Moments

Question Paper

Course	CIE IGCSE Physics
Section	1. Motion, Forces & Energy
Topic	Moments
Difficulty	Hard

Time Allowed 60

Score /46

Percentage /100

Question 1a

A tower crane has a load W, as shown in Fig. 3.1.

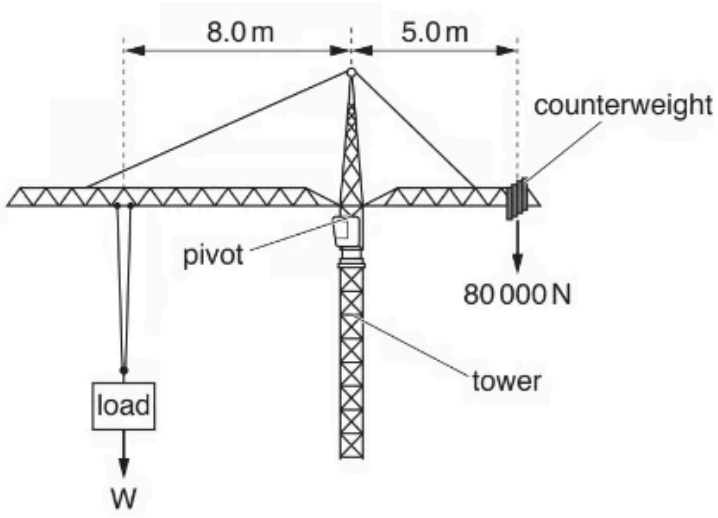

Fig. 3.1

The counterweight has a weight of 80 000 N. This acts at a distance of 5.0 m from the pivot, as shown in Fig. 3.1.

Calculate the moment of the counterweight about the pivot. Give the unit.

moment = ...

[3 marks]

Question 1b

The tower crane in Fig. 3.1 balances horizontally when holding the load W.

Calculate the weight of load W.

weight = ... N

[3 marks]

Question 2a

Extended tier only

Fig. 2.1 shows a uniform plank AB of length 2.0 m suspended from two ropes X and Y.

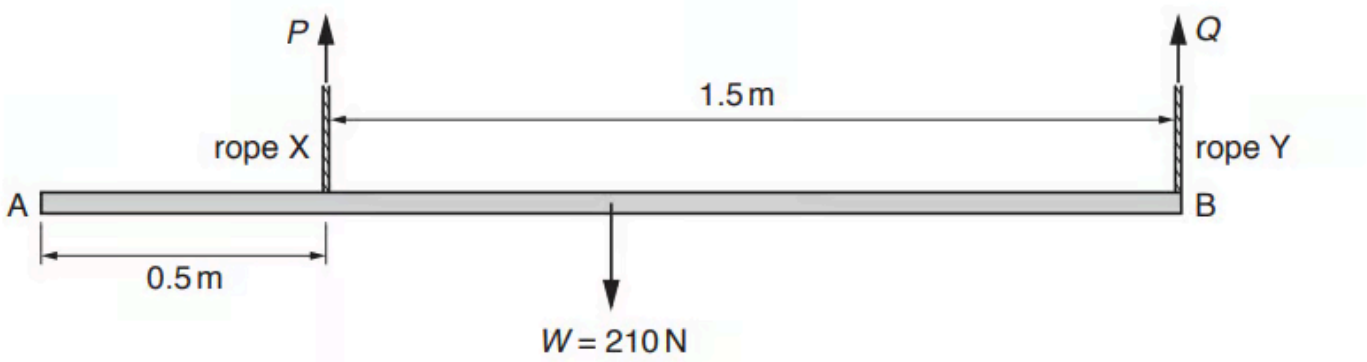

Fig. 2.1

The weight W of the plank is 210 N. The force in rope X is P. The force in rope Y is Q.

State, in terms of P, the moment of force P about B.

[1 mark]

Question 2b

Extended tier only

Calculate:

(i) the moment of *W* about B

moment = ...[1]

(ii) the force *P*

force P = ...[2]

(iii) the force Q.

force Q = ...[2]

[5 marks]

Question 3a

Fig. 4.1 shows a tractor fitted with a device for breaking up soil in a field.

