M1 - Lifts (1)

1. A lift, of mass 600 kg, travels downward non-stop from the top of a building to the ground floor. It starts from rest and accelerates downwards with constant acceleration of 0·4 ms^{-2}, then moves at constant speed before decelerating to rest.

(a) Calculate the tension in the lift cable when the lift is accelerating. [3]

(b) Find the tension in the lift cable when the lift is moving at a constant speed. [1]

2. A child of mass 30 kg stands in a lift. Find the reaction of the floor of the lift on the child when the lift is

(a) moving up with acceleration 1·5 ms^{-2}, [3]

(b) moving down with acceleration 0·8 ms^{-2}, [2]

(c) moving down at a constant speed of 5 ms^{-1}. [1]

3. A child, of mass 30 kg, is standing in a lift, which is of mass 720 kg. When the lift is accelerating upwards at a constant rate of a ms^{-2}, the tension in the lift cable is 9000 N.

(a) Calculate the value of a. [3]

(b) Modelling the child as a particle, find the reaction between the child and the floor of the lift. [3]

4. A lift starts from rest from the ground floor and accelerates upwards at 2 ms^{-2} until it reaches a speed of 6 ms^{-1}. It then moves with a constant speed of 6 ms^{-1} before finally decelerating at 5 ms^{-2}, coming to rest at the top floor. The lift has a mass of 750 kg.

Find the tension in the lift cable

(a) during acceleration, [3]

(b) during deceleration. [1]

5. On an upward journey, a lift accelerates from rest with uniform acceleration of 0·2 ms^{-2} until it reaches a speed of 1·5 ms^{-1}. It travels at this speed for a while, then decelerates uniformly to rest in 10 s. The mass of the empty lift is 240 kg.

(a) Find the greatest tension in the cable during a journey when the lift is empty. [3]

(b) The average mass of lift users is 80 kg. The lift manufacturer decides to use lift cables capable of sustaining a maximum tension of 10 000 N. Calculate the maximum number of persons of average mass that the lift can safely carry on an upward journey. [4]

M1 - Lifts (2)

(6) 1. A lift, starting from rest, descends with a uniform acceleration of 3 ms^{-2} until it reaches a speed of 9 ms^{-1}. It then travels at a constant speed of 9 ms^{-1} for a short time and finally, it is brought to rest with a uniform retardation of 2 ms^{-2}. An object, of mass 6 kg, is on the floor of the lift. Calculate the magnitude of the reaction of the floor on the object during each of the three stages of the motion. [5]

(7) 3. When a lift is descending with acceleration a ms^{-2}, the tension in the lift cable is 11 625 N. The total mass of the lift and its contents is 1250 kg.

(a) Find the value of a. [3]

(b) A crate on the floor of the lift has a mass of 200 kg. Find the magnitude of the reaction of the floor on the crate. [2]

(8) 3. The mass of a lift is 430 kg. When a man, of mass 70 kg, is standing in the lift and the tension in the cable is 4800 N, the lift is descending with acceleration a ms^{-2}.

(a) Find the value of a. [3]

(b) Determine the reaction of the floor of the lift on the man. [3]

(9) 4. A parcel is on the floor of a lift which is ascending with acceleration 0·8 ms^{-2}. The mass of the parcel is 20 kg and the mass of the lift is 700 kg.

(a) Calculate the tension in the lift cable. [3]

(b) Find the reaction of the floor of the lift on the parcel. [3]

(10) 3. The mass of a lift is 5600 kg. The lift starts from rest and descends with uniform acceleration for 8 s until it reaches a speed of V ms^{-1}. The tension in the lift cable is 50 400 N.

(a) Show that the magnitude of the acceleration of the lift is 0·8 ms^{-2}. [2]

(b) Find the value of V. [2]

The lift maintains this constant speed of V ms^{-1} for 25 s before decelerating uniformly to rest. The **total** time for descent is 40 s.

(c) Draw a sketch of the velocity-time graph of the motion. [3]

(d) Calculate the total distance that the lift descends. [3]

(e) Find the maximum tension in the lift cable during the motion. [3]