of the acceleration is equal to g.

Q57. Two particle are let drop from the cusp of a cycloid down the curve at an interval of time t. Prove that they will meet in time $2\pi\sqrt{\frac{a}{g}} + \frac{t}{2}$.

Q58. A particle slides down a catenary, whose plane is vertical and vertex upwards, the velocity at any point being due to fall from directrix. Prove that pressure at any point varies inversely, as the distance of that pt. from the directrix

59. A base of a rough cycloidal arc is horizontal and its vertex downwords. A bend slides along its starting from rest at the clasp and coming to rest at vertex. Show that $\mu^2 e^{\mu\pi} = 1$.

60. A particle slides down the outside of a smooth vertical circle starting from rest at the highest pt. Discuss the motion.

61. A particle of mass 'm' is projected in a vertical plane through the point of projection with velocity 'u' in a direction making an angle α with horizontal. Find its motion and path described.

62. If v_1 & v_2 be the velocities at the ends of the focal chord projectile's path & 'u' is the horizontal component of the velocity, show that $\frac{1}{v_1^2} + \frac{1}{v_2^2} \neq \frac{1}{u^2}$

63. A particle is projected from the lowest point inside a smooth sphere of radius a with velocity $2\sqrt{ag}$. Find the point at which leave the sphere & eqn to subsequent path of the particle.

64. A particle is thrown over an isosceles right angled triangle ABC, right angled at B, from one end A of horizontal base AC and grazing the vertex B falls at C. Show that the angle of projection is $\tan^{-1}(2)$.

65. A cricket ball thrown from a height of 6 ft. at an angle of 30° to the horizon with a speed of 60 ft/sec. is caught by another fieldsman at a height 2 ft. from the ground. How far apart were the two men?

66. The angular elevation of an enemy's position on a hill h feet high is β. Show that in order to shell it, the initial velocity of the projectile must not be less than $\sqrt{gh(1+\operatorname{cosec}\beta)}$

67. A particle is projected with a velocity of 24.5 m/sec in a direction making an angle 60° with the horizontal. Find the greatest height attained by the particle.

68. A ball is projected so as just to clear two walls, the first of height 6 m at a distance 4 m from the point of projection & the second of height 4 m distance 6 m from the point of projection. Find the range of the angle of projection.

69. A particle is projected with velocity 4.9 m/sec. such that its range in horizontal plane is twice the greatest height attained. Find the range on the horizontal plane.

70. A particle is projected in a direction making an angle θ with the horizon. If it passes through the points (x_1, y_1) & (x_2, y_2) referred to horizontal & vertical axes through

the point of projection, then prove that $\tan\theta = \frac{\ldots}{x_1 x_2 (x_2 - x_1)}$

Q71. What is horizontal range of projectile?

Q72. A body is projected vertically upwards from a point A with a given velocity 'u'. Show that the direction in which another body must be projected simultaneously with velocity 'v', from the point B is the same horizontal line with A so as to strike the first body is $\sin^{-1}\frac{u}{v}$.

Q73. A body is projected at an angle α to the horizon so as clear two walls of equal height a at a distance 2a from each other. show that the range is equal to $2a \cot\frac{\alpha}{2}$.

Q74. Prove that the orbit produced by a central force is a plane curve.

75 A particle describes an ellipse under force $\frac{\mu}{r^2}$ and has a velocity v at a distance r from the centre of a force. Show that its time period is

$$\frac{2\pi}{\sqrt{\mu}}\left[\frac{2}{r} - \frac{v^2}{\mu}\right]^{-3/2}$$

76 Define central force & central orbits.

77. Define Hooke's Law.

78. Derive the diff. eqn. of central orbit in Pedal form.

79. Find the law of force towards the pole under which the curve $r^n = a^n \cos n\theta$ can be describe. Hence obtain the law of force under which a cardioid can be described.

80. State principle of conservation of energy.

81. A particle moves with a central acceleration $\frac{\lambda}{(\text{distance})^3}$. Find the path and distinguish the cases.

82. If a particle is projected from an apse at a distance 'a' with velocity from infinity, under the action of a central force μr^{-7}, prove that the orbit is $r^2 = a^2 \cos 2\theta$.

83. A particle moves in a plane under a central force which varies inversely as square of the distance from the fixed point. To find the orbit.

84. The pedal eqn. of an ellipse with pole at the centre is $\frac{a^2b^2}{p^2} = a^2+b^2-r^2$. Find the law of force.

85. Establish the equivalence of Kepler's law for planetary motion & Newton's law of gravitation.

86. The greatest & least velocities of a certain planet in its orbit round the sun are 30 km/sec & 29.2 km/sec, respectively. Find the eccentricity of the orbit.

87. Prove that the time taken by earth to travel half its orbit remote from the sun separate by minor axes is two days more than half the year the eccentricity of orbit being $\frac{1}{60}$.

88. If v_1 & v_2 are max. & min. velocities of a planet, then prove that $(1-e)v_1 = (1+e)v_2$ for an elliptic path.

89 Find the acceleration of a particle in terms of cylindrical polar co-ordinates.

90. A heavy particle moves in a smooth sphere. show that if the velocity be that due to the level of the centre, the reaction of surface will vary at the depth below the centre.