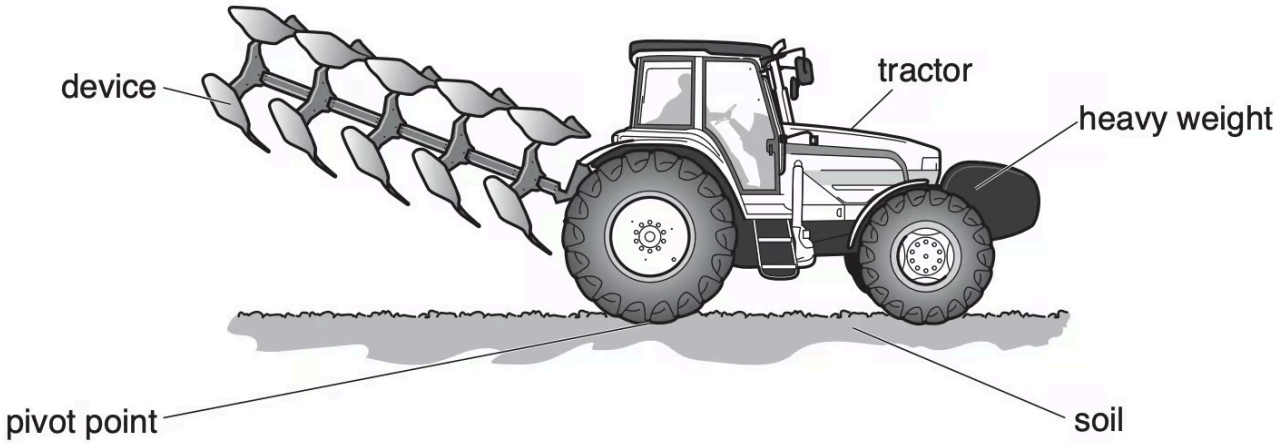

Fig. 4.1

(i) The tractor has a heavy weight at the front. Explain why the heavy weight is needed.

[1]

(ii) Fig. 4.2 represents the weight of the device and its distance from the pivot.

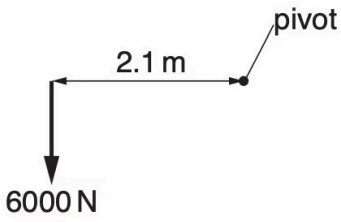

Fig. 4.2

Calculate the moment of the weight of the device about the pivot. State the unit.

moment = ... [4]

[5 marks]

Question 3b

Fig. 4.3 shows a tractor fitted with narrow tyres and the same tractor fitted with wide tyres.

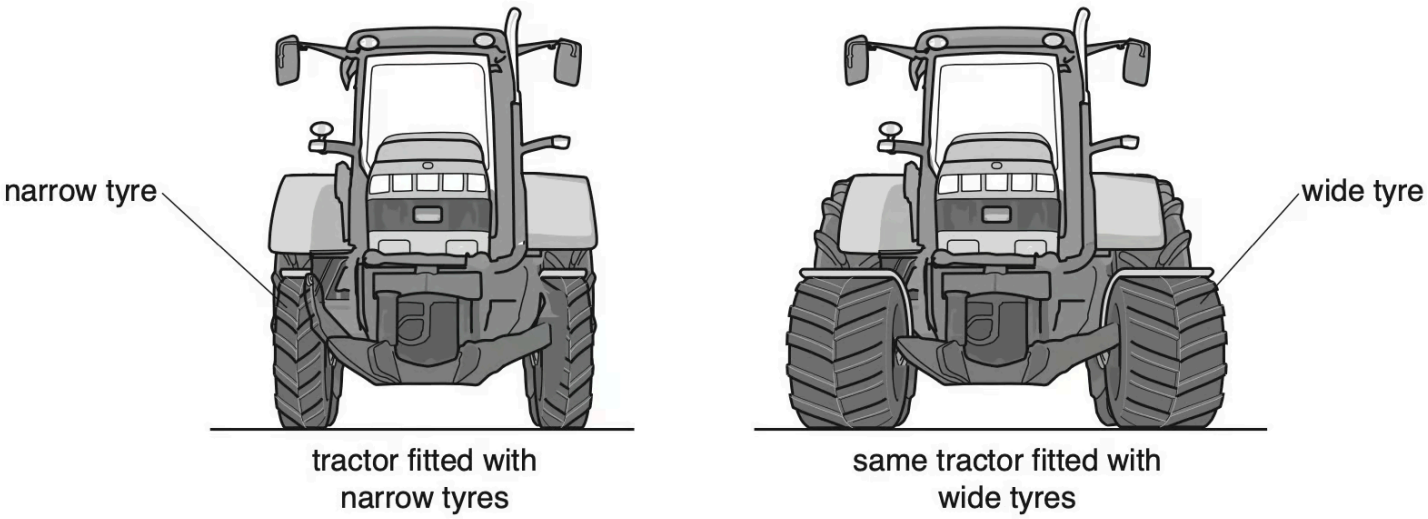

Fig. 4.3 (view from the front)

Explain why wide tyres are more suitable for the tractor on soft soil.

