QQQ – Mechanics Year 1 – Chapter 10 – Forces & Connected Particles (Version 1)

Total Marks: 25

(25 = Platinum, 23 = Gold, 20 = Silver, 17 = Bronze)

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1. An object of mass 5 kg is moving in a straight line.

As a result of experiencing a forward force of F newtons and a resistant force of R newtons it accelerates at 0.6 m s^{-2}

Which one of the following equations is correct?

Circle your answer. **[1 mark]**

- $F - R = 0$
- $F - R = 5$
- $F - R = 3$
- $F - R = 0.6$

(Total 1 marks)

2. Forces $\mathbf{F}_1 = (2\mathbf{i} + 9\mathbf{j})$ N and $\mathbf{F}_2 = (-\mathbf{i} + \mathbf{j})$ N act on a particle. A third force $\mathbf{F}_3$ acts so that the particle is in equilibrium under the action of the three forces.

Find the force $\mathbf{F}_3$. **[2]**

(Total 2 marks)

3. In this question use $g = 9.8$ m s^{-2}

Lamic has mass 60 kg.

He is standing on the floor of a lift.

The lift is accelerating upwards at 1.2 m s^{-2}

The reaction of the floor on Lamic is R newtons.

Find the value of R **[2 marks]**

(Total 2 marks)

4. A particle P has mass 0.25 kg.

The particle moves on a smooth horizontal surface under the action of two horizontal forces $\mathbf{F}_1$ and $\mathbf{F}_2$

Given that $\mathbf{F}_1 = (3\mathbf{i} - 5\mathbf{j})$ N and $\mathbf{F}_2 = (-6\mathbf{i} + 9\mathbf{j})$ N

(a) find, in terms of $\mathbf{i}$ and $\mathbf{j}$, the resultant force acting on P, **(1)**

(b) find the magnitude of the acceleration of P. **(3)**

A third horizontal force, $\mathbf{F}_3$, is now applied to P.

Under the action of $\mathbf{F}_1$, $\mathbf{F}_2$ and $\mathbf{F}_3$, the particle moves with constant velocity.

(c) Find $\mathbf{F}_3$, giving your answer in terms of $\mathbf{i}$ and $\mathbf{j}$. **(1)**

(Total 5 marks)

5. A tractor of mass 1800 kg uses a towbar to pull a trailer of mass 1000 kg on a level field. The tractor and trailer experience resistances to motion of 1600 N and 800 N respectively. The tractor provides a driving force of 6600 N.

(a) Draw a force diagram showing all the horizontal forces acting on the tractor and trailer. **[2]**

(b) Find the tension in the towbar. **[4]**

(Total 6 marks)

6.

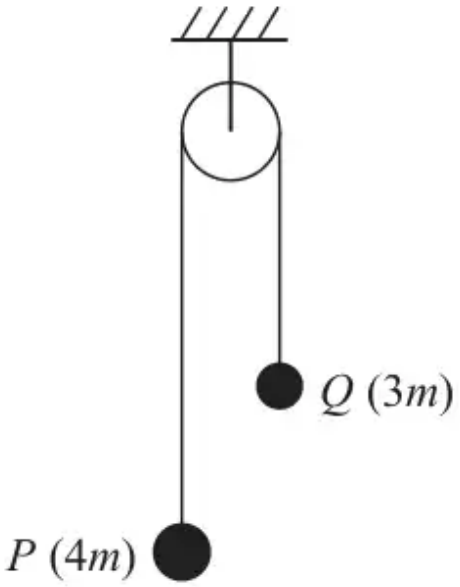


Figure 1

One end of a string is attached to a small ball P of mass $4m$.

The other end of the string is attached to another small ball Q of mass $3m$.

The string passes over a fixed pulley.

Ball P is held at rest with the string taut and the hanging parts of the string vertical, as shown in Figure 1.

Ball P is released.

The string is modelled as being light and inextensible, the balls are modelled as particles, the pulley is modelled as being smooth and air resistance is ignored.

(a) Using the model, find, in terms of m and g, the magnitude of the force exerted on the pulley by the string while P is falling and before Q hits the pulley. **(8)**

(b) State one limitation of the model, apart from ignoring air resistance, that will affect the accuracy of your answer to part (a). **(1)**

(Total 9 marks)