L 71 M. 51

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LEAVING CERTIFICATE EXAMINATION. 1983

APPLIED MATHEMATICS–ORDINARY LEVEL

FRIDAY, 24 JUNE–AFTERNOON, 2.00–4.30

Six questions to be answered. All questions carry equal marks.
Mathematics Tables may be obtained from the Superintendent.
Take the value of g to be 9·8 metres/second^2.

1. A car starts from rest with a uniform acceleration and reaches a velocity of 27m/s in 9 s. The brakes are then applied and it comes to rest with uniform deceleration after travelling a further 54 m. Calculate

   (i) the uniform acceleration

   (ii) the uniform deceleration

   (iii) the average speed of the car for the journey

   (iv) the two times that the velocity of the car will be 15 m/s.

2. A particle is projected from a point on a horizontal plane with an initial speed of 25 m/s and at an angle of elevation α, where $\sin \alpha = \frac{3}{5}$. Calculate

   (i) the height of the particle above the plane after 2 seconds

   (ii) the magnitude and direction of the velocity of the particle when its horizontal displacement is 10 m

   (iii) the range of the particle.

3. Two elastic spheres of mass 5 kg and 3 kg, travelling in opposite directions collide directly. The speeds before collision are 6 m/s and 4 m/s respectively. If the coefficient of restitution between the spheres is $\frac{1}{3}$, calculate

   (i) the speed of each sphere after the collision

   (ii) the loss in kinetic energy due to the collision suffered by the 5 kg sphere

   (iii) the change in momentum of the 3 kg sphere.

4. A particle of mass 20 kg is pulled along a rough horizontal plane by a string which is inclined at 30° to the horizontal. If the tension in the string is 80 N and the coefficient of friction between the particle and the plane is $\frac{1}{3}$, calculate

   (i) the horizontal and vertical components of the tension

   (ii) the normal reaction between the particle and the plane

   (iii) the acceleration of the particle

   (iv) the total work done in moving the particle through a distance of 0·5 m.

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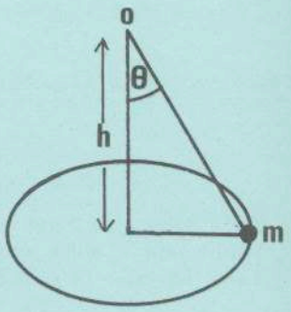
5. *abc* is an equilateral triangle of side *l*. Forces of 8 N, 8 N and 4 N act in the directions *ab*, *bc* and *ac* respectively. Calculate

   (i) the magnitude of the resultant

   (ii) the distance from *a* to the line of action of the resultant.

   If instead of reducing the forces to a single force they were reduced to a force at *a* and a couple of moment *M*, calculate *M*.

6. A particle of mass *m* kg is connected by means of a light inextensible string of length *l* metres to a fixed point *o*. The particle is describing a horizontal circle with angular speed ω rad/s. The centre of the circle is a distance *h* below *o*.



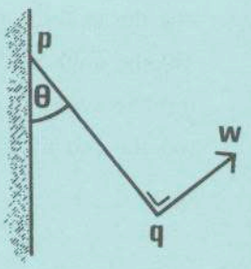
   (i) Draw a clear diagram showing all the forces acting on the particle.

   (ii) Write down the equations of motion.

   (iii) Show that $h = \frac{g}{\omega^2}$

   (iv) If the horizontal circle must remain at least 0·25 m below *o*, calculate, correct to one place of decimals, the maximum value of ω.

7. A uniform rod *pq* of weight $3W$ is freely hinged at *p* to a vertical wall. The rod is pulled aside by a force *W* applied at *q* and at right angles to *pq* (see diagram).



   (i) Draw a clear diagram showing all the forces acting on the rod.

   (ii) Find θ, the angle between the rod and the wall.

   (iii) Calculate the horizontal and vertical components of the reaction at *p*.

8. (*a*) Particles of weights 4 N, 5 N, 1 N and 3 N are placed on a horizontal plane at points (2,3), (x,4), (5,y) and (1,7) respectively.
   If the centre of gravity of the four-particle system is at (2,4), calculate *x* and *y*.

   (*b*) A hole of radius *r* and centre *b* is punched in a circular lamina of radius $4r$ and centre *a*. The line joining the centres *a* and *b* is horizontal. If $|ab| = 2r$, calculate the coordinates of the centre of gravity of the remaining portion, taking *a* as the origin.

9. (*a*) An object of mass 12·5 kg and of relative density 2·5 is lowered by means of a fine wire into a liquid of relative density 0·8, until it hangs fully immersed. Calculate

   (i) the volume of the object

   (ii) the mass of liquid displaced

   (iii) the tension in the wire.

   (*b*) A uniform rectangular block of wood 20 cm × 10 cm × 8 cm and of mass 1 kg floats in water with its longest edge vertical. Calculate

   (i) the volume of water displaced by the block

   (ii) the depth to which the block sinks in the water.

   (Density of water = 1000 kg/m^3)