[3 marks]

Question 4a

In a double-decker bus there are two passenger compartments, one above the other.

Fig. 3.1 shows a double-decker bus on a tilted platform.

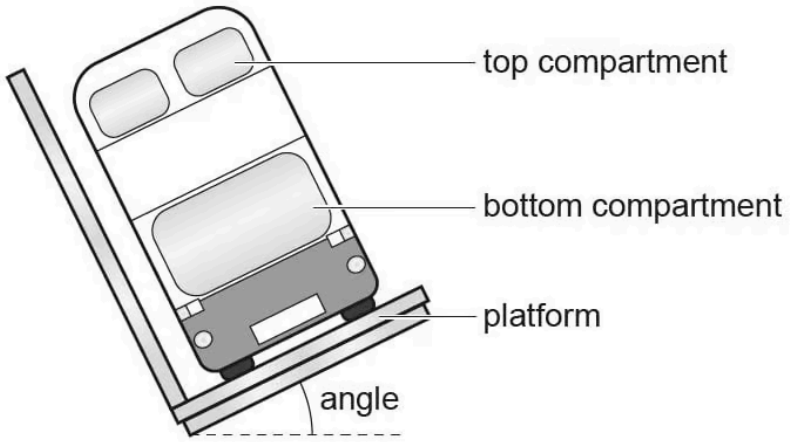

Fig. 3.1

The platform is used to test the stability of the bus.

The angle the bus makes with the horizontal is gradually increased until the bus begins to topple to the left.

Explain why the bus begins to topple.

[1 mark]

Question 4b

There are 30 passengers in the upper compartment of the bus and 2 passengers in the bottom compartment of the bus.

State how this affects the stability of the bus and the reason for this.

[2 marks]

Question 4c

Extended tier only

A bus is travelling along a straight road. The bus and the driver have a combined mass of 16000 kg when there are no passengers in it. The bus has 73 passengers. The average mass of each of the passengers is 65 kg.

(i) Calculate the total mass of the bus, the driver and the 73 passengers.

mass = ... [2]

(ii) The fully loaded bus accelerates uniformly from rest to a speed of 14 m / s. The time taken to reach a speed of 14 m / s is 20 s.

Calculate the resultant force on the bus during the acceleration.

force = ... [2]

[4 marks]

Question 5a

A university student is constructing some flat-pack furniture.

An Allen key has a hexagonal end and is used to tighten hexagonal bolts. An Allen key can be used with its longer end in the hexagonal bolt, or can be rotated to place the shorter end in the hexagonal bolt. This is shown in Fig. 1.1.

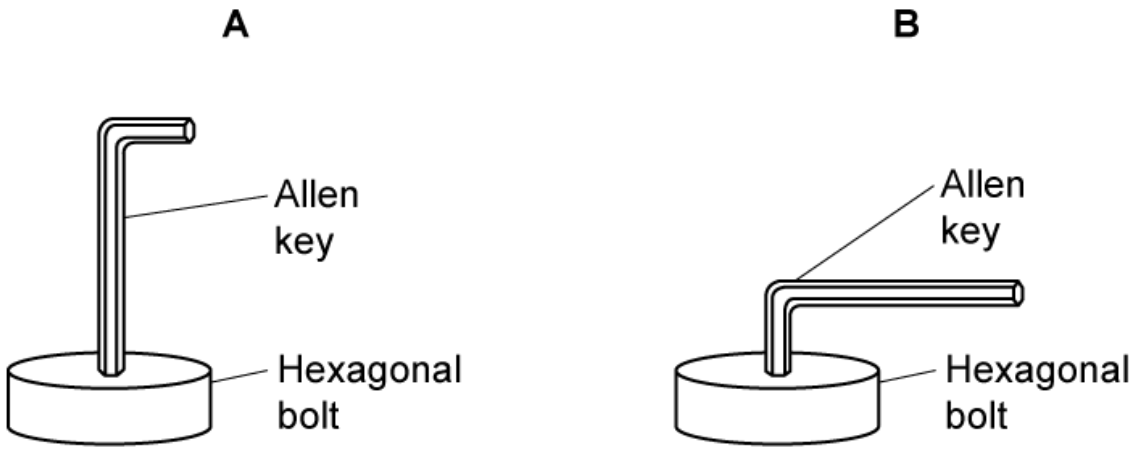

Fig. 1.1

State which orientation, A or B, will allow the bolt to be tightened more easily.

