Bago University
Department of Mathematics
First Semester Examination, March 2019

Second Year (B.Sc)
(Mathematics Specialization)

Math 2103
Vector algebra and Statics
Time Allowed: (3) hours

Answer All Questions.

1.(a) The resultant of two forces P and Q is equal to P in magnitude, and that of two forces $2P$, Q (acting in the same directions as before) is also equal to P. Find the magnitude of Q and prove that the direction of Q makes an angle of 150° with that of P.

(b) A particle of weight 10 lb. is placed on a smooth plane of inclination 60°. What force applied (i) parallel to the surface of the plane, (ii) horizontally, will keep the particle at rest?

2.(a) A string is tied to two points at the same level, and a smooth ring of weight W which can slide freely along the string is pulled by a horizontal force of P lb. wt. If in the position of equilibrium the portions of the string are inclined at angles 60° and 30° to the vertical, find the value of P and tension in the string.

(b) A body weighing 20 lb. is resting on a rough horizontal plane, the coefficient of friction being 0.5; find the least force which acting (i) horizontally, (ii) at an angle 30° with the horizontal, would move the body.

3.(a) P and Q are like parallel forces . If Q is moved parallel to itself, through a distance x, prove that the resultant of P and Q moves, through a distance $\frac{Qx}{P+Q}$.

(b) A uniform beam AB, 20 ft long and weighing 40 lb., rest on two supports, one at A and the other 4 ft, from B. If a weight of 20 lb, is attached to the beam at a point 12 ft. from A, find the pressure on the supports.

4.(a) A uniform beam AB, 6 ft long, weights 40 lb. The end A, about which the beam can turn freely, is attached to a vertical wall, and the beam is kept in a horizontal position by a rope attached to a point of the beam $1\frac{1}{4}$ ft. from A and to a point of the wall vertically above A. If the tension of the rope is not to exceed 120 lb. wt., show that the height above A of the point of attachment of the string to the wall must not be less than $1\frac{2}{3}$ ft.

(b) One end of a uniform rod of weight W is attached to a hinge, and the other end is supported by a string attached to the other end of the rod and to a point on the same level as the hinge, the rod and string being inclined at the same angle to the horizontal. Find the tension in the string and the action at the hinge.

5.(a) A heavy chain is placed on a rough plane inclined to the horizontal at an angle α equal to the angle of friction, with a portion a ft. long along a line of greatest slope and the remainder of length b ft. hanging vertically over the top of the plane. If the chain is on the point of slipping, show that b is either zero or $2a \sin\alpha$.

P.T.O

(b) A uniform sphere is held in equilibrium on a rough inclined plane of angle α by a force of magnitude $\frac{1}{2}W\sin\alpha$ applied tangentially to its circumference, where W is the weight of sphere. Prove that the force must act parallel to the plane, and that the coefficient of friction must be not less than $\frac{1}{2}\tan\alpha$.

6.(a) Derive a formula for the centre of gravity of a uniform circular arc.

(b) A uniform ladder rests with its upper end against a smooth vertical wall and its foot on rough horizontal ground; to find the force of friction at the ground.

****