

Date:

**HFS HW Two**

Name:

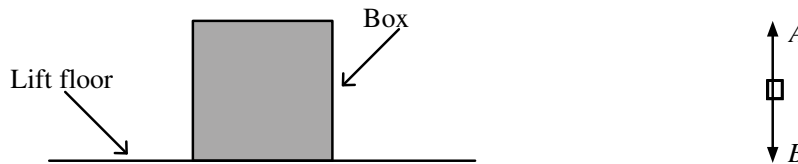
**Total Marks 39**

1. For each of the physical quantities in the table below add the missing information. The first one has been done for you.

Physical quantity	Base units	Vector or scalar
force	$\text{kg m s}^{-2}$	vector
displacement		
gravitational potential energy		
power		

(Total 3 marks)

2. Figure 1 shows a box resting on the floor of a stationary lift. Figure 2 is a free-body force diagram showing the forces *A* and *B* that act on the box.

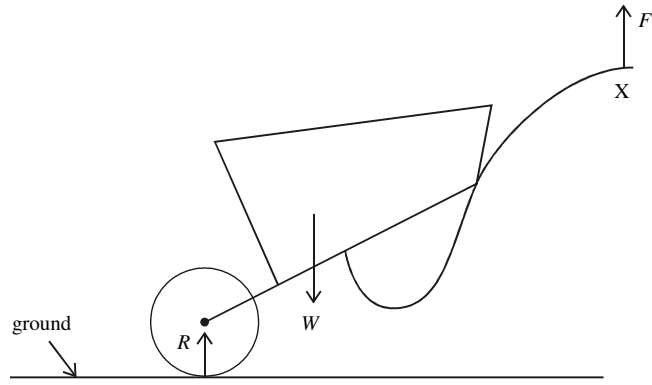


For each of the following situations, **tick** the appropriate boxes to show how the magnitude of the forces *A* and *B* change, if at all, compared with when the lift is stationary.

Situation	Force <i>A</i>			Force <i>B</i>		
	increases	no change	decreases	increases	no change	decreases
Lift accelerating upwards						
Lift moving with constant speed upwards						
Lift accelerating downwards						
Lift moving with constant speed downwards						

(Total 4 marks)

3. A gardener tilts a wheelbarrow of weight *W* by applying a total upward force *F* to its handles. The diagram shows the forces acting on the wheelbarrow. *R* is the normal reaction (contact) force acting on the wheel.



(a) (i) The wheelbarrow is stationary. State an expression that relates  $R$ ,  $W$  and  $F$ .

.....

(1)

(ii) Each of these three forces is one of a Newton's third law pair of forces.

Complete the following statements.

The force that pairs with  $R$  acts on .....

The force that pairs with  $W$  acts on .....

The force that pairs with  $F$  acts on .....

(3)

(b) The gardener now pushes the wheelbarrow forward. To do this he must change the magnitude and direction of the force  $F$ .

(i) Add an arrow to the diagram, at  $X$ , to show the approximate direction in which this force must act. Label this arrow  $P$ .

(1)

(ii) Explain why the magnitude and direction of force  $F$  must change when the gardener pushes the wheelbarrow forward.

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(3)

(Total 8 marks)

4. The photograph shows a climber abseiling down a rock face. At the instant shown the climber is in equilibrium.



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- (a) Explain what is meant by equilibrium in this context.

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 .....

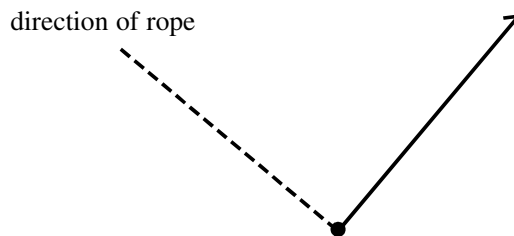
(1)

- (b) The climber's mass is 65 kg. Calculate his weight.

Weight = .....

(2)

- (c) (i) Below is an incomplete free-body force diagram for the climber.



One of the forces, which is assumed to be acting perpendicular to the rope is already shown. Label this force, and add labelled arrows to the diagram to represent the other two forces acting on the climber. Assume that the rope hanging down from the climber exerts a negligible force on him.

(3)

- (ii) The rope is at an angle of  $40^\circ$  to the horizontal. Calculate the tension in the rope.

Tension in rope = .....

