Kinematics and Projectiles

Mechanics · 4 questions · step-by-step answers at the end

Name: Date: Score: / 4

USEFUL EQUATIONS

$v = u + at$ $s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$ $s = \frac{1}{2}(u + v)t$

Questions

Show your working in the space under each question.

1. A stone is dropped from a cliff and hits the sea 3.0 s later. How high is the cliff?

2. A ball is kicked from level ground at 20 m s^{-1} at 30° above the horizontal. Find its time of flight, range and maximum height.

3. A ball is thrown vertically upward at 15 m s^{-1}. Find the maximum height and the time to reach it.

4. A car accelerates from rest at 2.0 m s^{-2} for 5.0 s, then travels at constant speed for 10 s. Find the total distance.

Step-by-step answers

Kinematics and Projectiles

1. $s = \frac{1}{2} \times 9.81 \times 3.0^2 =$ **44 m**.

2. 1. Components: $u_x = 20 \cos 30° = 17.3$ m s^{-1}; $u_y = 20 \sin 30° = 10.0$ m s^{-1}.
2. Vertical, back to the ground ($s = 0$): $0 = 10.0t - \frac{1}{2}(9.81)t^2 \rightarrow t =$ **2.04 s**.
3. Range $= u_x t = 17.3 \times 2.04 =$ **35.3 m**.
4. Maximum height: $0 = 10.0^2 - 2(9.81)h \rightarrow h =$ **5.10 m**.

Answer: 2.04 s; 35.3 m; 5.10 m

3. $h = u^2/2g = 225/19.62 =$ **11.5 m**; $t = u/g =$ **1.53 s**.

4. $\frac{1}{2} \times 2.0 \times 25 = 25$ m, then $10 \times 10 = 100$ m: **125 m**.