AS Level Mathematics B (MEI)

H630/01 Pure Mathematics and Mechanics

Question Set 6

1. In this question, the x and y directions are horizontal and vertically upwards respectively.

A particle of mass 1.5 kg is in equilibrium under the action of its weight and forces $\mathbf{F}_1 = \begin{pmatrix} 4 \\ -2 \end{pmatrix}$N and $\mathbf{F}_2$.

(a) Find the force $\mathbf{F}_2$. **[3]**

The force $\mathbf{F}_2$ is changed to $\begin{pmatrix} 2 \\ 20 \end{pmatrix}$N.

(b) Find the acceleration of the particle. **[2]**

2 **In this question you must show detailed reasoning.**

A particle moves in a straight line. Its velocity $v\,\text{ms}^{-1}$ after ts is given by $v = t^3 - 5t^2$.

(a) Find the times at which the particle is stationary. **[2]**

(b) Find the total distance travelled by the particle in the first 6 seconds. **[3]**

3 A car travelling in a straight line accelerates uniformly from rest to $V\,\text{ms}^{-1}$ in Ts. It then slows down uniformly, coming to rest after a further $2T$s.

(a) Sketch a velocity-time graph for the car. **[2]**

The acceleration in the first stage of the motion is $2.5\,\text{ms}^{-2}$ and the total distance travelled is 240 m.

(b) Calculate the values of V and T. **[4]**

4 An astronaut on the surface of the moon drops a ball from a point 2 m above the surface.

(a) Without any calculations, explain why a standard model using $g = 9.8\,\text{ms}^{-2}$ will not be appropriate to model the fall of the ball. **[1]**

The ball takes 1.6 s to hit the surface.

(b) Find the acceleration of the ball which best models its motion. Give your answer correct to 2 significant figures. **[2]**

(c) Use this value to predict the maximum height of the ball above the point of projection when thrown vertically upwards with an initial velocity of $15\,\text{ms}^{-1}$. **[2]**

Total Marks for Question Set 6: 21 marks