GX1684

OLLSCOIL NA hÉIREANN, GAILLIMH
NATIONAL UNIVERSITY OF IRELAND, GALWAY

SUMMER EXAMINATIONS, 2000

FIRST YEAR
MATHEMATICAL PHYSICS (MP102)

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Paper 1

Time allowed: *TWO* hours.
Attempt *ALL* questions.

1. A car accelerates uniformly from an initial velocity of 4ms^{-1} to a final velocity of 6ms^{-1} over 5 metres. Find the acceleration.

2. A particle moves with position $s = 3t - 4t^2$. Find the velocity and acceleration.

3. Find the value of x for which the two vectors $\mathbf{a} = 3\mathbf{i} - 4\mathbf{j} + \mathbf{k}$ and $\mathbf{b} = -\mathbf{i} + 2\mathbf{j} + x\mathbf{k}$ are perpendicular.

4. A particle moves with acceleration $\mathbf{a} = 2\mathbf{i} + \mathbf{j}$ at time t. If the initial velocity and position vectors are $\mathbf{v} = 2\mathbf{j} - \mathbf{k}$ and $\mathbf{r} = \mathbf{i} - 3\mathbf{k}$ respectively, find the position vector for all time.

5. A particle of mass 1 kg is projected at 2 m/s along a rough table. The coefficient of friction between the particle and the table is 1/5. How far does the particle travel before coming to rest?

6. A ball is projected with a velocity of 20 m/s and hits the ground a distance 20 metres away. Find two possible angles of projection. You may approximate $g \simeq 10\text{ms}^{-2}$.

7. A rock of mass 5 Kg rolls from rest down a hill of height 4 m and reaches ground level with a velocity of 4ms^{-1}. Find the total work done by frictional forces. You may approximate $g \simeq 10\text{ms}^{-2}$.

p.t.o.

8. A particle of mass 2 kg undergoes circular motion with radius 5 m and constant speed 3 ms^{-1}. What is the magnitude and direction of the resultant force acting?

9. A mass attached to a spring undergoes simple harmonic motion with a period of 4 secs. The mass is released from rest 1 metres from its equilibrium point. Find the time taken to travel 0.5 metres.

10. A uniform square block lies on an inclined plane. Assuming no slipping occurs, find the angle at which the block topples.

11. Find the moment about the origin of the force $\mathbf{F} = 3\mathbf{i} - 4\mathbf{j} + \mathbf{k}$ acting at the point $(-1, 0, 2)$.

12. Find the vector equation of the line which passes through the points (1, 0, 1) and (2, 1, 0).

13. The velocities of A and B are constant and are equal to $2\mathbf{i} - \mathbf{j}$ and $3\mathbf{i} - 5\mathbf{j}$, respectively. Find the magnitude and direction of the velocity of B relative to A.

14. Find the general solution of the ordinary differential equation

$$\frac{dy}{dx} = \frac{1}{x\,(1 + x)}.$$

15. A uniform thin wire forms a circular arc of radius r , semi-angle α. Determine the position of its centre of gravity.

16. Find the moment of inertia of a uniform rectangular lamina of sides $2a$ and $2b$ about an axis through the centre of mass and parallel to sides of length $2b$.