## LEAVING CERTIFICATE EXAMINATION, 1962.

### APPLIED MATHEMATICS — Honours.

### TUESDAY, 19th JUNE — Morning, 10 to 12.30.

Not more than *six* questions may be answered.  All questions are of equal value.
Mathematical Tables may be obtained from the Superintendent.

1. A uniform ladder is put leaning against a rough vertical wall (coefficient of friction 0·5), the bottom of the ladder being on a rough horizontal plane (coefficient of friction 0·4).  What is the least angle the ladder can make with the plane without slipping ?

2. ABCD is a quadrilateral lamina in which AB = 3", BC = CD = 5", BD = 8" and ∠ABD = 90°.  Find the position of its centre of gravity.

3. (i) A is travelling due west at 6 m.p.h. and B is travelling at 4 m.p.h. in a direction 30° west of south.  Find the velocity of A relative to B, in magnitude and direction.

   (ii) A steady wind is blowing at 10 m.p.h.  To a man walking due east at 2 m.p.h. the wind appears to be blowing from the north—east.  Find the actual direction of the wind.

4. If a projectile takes a time $t$ to travel between two points which are in the same horizontal line, show that the greatest height it reaches above that line is $\frac{1}{8}gt^2$.

   Two vertical posts of equal height stand 90 feet apart on a horizontal plane. A particle is projected from a point in the plane 105 feet from the nearer post and just clears the top of each post.  If the greatest height the particle reaches is 9 feet higher than the tops of the posts, find its initial velocity.

5. A car of mass one ton, descending an incline of 1 in 80, accelerated uniformly from 15 m.p.h. to 30 m.p.h. in 220 yards.  Find the acceleration in ft. per sec².

   If the frictional resistances to motion were equivalent to 30 lb. wt., find the horse—power at which the car was working when its speed was 25 m.p.h.

6. A bullet of mass 2 ounces is fired with a velocity of 1600 ft. per sec. from a gun of mass 10 lb. which is free to recoil.  Find the velocity with which the gun begins to recoil, and find the total kinetic energy of the bullet and the gun in foot—pounds.

   If the bullet had been fired with the same velocity from another gun, the total kinetic energy would have been greater by $62\frac{1}{2}$ foot—pounds.  Find the mass of the other gun.

7. A body of mass 2 lb. suspended from a fixed peg by a light inextensible string 3 feet long is describing a horizontal circle at a uniform rate of 4 radians per second.  Find the tension in the string, in lb.wt., and find the angle which the string makes with the vertical.

   What vertical distance would the body rise if its angular velocity were increased to 5 radians per second ?

8. A particle is moving along a straight line so that its distance $x$(cm.) from a fixed point P at time $t$(sec.) is given by the formula $x = 10\sin\pi t$.  Show that the motion is simple harmonic.

   Find (i) the period of the motion, (ii) the distance the particle travels from P in a quarter of a second, (iii) the time the particle takes to travel 5 feet from P, (iv) the velocity of the particle when its acceleration is half its maximum acceleration.

9. ABCD is a quadrilateral lamina in which AB = AD = 15 cm., BD = 24 cm. and BC = CD = 13 cm.  The lamina is immersed in water with the vertex C vertically below A.  Find the total thrust of the water on the lamina

   (i) when A is at the surface,
   (ii) when A is 3 cm. below the surface,
   (iii) when A is 3 cm. above the surface.

   (A cubic centimetre of water weighs one gram.)