

- 1 (a) State what is meant by the *inertia* of a body.

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..... [1]

- (b) A planet has a radius of  $1.74 \times 10^6\text{m}$  and may be considered to be a point mass of  $7.35 \times 10^{22}\text{kg}$ , situated at its centre. The planet has no atmosphere and is isolated in space.

Show that the gravitational field strength  $g$  at the surface of the planet is  $1.62\text{N kg}^{-1}$ .

[2]

- (c) A rocket of initial mass  $4000\text{kg}$  is situated on the surface of the planet in (b).

The rocket fires its engines. The exhaust gases from the engines are all ejected vertically downwards, and the mass of the rocket reduces at a rate of  $70.0\text{kg s}^{-1}$ . A constant thrust of  $10.0\text{kN}$  is generated on the rocket, and it accelerates vertically away from the surface of the planet.

- (i) Calculate the speed of the exhaust gases at the instant when the rocket lifts off.

speed = .....  $\text{ms}^{-1}$  [3]

- (ii) Calculate the acceleration of the rocket after the engines have fired for  $15.0\text{s}$ .

You may assume that the gravitational field strength of the planet acting on the rocket is constant.

acceleration = .....  $\text{ms}^{-2}$  [3]





- (iii) The actual acceleration of the rocket after the engines have fired for 15.0 s is different from the value calculated in (c)(ii).

State and explain whether the actual acceleration is greater than or less than the value calculated in (c)(ii).

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[2]

[Total: 11]