(2)

- (d) The climber is wearing protective headgear in case of an accident. Describe the properties of a material suitable for the headgear, and explain why these properties are desirable.

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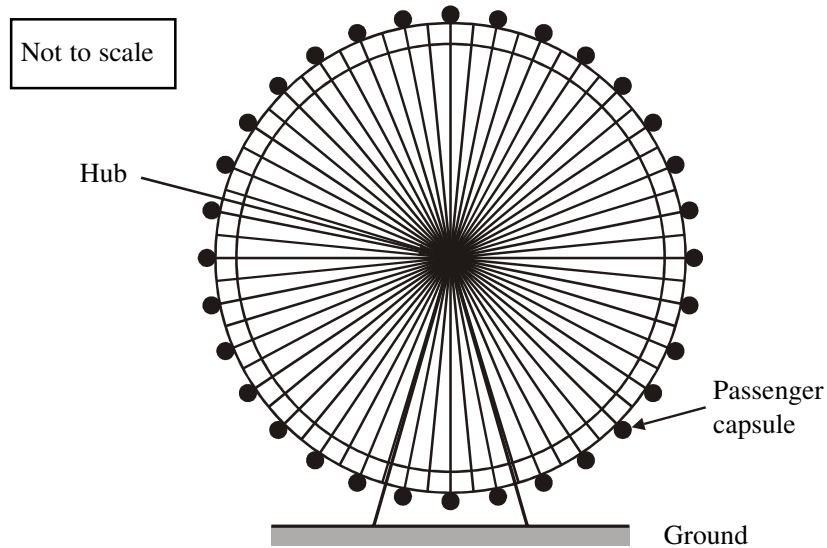
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(4)

(Total 12 marks)

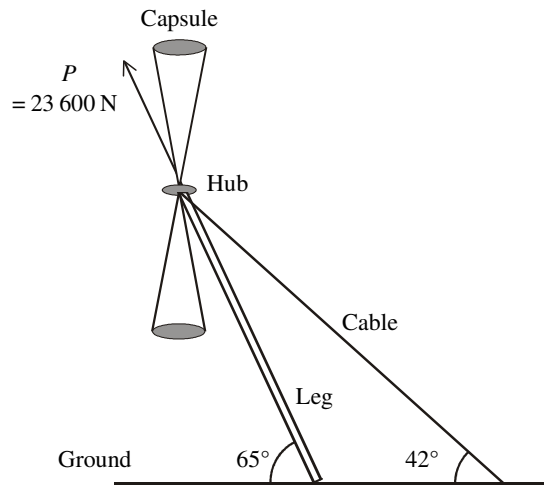
5. The London Eye is like a giant bicycle wheel supported in a vertical position, as shown in Figure 1.

Figure 1



This question is about modelling one way of supporting the wheel. In this model there is just one leg supporting the axle, and one cable exerting enough tension to hold the wheel upright, as shown in Figure 2 below.

**Figure 2**



The total weight  $W$  of the wheel and passengers is 12 400 N. Assume that the weights of the leg and cable are negligible.

In this model we will assume that there are only three forces acting on the wheel: its weight  $W$ , the tension from the cable  $T$  and the push from the leg  $P$ .

- (a) The direction of  $P$  is marked on Figure 2. Use labelled arrows to show the direction of  $W$  and the direction of  $T$ . (2)

- (b) The magnitude of  $P$  is 23 600 N. Calculate the horizontal component of  $P$ .

.....  
 .....

Horizontal component of  $P$  = ..... (2)

- (c) (i) State the magnitude of the horizontal component of  $T$ .

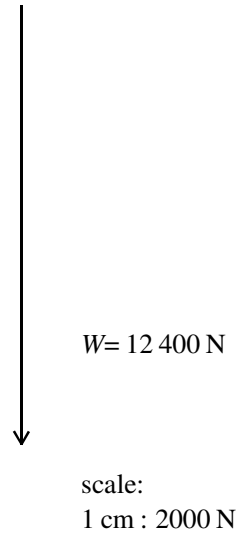
Horizontal component of  $T$  = ..... (1)

- (ii) Calculate the magnitude of  $T$ .

.....  
 .....  
 .....

Magnitude of  $T$  = ..... (2)

(d) Complete the drawing to find the resultant of  $W$  and  $P$ .



Magnitude of resultant = .....

Angle of resultant with horizontal = .....

(4)

(e) State one other force which might act on the real wheel.

.....

.....

(1)

(Total 12 marks)