A2-2007 Q2

2. A barge loaded with iron ore floats along a canal and crosses a valley by passing along an aqueduct. What happens to the load on the supports of the aqueduct as the barge approaches and then passes across the aqueduct? Explain your reasoning.

(2 marks)

A2-2008 Q2

2. A fish rests at the bottom of a bucket of water whilst the bucket is being weighed on a balance. When the fish begins to swim around, does the reading on the balance change?

(2 marks)

A2-2009 Q2

An object of mass 2.00 kg is suspended from two cables attached to the ceiling and the wall as shown in Fig.2.

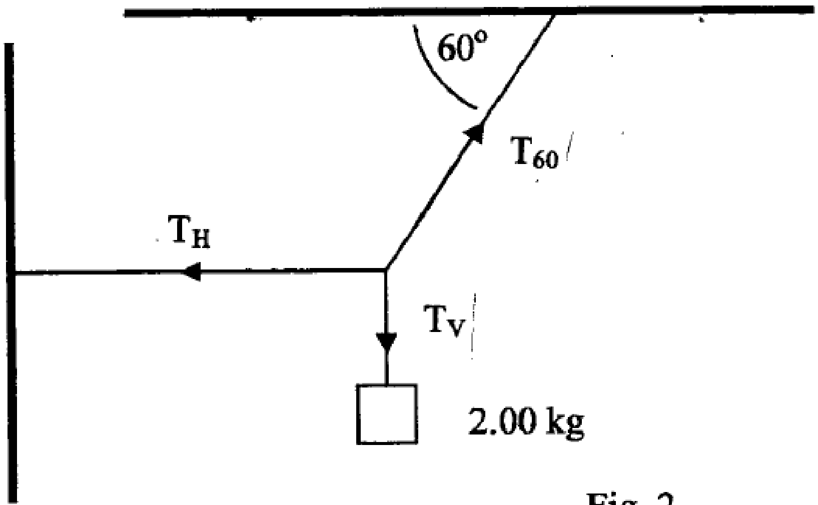

Fig. 2

(a) Calculate the tension in the horizontal string T_H, the tension T_{60} in the cable attached to the ceiling, and the tension T_V in the vertical cable supporting the weight.

(3 marks)

(b) Explain why, although the system is in equilibrium, adding the magnitudes of two of the forces together will not be equal to the third force, but adding the squares of two of the forces together will be equal to the square of the third force.

(2 marks)

(c) A large bird is perching on a massive wire which takes up a curved shape as shown in Fig. 3. The angle of sag, i.e. the angle from the horizontal at each support, θ is given. If without the bird the angle of sag of the wire is 12° and, with the bird perching on the wire, the angle is increased by 0.5°, calculate the mass of the bird. The mass of the wire alone is 20.0 kg

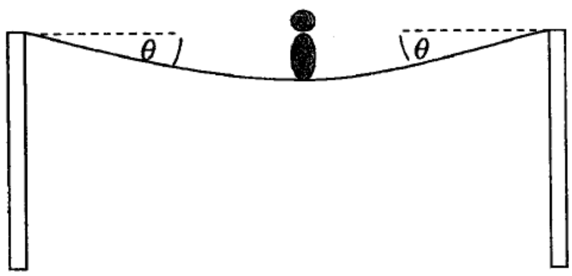

Fig. 3

(3 marks)

[8]

A2-2009 Q3

3. A man has a typical mass of 70 kg and the minimum cross sectional area of the bones in each leg is approximately 5.0×10^{-4} m^2. The compressive breaking stress of bone is approximately 1.0×10^7 Nm^{-2}. If the man stands with his weight equally supported by each leg, calculate the following:

(a) The maximum stress in his leg bones

(2 marks)

(b) The ratio of the maximum stress to the breaking stress

(1 marks)

If a giant grew to such a size that each of the linear dimensions of his body increased by a factor of nine calculate:

(c) The mass of the typical giant

(2 marks)

(d) The new ratio of the maximum stress to the breaking stress

(2 marks)

(e) Is the giant able to stand on one leg?

(1 marks)

[8]

A2-2011 Q3

(a) A broom used to sweep up dust is pushed steadily across the floor of a room, as shown in **Figure 2** below. Sketch a free body diagram for the head of the broom, showing the push, the weight of the broom head, the reaction of the floor and the frictional force due to the floor.

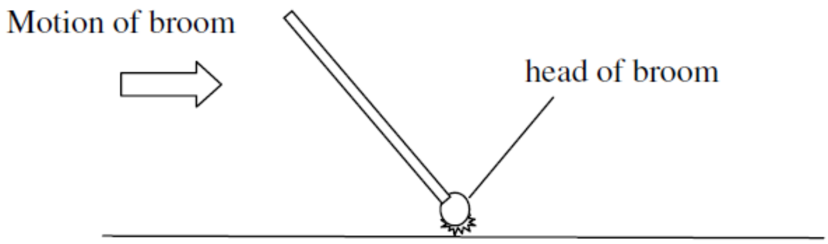

Figure 2. *Motion of broom to the right.*

[4]

(b) In **Figure 3** below, a ladder is shown leaning against a wall. The ladder remains in place because there is both friction of the ladder on the wall and friction of the ladder on the floor. Draw a free body diagram for the ladder showing all of the forces acting upon it.

[2]

(c) If the wall was made frictionless, the ladder would still remain upright. Draw a free body diagram for the ladder in this situation.

[1]

(d) If the floor was made frictionless, whilst the wall is rough and produces friction, decide and explain whether the ladder would fall or remain upright. Use a free body diagram for the ladder to help explain your answer.

[4]

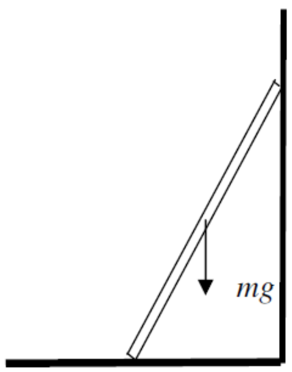

Figure 3. *Ladder leaning against a wall.*

(11 marks)

A2-2012 Q3

The physicist is inevitably well prepared for travelling and packs his clothes into the idealised rolling suitcase. The empty, rectangular suitcase has a uniform mass distribution of 5 kg acting as a load at the centre of mass. In this question, the load is measured in kilograms rather than being converted into newtons. The case has a pair of wheels at corner C and a handle at corner A, as shown in the diagram below. The suitcase contents can be modelled as two point masses of 14 kg and 4 kg, of clothing and shoes respectively, located at diagonally opposite corners of the suitcase. When the handle end of the case is just raised off the ground, so that CD is horizontal, the physicist is not lifting the full 23 kg of load.

a) State or sketch on a rectangle where the load of the empty suitcase acts.

b) Fill in the right hand column of the table with the values for the load (measured in kilograms, kg) that the physicist would feel with the distributions of the masses at diagonally opposite corners. (You only need to copy down the first and final two columns of the table).

c) If instead the two masses could now be placed at **any** two corners of the case, which examples would be the two best choices and what would be the load when lifting the handle at A?

d) Of these two examples in (c), suggest which arrangement might be better if pulling the suitcase over rough ground and explain your answer.

Example	A	B	C	D	Working out	Load at handle
1	14 kg		4 kg			
2	4 kg		14 kg			
3		14 kg		4 kg		
4		4 kg		14 kg		

Figure 1. The physicist's ideal suitcase on wheels.

(8 marks)