Explain why, referring to moments in your answer.

[3 marks]

Question 5b

The dimensions of the Allen key are shown in Fig. 1.2.

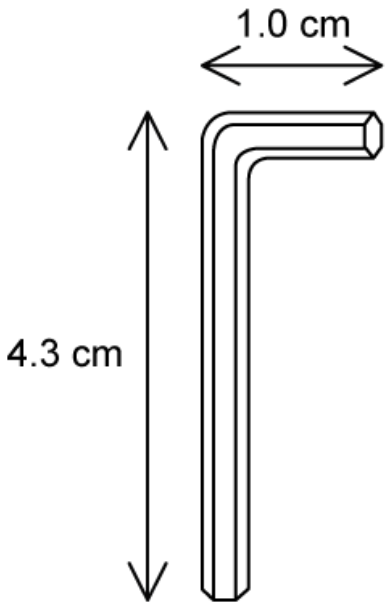

Fig. 1.2

The student building the furniture applies a force of 150 N to the Allen key.

(i) Calculate the moment when the Allen key is in orientation A.

moment in orientation A = ... N m [4]

(ii) Calculate the moment when the Allen key is in orientation B.

moment in orientation B = ... N m [3]

[7 marks]

Question 5c

The student constructs the furniture but realises they need to lift it up to place a rug underneath.

The furniture has a weight of 800 N and is too heavy for the student to lift.

Remembering a lecture about the principle of moments, they use a pivot and a plank of wood to lift it. As shown in Fig. 1.3, the furniture exerts a perpendicular force F_A on the plank, which is equal to 30% of the weight of the furniture.

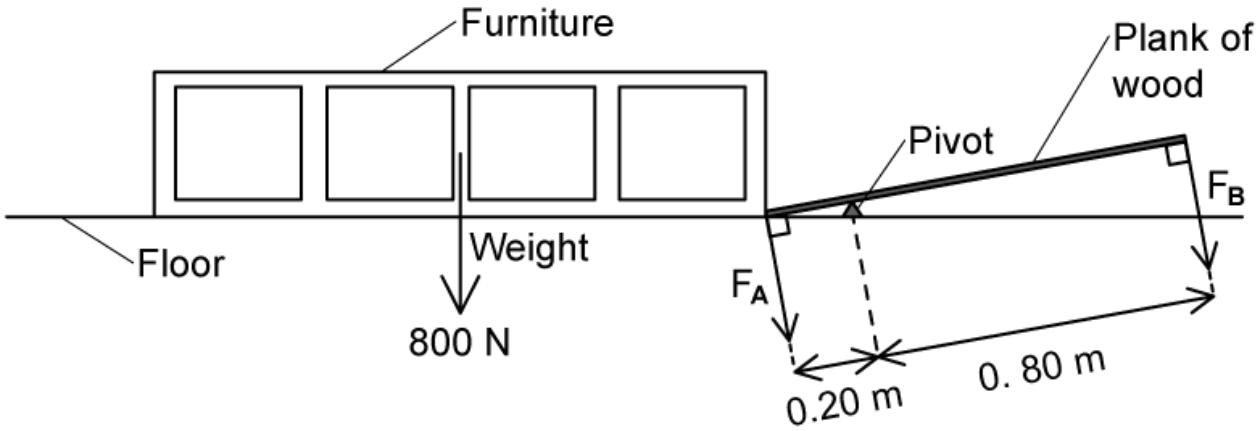

Fig. 1.3

Calculate the minimum force F_B the student must exert to lift the furniture.

[6 marks]

Question 5d

Extended tier only

The calculation in part (c) neglected the weight of the plank of wood.

Assuming the plank of wood has evenly distributed mass, explain how this would affect the size of the force that the student must exert to lift the furniture.

[3 marks]