

15007

KPK, PUBLIC SERVICE COMMISSION
Competitive Examination for the posts of PMS/AS, 2018
Applied Mathematics, Paper-1

Time Allowed: 03 Hours

Max Marks: 100

Instructions: Attempt total FIVE questions, TWO from Section-A and THREE from Section-B.

Section-A

1. (a) Show that $(b \times c) \cdot (c \times a) \times (a \times b) = (a \cdot b \times c)^2$ (10)
(b) Prove the physical interpretation of cross product $a \times b$. (10)
2. (a) If $r = xi + yj + zk$ and a is constant, prove that $\text{div}[a \times \text{grad}(1/r)] = 0$. (10)
(b) Show that $\text{Curl Curl } f = \text{grad div } f - \nabla^2 f$ (10)
3. (a) Forces P, Q act at a point O and their resultant is R . If any transversal cuts the lines of the forces on the points A, B, C respectively, prove that $\frac{P}{OA} + \frac{Q}{OB} = \frac{R}{OC}$ (10)
(b) If forces $l \vec{AB}, m \vec{BC}, n \vec{CD}, p \vec{DA}$ acting along the sides of a quadrilateral are equivalent to a couple, show that either $l = m$ or $ABCD$ is a parallelogram. (10)
4. (a) A body weighing $40lb$ is resting on a rough horizontal plane and can just be moved by a force of $10lb$ weight acting horizontally. Find the coefficient of friction. (10)
(b) Define Principle of virtual work and explain briefly its application with example. (10)

Section-B

5. (a) Obtain Tangential and Normal components of acceleration. (10)
(b) Obtain Radial and Transverse components of velocity. (10)
6. (a) Find the distance travelled and the velocity attained by a particle moving in a straight line, at any time t if it starts from rest at $t = 0$ and is subject to an acceleration $t^2 + \sin t + e^t$. (10)
(b) A particle is projected vertically up wards 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. (10)
7. (a) A point describes simple harmonic motion in such a way that its velocity and acceleration at a point P are u and f respectively and the corresponding quantities at another point Q are v and g . Find the distance PQ . (10)
(b) If a point P moves with a velocity v given by $v^2 = n^2(ax^2 + 2bx + c)$, show that P executes a simple harmonic motion. Find the centre, the amplitude and time period of the motion. (10)
8. (a) A particle is moved by a force $F = 20i - 30j + 15k$ along a straight line from the point A to the point B with position vectors $2i + 7j - 3k$ and $5i - 3j - 6k$ respectively. Find the work done. (10)
(b) Show that $F = -kr^3r$ is conservative. (10)
9. (a) Explain Apsides and apsidal distances with examples for nearly circular orbits. (10)
(b) Define the Three Laws of Kaplers Law of Planatry motion with at least one mathematical example and Sketch its motion. (10)