2 **(a)** State Newton's first law of motion.

.....

.....

..... [1]

(b) **(i)** A sky-diver jumps from a high-altitude balloon.

Explain briefly why the acceleration of the sky-diver decreases with time.

.....

.....

..... [2]

(ii) The variation with time t of the vertical speed v of the sky-diver is shown in Fig. 2.1.

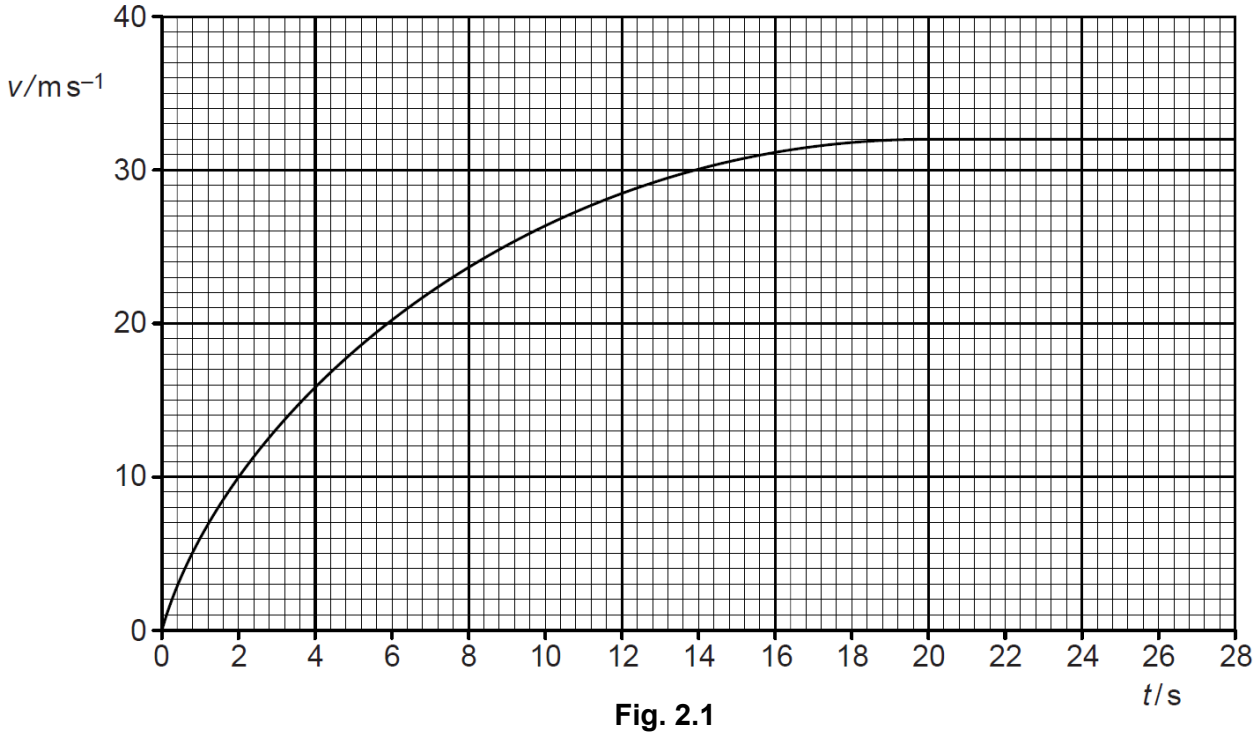

Fig. 2.1

Using Fig. 2.1, determine the acceleration of the sky-diver at time t = 4.0 s.

acceleration = ... m s^{-2} [2]

(iii) The sky-diver and his equipment have a total mass of 80 kg and accelerates downwards.

Calculate the accelerating force at time t = 4.0 s.

force = ... N [1]

(iv) Use your answer to **(b)(ii)** to determine the total resistive force acting on the sky-diver at time t = 4.0 s.

force = ... N [2]

(v) The sky-diver descends such that his body remains in the horizontal plane..

In Fig. 2.1, sketch the variation with time t of the vertical speed v of another sky-diver who dives head first. [1]

(c) For the sky-diver in **(b)(i)**, the variation with gravitational potential energy GPE and work done against resistive force W of the height from the ground for the first 28 s is shown in Fig. 2.2.

In Fig. 2.2, sketch the variation of kinetic energy with height of the sky-diver. [1]

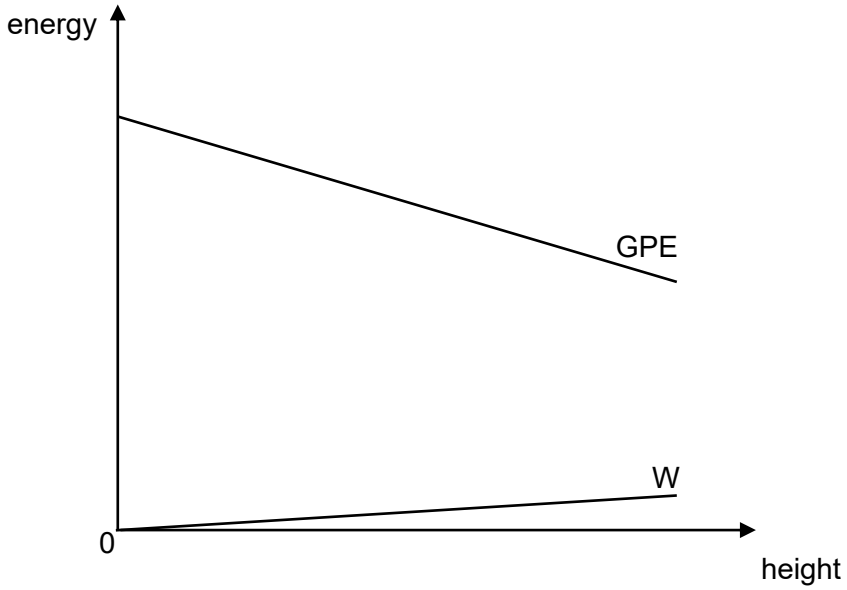

Fig. 2.2

[Total: 10]