Pulleys/Lifts - Past Edexcel Exam Questions

1. **(Question 5 - M1 June 2018)**

5.

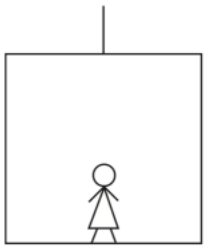

Figure 3

A lift of mass 250 kg is being raised by a vertical cable attached to the top of the lift. A woman of mass 60 kg stands on the horizontal floor inside the lift, as shown in Figure 3. The lift ascends vertically with constant acceleration $2\,\text{m s}^{-2}$. There is a constant downwards resistance of magnitude 100 N on the lift. By modelling the woman as a particle,

(a) find the magnitude of the normal reaction exerted by the floor of the lift on the woman.

(3)

The tension in the cable must not exceed 10 000 N for safety reasons, and the maximum upward acceleration of the lift is $3\,\text{m s}^{-2}$. A typical occupant of the lift is modelled as a particle of mass 75 kg and the cable is modelled as a light inextensible string. There is still a constant downwards resistance of magnitude 100 N on the lift.

(b) Find the maximum number of typical occupants that can be safely carried in the lift when it is ascending with an acceleration of $3\,\text{m s}^{-2}$.

(7)

2. **(Question 5 - M1 June 2017)**

5.

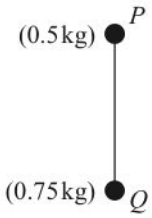

Figure 2

A vertical light rod PQ has a particle of mass 0.5 kg attached to it at P and a particle of mass 0.75 kg attached to it at Q, to form a system, as shown in Figure 2. The system is accelerated vertically upwards by a vertical force of magnitude 15 N applied to the particle at Q. Find the thrust in the rod.

(6)

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3. **(Question 2 - M1 June 2016)**

2.

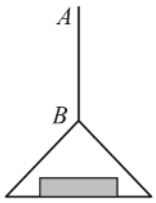

Figure 1

A vertical rope AB has its end B attached to the top of a scale pan. The scale pan has mass 0.5 kg and carries a brick of mass 1.5 kg, as shown in Figure 1. The scale pan is raised vertically upwards with constant acceleration 0.5 m s^{-2} using the rope AB. The rope is modelled as a light inextensible string.

(a) Find the tension in the rope AB.

(3)

(b) Find the magnitude of the force exerted on the scale pan by the brick.

(3)

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4. **(Question 4 - M1 June 2015)**

4.

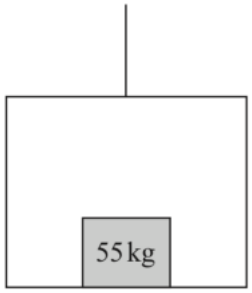

Figure 2

A lift of mass 200 kg is being lowered into a mineshaft by a vertical cable attached to the top of the lift. A crate of mass 55 kg is on the floor inside the lift, as shown in Figure 2. The lift descends vertically with constant acceleration. There is a constant upwards resistance of magnitude 150 N on the lift. The crate experiences a constant normal reaction of magnitude 473 N from the floor of the lift.

(a) Find the acceleration of the lift.

(3)

(b) Find the magnitude of the force exerted on the lift by the cable.

(4)

5. **(Question 7 - M1 June 2014)**

7.

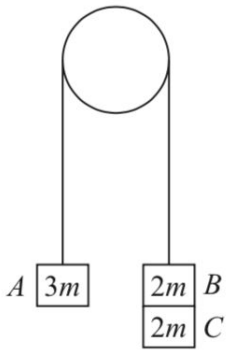

Figure 5

Three particles A, B and C have masses $3m$, $2m$ and $2m$ respectively. Particle C is attached to particle B. Particles A and B are connected by a light inextensible string which passes over a smooth light fixed pulley. The system is held at rest with the string taut and the hanging parts of the string vertical, as shown in Figure 5. The system is released from rest and A moves upwards.

(a) (i) Show that the acceleration of A is $\frac{g}{7}$

(ii) Find the tension in the string as A ascends.

(7)

At the instant when A is 0.7 m above its original position, C separates from B and falls away. In the subsequent motion, A does not reach the pulley.

(b) Find the speed of A at the instant when it is 0.7 m above its original position.

(2)

(c) Find the acceleration of A at the instant after C separates from B.

(4)

(d) Find the greatest height reached by A above its original position.

(3)

6. **(Question 8 - M1 June 2013)**

8.

