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Answers

Practice exam questions

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All answers are to three significant figures.

The mechanics of rocket thrust

1 **a** 18.2 ms^{-2}

b 2000 ms^{-1}

2 2.28 MN

Modelling simple impact craters

1 **a** 2.39 × 10^{-11} megatons of TNT

b A fraction of the energy is used to physically displace material, forming the crater. A significant portion converts into thermal energy, melting or vaporising both the meteorite and the planetary surface. Some energy propagates through the ground as shock waves, causing localised earthquakes. If the meteorite is brittle, it might break apart before hitting the ground, losing energy in the atmosphere. If the impact occurs in a dense atmosphere (like Earth), some energy is lost to powerful air pressure waves, causing additional damage.

2 10,000 kg

Aerodynamics in sport

1 **a** 637 kg m^{-3}

b Density relates to mass per unit volume, while viscosity relates to resistance to motion. Density affects buoyancy, while viscosity affects flow behaviour and the drag force.

c 0.229 N

2 5.09 x 10^{-12} N

SpinLaunch: slinging satellites into space

1 **a** 47.1 rad s^{-1}

b 1.11 × 105 m s^{-2}

c 22.2 MN

d 103 kW

2 **a** 1.01 N

b 14.9 m s^{-2}

c 3.02 km

3 As the bullet slows down, the drag force decreases, so the deceleration of the bullet decreases and so its speed is greater than that which would be calculated if the deceleration was constant. The drag force also decreases because the density of the air decreases with height. Because the speed is greater than that calculated assuming constant drag, the bullet rises further.