show that .

b). A smooth wedge of mass and inclination is placed on an inclined plane with inclination **,** such that the upper face of the wedge is horizontal. A particle of mass is placed on this horizontal face at a distance from the fixed inclined plane. If the system is released from rest and it the particle approaches the inclined plane in a time . Show that,

13. a). The position vectors of three points and relative an origin are , and respectively.

Show that the points and lie on the same straight line, and state the ratio . Given that is a parallelogram and that is the point such that

, Find the position vectors of and relative to .

b). is a rhombus of side and . Forces of magnitude and act along and respectively. If the resultant of the system is , then express in terms of and .

Hence show that, for any value of,

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14. a). Four uniform rods and each of length and weight , are freely jointed together to form a rhombus. It is suspended from and a smooth disk of weight and radius is kept touching and . Also the joints and are connected by a light rod of length . If the system is in equilibrium then find,

i). The reactions from the rods to disk.

ii). Show that the thrust in the light rod is

.

b). The framework shown in the diagram

consists of five light rods. It has been

hinged to a fixed point at . A load of

is hung at point and it is kept in

equilibrium by a horizontal force applied at .

i). Find the value of

ii). Draw a stress diagram using Bow’s

notation find the stress in each rod

and stating their nature.

15. a). A smooth hemispherical bowl of diameter a is fixed so that its horizontal rim touches a smooth vertical wall. A uniform rod is in equilibrium inclined at to the horizontal, with one end resting on the inner surface of the bowl and the other end resting against the wall. Show that the length of the rod is equal to .

b). A uniform rod of length , hangs against a smooth vertical wall, being supported by a string of length tied to one end of the rod with the other end of the string being attached to a point in the wall above the rod. Show that the rod can rest inclines to the wall at an angle then,

16. a). A uniform ladder of weight and length is resting between a rough horizontal plane and smooth vertical wall at angle with the horizontal. If a man of weight is at the distance from the foot of ladder and the system is in equilibrium then show that,

Where is the coefficient of friction between the ladder and the horizontal plane.

If given that, and the man can climb any where in the ladder without breaking the equilibrium then prove that,