Quantities, Units, Uncertainties and Vectors

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

Name: Date: Score: / 4

USEFUL EQUATIONS

% uncertainty = $(\Delta x / x) \times 100$ $F_x = F\cos\theta,\ F_y = F\sin\theta$

Questions

Show your working in the space under each question.

1. Show that the unit of pressure, the pascal, is kg m^{-1} s^{-2} in base units.

2. A sample has mass 45.0 ± 0.5 g and volume 5.0 ± 0.2 cm^3. Find its density with its uncertainty.

3. Estimate the kinetic energy of a sprinter.

4. Show that $v^2 = 2as$ is homogeneous.

Step-by-step answers

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1. p = F/A: (kg m s^{-2})/(m^2) = **kg m^{-1} s^{-2}**.

2. 1. ρ = m/V = 45.0/5.0 = 9.0 g cm^{-3}.
2. Percentage uncertainties: mass 0.5/45.0 = 1.1%; volume 0.2/5.0 = 4.0%.
3. Dividing, so add them: 5.1%. Absolute: 0.051 × 9.0 = 0.46.
4. ρ = **9.0 ± 0.5 g cm^{-3}**.

Answer: 9.0 ± 0.5 g cm^{-3}

3. Take m ≈ 80 kg and v ≈ 10 m s^{-1}: ½ × 80 × 10^2 ≈ **4000 J**.

4. Left: (m s^{-1})^2 = m^2 s^{-2}. Right: (m s^{-2})(m) = **m^2 s^{-2}**. ✓