

1 (a) Define acceleration.

.....
 [1]

(b) A rocket is launched vertically from the surface of the Earth.

Fig. 1.1 shows the variation of the velocity of the rocket with time for the first 20 s after its launch.

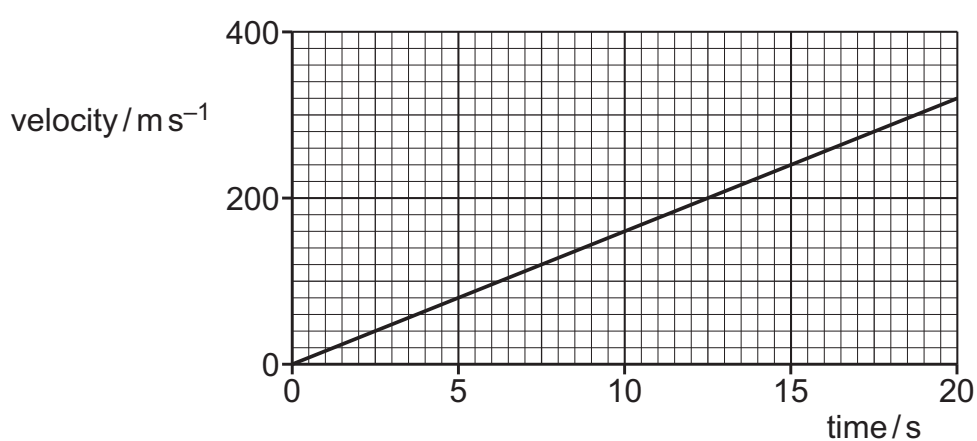


Fig. 1.1

(i) Determine the acceleration of the rocket.

acceleration = ms^{-2} [1]

(ii) Show that the height of the rocket above the surface of the Earth at a time of 20 s after launch is 3.2 km.

[2]

(c) The mass of the rocket in (b) is $2.9 \times 10^6 \text{ kg}$. Assume that this mass remains constant.

For this rocket, from launch to its height at a time of 20 s after launch:

(i) calculate the gain in gravitational potential energy ΔE_p

$\Delta E_p = \dots\dots\dots \text{ J}$ [2]

(ii) calculate the gain in kinetic energy ΔE_k

$\Delta E_k = \dots\dots\dots \text{ J}$ [2]

(iii) determine the average power output of the rocket engines. Assume that resistive forces are negligible.

power = W [2]

[Total: 10]