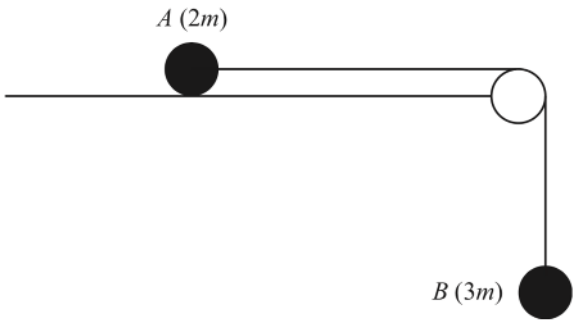

Figure 2

Two particles A and B have masses $2m$ and $3m$ respectively. The particles are attached to the ends of a light inextensible string. Particle A is held at rest on a smooth horizontal table. The string passes over a small smooth pulley which is fixed at the edge of the table. Particle B hangs at rest vertically below the pulley with the string taut, as shown in Figure 2. Particle A is released from rest. Assuming that A has not reached the pulley, find

(a) the acceleration of B,

(5)

(b) the tension in the string,

(1)

(c) the magnitude and direction of the force exerted on the pulley by the string.

(4)

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7. **(Question 2 - M1 June 2013)**

2. A woman travels in a lift. The mass of the woman is 50 kg and the mass of the lift is 950 kg. The lift is being raised vertically by a vertical cable which is attached to the top of the lift. The lift is moving upwards and has constant deceleration of 2 m s^{-2}. By modelling the cable as being light and inextensible, find

(a) the tension in the cable,

(3)

(b) the magnitude of the force exerted on the woman by the floor of the lift.

(3)

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8. **(Question 7 - M1 June 2012)**

7.

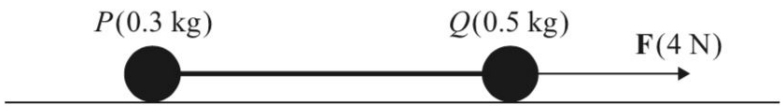

Figure 3

Two particles P and Q, of mass 0.3 kg and 0.5 kg respectively, are joined by a light horizontal rod. The system of the particles and the rod is at rest on a horizontal plane. At time $t = 0$, a constant force **F** of magnitude 4 N is applied to Q in the direction PQ, as shown in Figure 3. The system moves under the action of this force until $t = 6$ s. During the motion, the resistance to the motion of P has constant magnitude 1 N and the resistance to the motion of Q has constant magnitude 2 N.

Find

(a) the acceleration of the particles as the system moves under the action of **F**,

(3)

(b) the speed of the particles at $t = 6$ s,

(2)

(c) the tension in the rod as the system moves under the action of **F**.

(3)

At $t = 6$ s, **F** is removed and the system decelerates to rest. The resistances to motion are unchanged. Find

(d) the distance moved by P as the system decelerates,

(4)

(e) the thrust in the rod as the system decelerates.

(3)

9. **(Question 8 - M1 June 2010)**

8.

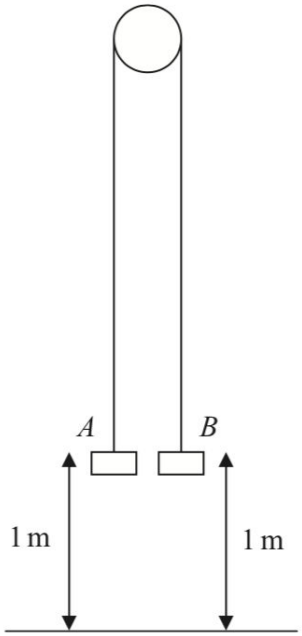

Figure 3

Two particles A and B have mass $0.4\,\text{kg}$ and $0.3\,\text{kg}$ respectively. The particles are attached to the ends of a light inextensible string. The string passes over a small smooth pulley which is fixed above a horizontal floor. Both particles are held, with the string taut, at a height of $1\,\text{m}$ above the floor, as shown in Figure 3. The particles are released from rest and in the subsequent motion B does not reach the pulley.

(a) Find the tension in the string immediately after the particles are released.

(6)

(b) Find the acceleration of A immediately after the particles are released.

(2)

When the particles have been moving for $0.5\,\text{s}$, the string breaks.

(c) Find the further time that elapses until B hits the floor.

(9)

Solutions

1. (a) 708N
   (b) 6 occupants
2. $T = 6$N
3. (a) $T = 20.6$N
   (b) 15.5N
4. (a) $a = 1.2$ ms^{-2}
   (b) 2040N
5. (a) i. -
      ii. $T = \frac{24}{7}mg$
   (b) $v = 1.4$ ms^{-1}
   (c) $a = \frac{g}{5}$ ms^{-2}
   (d) 1.2 metres
6. (a) $a = \frac{3g}{5}$ ms^{-2}
   (b) $T = \frac{6}{5}mg$
   (c) $\frac{6\sqrt{2}}{5}mg$ at a 45 degree angle (NorthEast)
7. (a) $T = 7800$N
   (b) $R = 390$N
8. (a) $a = 1.25$ ms^{-2}
   (b) $v = 7.5$ ms^{-1}
   (c) $T = 1.375$N
   (d) $s = 7.5$m
   (e) $Th = 0.125$N
9. (a) $T = \frac{12}{35}g$
   (b) $a = \frac{g}{7}$ ms^{-2}
   (c) 0.57 seconds