3.8 Mechanics: Projectiles and Applications Depth: 10-minute Pack

EDEXCEL 9MA0 · Calculator allowed · about 10 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

Key results: projectile motion and combining kinematics with forces

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Unless a question states otherwise, take g = 9.8 m/s^2 and model every object as a particle moving freely under gravity once released, so that gravity is the only force acting during the flight itself. For a particle projected from a point on horizontal ground with speed U at angle alpha above the horizontal, resolve the initial velocity into a horizontal component U cos(alpha), which is constant throughout the flight, and a vertical component U sin(alpha), which reduces uniformly under gravity; the horizontal and vertical motions can then be treated independently using the suvat equations, and combined using Pythagoras' theorem and trigonometry to find the resultant speed and direction at any instant. Two standard results you may quote without proof, unless a question asks you to derive them, are the time of flight on level ground, T = 2Usin(alpha)/g, and the range on level ground, R = U^2 sin(2alpha)/g; the greatest height reached is H = U^2 sin^2(alpha)/(2g). Several questions in this worksheet combine projectile motion with forces: where a particle or block is first accelerated by gravity and/or friction while in contact with a surface (for example sliding down a rough inclined plane, or being pulled by a connected particle over a pulley), use Newton's second law, F = ma, resolving forces parallel and perpendicular to the relevant surface, to find its speed at the point where it becomes a projectile, and then apply projectile motion to the remainder of its path. Vectors are given in terms of perpendicular unit vectors i and j; a position vector r(t) for a projectile can be written in terms of t by integrating, or by using the suvat equations componentwise, with constant acceleration -gj.

1 A particle P moves in a straight line with constant acceleration. It passes a point A with speed 17 m/s and reaches a point B with speed 35 m/s, after travelling a distance of 156 m from A.

(a) Find the acceleration. **(3)**

(b) Find the time taken to travel from A to B. **(2)**

(c) Find the distance travelled in the 3rd second after passing A. **(3)**

(Total for Question 1 is 8 marks)

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Mark scheme · 3.8 Mechanics: Projectiles and Applications Depth: 10-minute Pack

Question 1

(a) uses $v^2 = u^2 + 2as$ **M1**

(a) $35^2 = 17^2 + 2a(156)$ **A1**

(a) $a = 3$ m/s^2 **A1**

(a) Answer: 3 m/s^2

(b) uses $v = u + at$ **M1**

(b) $t = (35 - 17)/3 = 6$ s **A1**

(b) Answer: 6 s

(c) distance in first 3 s minus distance in first 2 s **M1**

(c) 64.5 - 40 **A1**

(c) 24.5 m **A1**

(c) Answer: 24.5 m

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