QQQ – Mechanics Year 1 – Chapter 10 – Forces & Connected Particles (Version 2)

Total Marks: 24

(24 = Platinum, 22 = Gold, 19 = Silver, 16 = Bronze)

1. A go-kart and driver, of combined mass 55 kg, move forward in a straight line with a constant acceleration of 0.2 m s^{-2}

The total driving force is 14 N

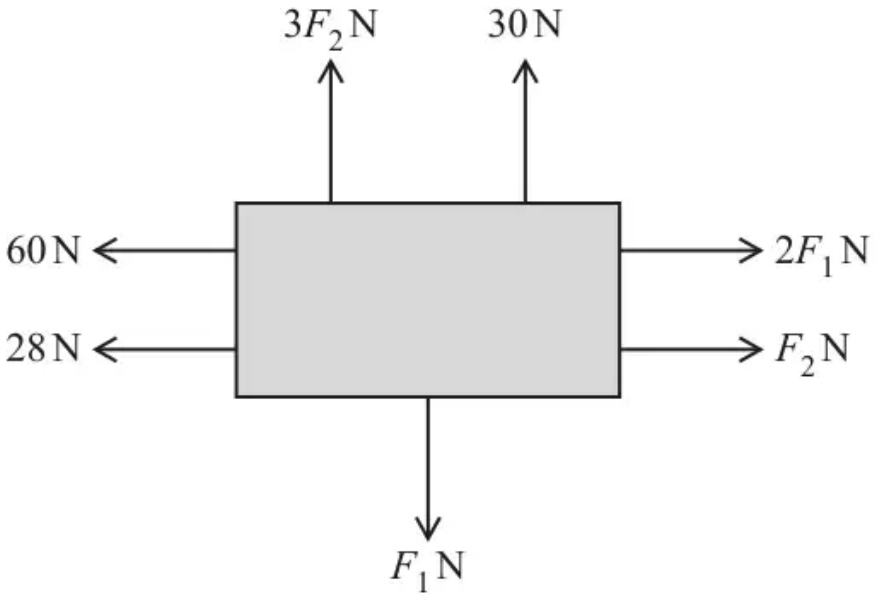
Find the total resistance force acting on the go-kart and driver.

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

- 0 N
- 3 N
- 11 N
- 14 N

(Total 1 marks)

2.



A body remains at rest when subjected to the horizontal and vertical forces shown in the diagram.

Determine the value of F_1 and the value of F_2. **[3]**

(Total 3 marks)

3. A particle is in equilibrium under the action of the following three forces:

$(2p\mathbf{i} - 4\mathbf{j})$ N, $(-3q\mathbf{i} + 5p\mathbf{j})$ N and $(-13\mathbf{i} - 6\mathbf{j})$ N.

Find the values of p and q. **[3]**

(Total 3 marks)

4. A particle P lies at rest on a smooth horizontal table.

A constant resultant force, $\mathbf{F}$ newtons, is then applied to P.

As a result P moves in a straight line with constant acceleration $\begin{bmatrix} 8 \\ 6 \end{bmatrix}$ m s^{-2}

(a) Show that the magnitude of the acceleration of P is 10 m s^{-2} **[1 mark]**

(b) Find the speed of P after 3 seconds. **[1 mark]**

(c) Given that $\mathbf{F} = \begin{bmatrix} 2 \\ 1.5 \end{bmatrix}$ N, find the mass of P. **[2 marks]**

(Total 4 marks)

5. Two blocks A and B have masses 5 kg and 2 kg respectively. The blocks are joined together by a light rigid horizontal bar and slide across a horizontal surface. The resistances on the blocks A and B are modelled as 7 N and 1.75 N respectively. There are no other external horizontal forces.

(a) Calculate the acceleration of the system, according to the model. **[3]**

(b) In reality, the acceleration of the system is **not** constant. State an improvement that could be made to the model so that it will produce results which are closer to the real situation. **[1]**

(Total 4 marks)

6.

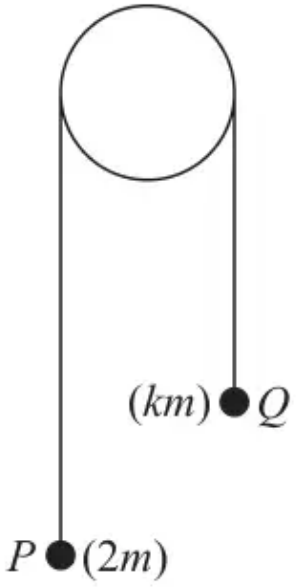


Figure 1

Two small balls, P and Q, have masses $2m$ and km respectively, where $k < 2$.
The balls are attached to the ends of a string that passes over a fixed pulley.
The system is held at rest with the string taut and the hanging parts of the string vertical, as shown in Figure 1.

The system is released from rest and, in the subsequent motion, P moves downwards with an acceleration of magnitude $\frac{5g}{7}$

The balls are modelled as particles moving freely.
The string is modelled as being light and inextensible.
The pulley is modelled as being small and smooth.

Using the model,

(a) find, in terms of m and g, the tension in the string, **(3)**

(b) explain why the acceleration of Q also has magnitude $\frac{5g}{7}$ **(1)**

(c) find the value of k. **(4)**

(d) Identify one limitation of the model that will affect the accuracy of your answer to part (c).
(1)

(Total 9 marks)