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University of Sargodha

B.A/B. Sc 1st Annual Examination 2011

Applied Math **Paper: B**

Maximum Marks: 100 **Time Allowed: 3 Hours**

Note: **Attempt any two questions from each section.**

Section- I

Q.1. (a) Find the position vector of a point which divides the join of two points with position vectors $\underline{a}$ and $\underline{b}$ in the ratio $\lambda:\mu$. (8)

(b) Show that $div\, r^7 \underline{r} = 10r^7$ (9)

Q.2. (a) Show that the four points $4\underline{i}+5\underline{j}+\underline{k}, -\underline{j}-\underline{k}, 3\underline{i}+9\underline{j}+4\underline{k}$ *and* $-4\underline{i}+4\underline{j}+4\underline{k}$ are coplanar. (8)

(b) Prove that the inner product of two tensors is also a tensor. (9)

Q.3. (a) Prove that a system of coplanar forces is in equilibrium if the algebraic sum of moments of all the forces about three different points O, A, B not in the same straight line, are separately zero. (8)

(b) If forces $p\overrightarrow{AB}, q\overrightarrow{CB}, r\overrightarrow{CD}, s\overrightarrow{AD}$ acting along the sides of a plane quadrilateral are in equilibrium, show that $pr = qs$. (9)

Q.4. (a) A circular disc of weight W and radius a is suspended horizontally by two vertical strings each of length ℓ attached to the ends of a diameter. A horizontal couple applied to the disc turns it through an angle θ. Find the moment of the couple. (8)

(b) A cylinder of radius r, whose axis is fixed horizontally touches a vertical wall along a generating line. A flat beam of uniform material, of length 2ℓ and weight W, rests with its extremities in contact with wall and the cylinder, making an angle of 45° with the vertical. Show that, in absence of friction $\frac{\ell}{r}=\frac{\sqrt{5}-1}{\sqrt{10}}$, that the pressure on the wall is $\frac{1}{2}W$ and the reaction of cylinder is $\frac{1}{2}\sqrt{5}W$. (9)

Section- II

Q.5. (a) In a uniform circular disc of 8″ radius a circular hole of 2″ radius is cut, the centre of the hole being 3″ from the centre of the disc. Find the centre of mass of the remainder of the disc. (8)

(b) Four equal heavy uniform rods are freely jointed to form a rhombus $ABCD$ which is freely suspended from A, and kept in shape of a square by an inextensible string connecting A and C. show that tension in the string is $2W$, where W is the weight of one rod. (8)

Q.6. (a) A uniform ladder rests in limiting equilibrium with one end on a rough floor whose co-efficient of friction is μ and the other against a smooth vertical wall. Show that its inclination to the vertical is $\tan^{-1}(2\mu)$ (8)

b. A uniform rod of weight W is placed with lower end on a rough horizontal floor and its upper end against an equally rough vertical wall. The rod makes an angle α with the wall and is just prevented from slipping down by a horizontal force P applied at its mid point. Prove that $P = W\tan(\alpha - 2\lambda)$ where λ is angle of friction and $\lambda < \frac{\alpha}{2}$ (8)

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Q.7. (a) Two uniform solid spheres, composed of the same material and whose diameters are 6 inches and 12 inches respectively, are firmly united. Find the centre of mass of the combined body. (8)

(b) Find the radial and transverse components of velocity and acceleration. (8)

Q.8. (a) A particle is projected vertically upwards with a velocity $\sqrt{2gh}$ and another is let fall from a height h at the same time. Find the height of the point where they meet each other. (8)

(b) A particle moves in a straight line with an acceleration KV^3. If its initial velocity is μ, find the velocity and time spent when the particle has travelled a distance x. (8)

Section- III

Q.9. (a) Find the range of a rifle bullet when α is the elevation of projection and v_0 the speed. Show that, if the rifle is fired with the same elevation and speed from a car travelling with speed V towards a target, the range will be increased by $\frac{2v_oV}{g}\sin\alpha$ (8)

(b) What is the maximum range possible for a projectile fired from a cannon having muzzle velocity v_0, and prove that the height reached $\frac{v_0^2}{4}$. (9)

Q.10. (a) A particle describes the curve $r^n\cos n\theta = a^n$ under force F to the pole, show that $F \propto r^{2n-3}$. (8)

(b) The law of force is MU^5 and a particle is projected from an apse at distance a. find the orbit when the velocity of projection is $\frac{\sqrt{M}}{a^2}$ (9)

Q.11. (a) Show that the straight lines (8)

$\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}$ *and* $\frac{x-2}{3}=\frac{y-3}{4}=\frac{z-4}{5}$ are coplanar.

(b) Show that the shortest distance between the lines $x+a=2y=-12z$ and $x=y+2a=6(z-a)$ is 2a. (9)

Q.12. (a) A particle P moves such that the square of its distance from the origin is proportional to its distance from a fixed plane. Show that P always lies on a sphere. (8)

(b) Prove that for a place on the equator the direction of Qibla is inclined at arctan(tan$\phi_\circ$ *cosec* ℓ) north of west or north of east according as its classical longitude ℓ is east or west ($\phi_\circ$ is latitude of Khana-e-Ka'aba) (9)

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