Ollscoil na hÉireann, Gaillimh GX 2153
National University of Ireland, Galway
Summer Examinations, 2003/2004

Exam Code(s)	1BA1;1BS1;1EL1;1ER1;1MR1;1PT1
Exam(s)	First Year and First Arts
Module Code(s)	AM100
Module(s)	Applied Mathematics
Paper No	1
Repeat Paper	Special Paper
External Examiner(s)	Professor Brian Straughan
Internal Examiner(s)	Dr. M. Ó Confhaola
	Dr. P.M. O'Leary.
Instructions:	Attempt **all** questions. You may assume throughout that the Earth's gravitational acceleration is $g = 10ms^{-2}$.
Duration	2 hrs
No. of Answer books	
Requirements	
Handout	
MCQ	
Statistical Tables	Yes - Log Tables
Graph paper	
Log Graph Paper	
Other Material	
No. of Pages	3
Department(s)	Mathematical Physics

1. A car accelerates with constant acceleration of 0.4 ms^{-2} from an initial velocity of 2 m/s over 5 seconds. Find its final position and velocity.

2. A particle moves with acceleration $3\hat{\imath} - 2\hat{\jmath} + 3\hat{k}$ at time t. If the initial velocity is $2\hat{\imath} + \hat{\jmath}$ and initial position vector is $2\hat{\jmath} + \hat{k}$, find the position vector for any time t.

3. Use the scalar product to find values of λ for which the vectors $3\lambda\hat{\imath} - \lambda\hat{\jmath} - 3\hat{k}$ and $2\lambda\hat{\imath} + 7\hat{\jmath} + \hat{k}$ are perpendicular.

4. A block is projected with velocity 4 m/s along a rough horizontal plane with coefficient of friction $\mu = 1/3$. How long does it take for the velocity to decrease to 2 m/s ?

5. A ball is projected at 4 m/s at angle 30^0 to the horizontal. Find the range on a horizontal plane.

6. A particle is projected vertically upwards with velocity 30 m/s. Ignoring frictional effects, find the greatest height reached and how long it take to reach that height.

7. A force of magnitude 21 N acts in a direction parallel to $\hat{\imath} - 2\hat{\jmath} + 2\hat{k}$. Find the work done when the point of application undergoes a displacement of $\hat{\imath} - \hat{\jmath} + \hat{k}$ m.

8. A particle is moving with simple harmonic motion of period π s and maximum speed 10 m/s. Find the amplitude of the motion.

9. Masses of 2 kg, 3 kg, and 5 kg are placed at A (3, 1), B(1, 3), C(3, 5) respectively. Find the location of the centre of mass of the system.

10. Find the moment about the origin of a force $(4\hat{\imath} + 2\hat{\jmath} - 5\hat{k})$ N acting at the point with coordinates (1, -3, 4) m.

11. A 4 kg ball with initial velocity 3 m/s collides elastically with a second ball of mass 2 kg and initial velocity 1 m/s, in same direction. If the coefficient of restitution is 1/2, find the velocity of the 4 kg ball after the collision.

12. Solve the differential equation

$$\frac{dx}{dt} + 3x = e^t$$

subject to the initial condition $x(0) = 1$.

13. A cyclist A moves due East at 5 m/s and sees a car moving North at 12 m/s, find the speed of the car relative to the cyclist.

14. Find the moment of inertia of a uniform rod of length 3m and mass 4 kg about an axis perpendicular to one end.

15. Find in vector terms the acceleration of a body of mass 3 kg acted on simultaneously by forces $\hat{\imath} + \hat{\jmath} + 5\hat{k}, 3\,\hat{\imath} + \hat{\jmath} + \hat{k}$ and $\hat{\imath} + 7\hat{\jmath} + 2\hat{k}$.

16. An object of mass 50 kg is on the floor of a lift. Find the reaction between the object and the floor of the lift when the lift is accelerating upwards with acceleration 2 ms^{-2}.