Mechanics: Kinematics and Forces

Mechanics · 6 questions · step-by-step answers at the end

Name: Date: Score: / 6

USEFUL EQUATIONS

$v = u + at$ $s = ut + (1/2)at^2$ $v^2 = u^2 + 2as$ $F = ma$

Questions

Show your working in the space under each question.

1. EASY A particle starts from rest and accelerates at 3 m/s² over 24 m. Find its final speed.

2. EASY A car slows from 20 m/s to rest in 50 m. Find its acceleration.

3. MEDIUM A 1200 kg car has a driving force of 3000 N and resistance 600 N. Find its acceleration.

4. MEDIUM A 70 kg person stands in a lift accelerating upward at 1.5 m/s². Find the reaction from the floor.

5. HARD A cyclist accelerates from rest at 2 m/s² for 5 s, then rides at constant speed for 10 s. Find the total distance.

6. HARD A particle has velocity $v = 3t^2 - 12t$ (m/s). Find its acceleration at $t = 3$, when it is at rest, and its displacement from $t = 0$ to $t = 4$.

Step-by-step answers

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1. $v^2 = 0 + 2(3)(24) = 144$, so **v = 12 m/s**.
2. $0 = 400 + 2a(50)$, so **a = −4 m/s²**.
3. $3000 - 600 = 1200a$, so **a = 2 m/s²**.
4. $R - 70g = 70(1.5)$, so $R = 70(9.8 + 1.5) =$ **791 N**.
5. First stage: $s = (1/2)(2)(25) = 25$ m, reaching 10 m/s. Second: $10 \times 10 = 100$ m. Total **125 m**.
6. $a = 6t - 12 =$ **6 m/s²**. At rest when $3t(t - 4) = 0$: **t = 0 and t = 4 s**. Displacement $= [t^3 - 6t^2]$ from 0 to 4 $= 64 - 96 =$ **−32 m**.