



Resources available from

**kickstart  
tutors**

Student number

--	--	--	--	--

Name \_\_\_\_\_

Date \_\_\_\_\_

Attempt/Time taken \_\_\_\_\_

# GCSE PHYSICS

Topic Paper: 5.4 Moments, levers and gears (physics only)  
Part 1

---

Time allowed: 40 minutes

## Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

## Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

## Information

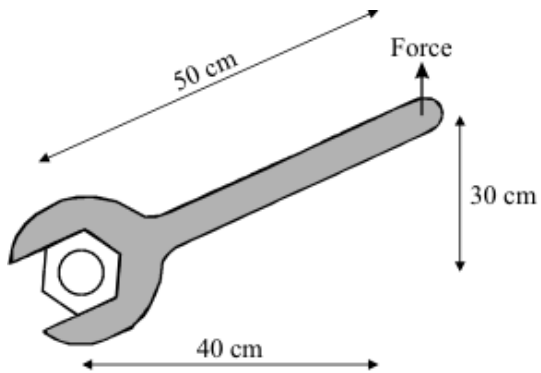
- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.



**37 Marks**



**Q1.** The diagram shows a spanner being used to undo a tight nut.



The nut was tightened using a moment of 120 newton metres.

Use the following equation to calculate the force needed to undo the nut. Show clearly how you work out your answer.

$$\text{moment} = \text{force} \times \text{perpendicular distance from pivot}$$

.....  
.....

Force = ..... N

**(Total 2 marks)**



**Q2.** The London Eye is the largest observation wheel in the world.



The passengers ride in capsules. Each capsule moves in a circular path and accelerates.

(a) Explain how the wheel can move at a steady speed and the capsules accelerate at the same time.

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

(2)

(b) In which direction does each capsule accelerate?

.....

(1)

(c) What is the name of the resultant force that causes the capsules to accelerate?

.....

(1)



(d) The designers of the London Eye had to consider **three** factors which affect the resultant force described in part (c).

Two factors that increase the resultant force are

- an increase in the speed of rotation
- an increase in the total mass of the wheel, the capsules and the passengers.

Name the other factor that affects the resultant force and state what effect it has on the resultant force.

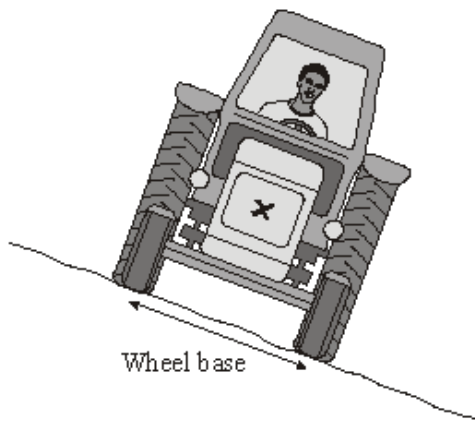
.....

.....

(1)  
(Total 5 marks)

**Q3.** Tractors are often used on sloping fields, so stability is important in their design.

On the diagram, the centre of the **X** marks the centre of mass of the tractor.



(a) Explain why the tractor has **not** toppled over. You may add to the diagram to help you to explain.

.....

.....

.....

.....

.....

.....

(3)



(b) Give **two** features of the tractor which affect its stability and state how each feature could be changed to increase the tractor's stability.

Feature 1 .....

.....

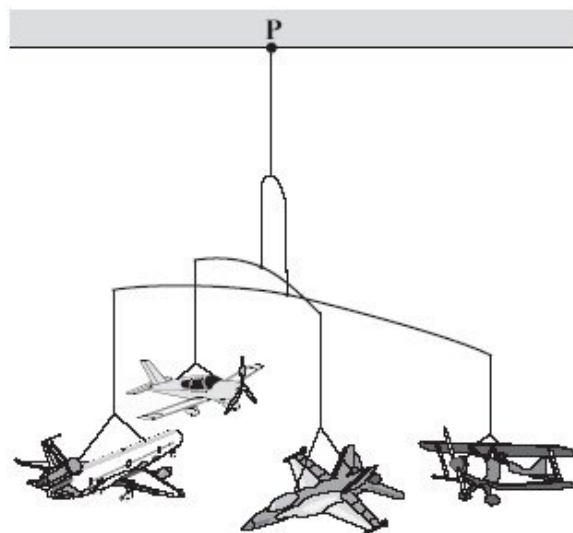
Feature 2 .....

.....

(2)  
(Total 5 marks)

**Q4.** (a) The diagram shows a child's mobile. The mobile hangs from point **P** on the ceiling of the child's bedroom.

(i) Mark the position of the centre of mass of the mobile by drawing a letter **X** on the diagram. Do this so that the centre of the **X** marks the centre of mass of the mobile.



(1)

(ii) Explain why you have chosen this position for your letter **X**.

.....

.....

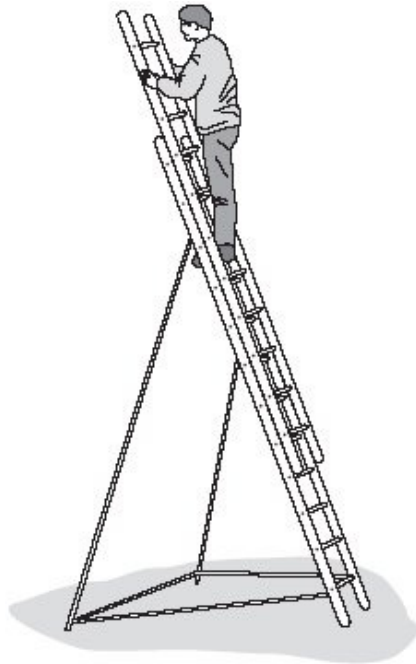
.....

.....

(2)



(b) The diagram shows a device which helps to prevent a ladder from falling over.



Use the term *centre of mass* to explain why the ladder, in the situation shown, is unlikely to topple over.

You may add to the diagram to illustrate your explanation.

.....

.....

.....

.....

.....

.....

(3)  
(Total 6 marks)

**Q5.** This page is from a science magazine.

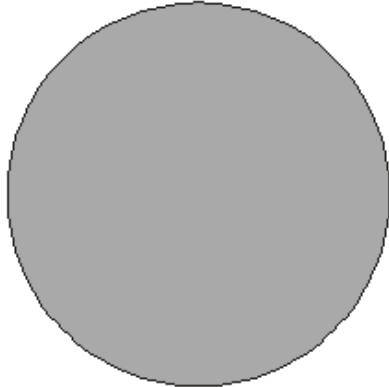
**The Red Planet**

The two natural satellites, or moons, of Mars are Phobos (fear) and Deimos (terror). They are named after the horses which pulled the chariot of Mars, the god of war in the mythology of Ancient Greece.

Phobos takes less than eight hours to orbit Mars and gets slightly closer every time it does so. Scientists predict that in about 100 million years time it will either be ripped apart by the gravitational force or will crash onto the surface of Mars.

● Deimos

● Phobos



Not to scale

(a) Suggest how scientists have arrived at their prediction of about 100 million years.

.....  
.....

(2)

(b) The centripetal force on Phobos is gradually changing as it orbits Mars.

Is the force increasing or decreasing?

.....

Explain your answer.

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

(2)



(c) Scientists expect that the mass of Mars and the mass of Phobos will not increase.

Explain what will happen to the gravitational force on Phobos as it orbits Mars.

.....

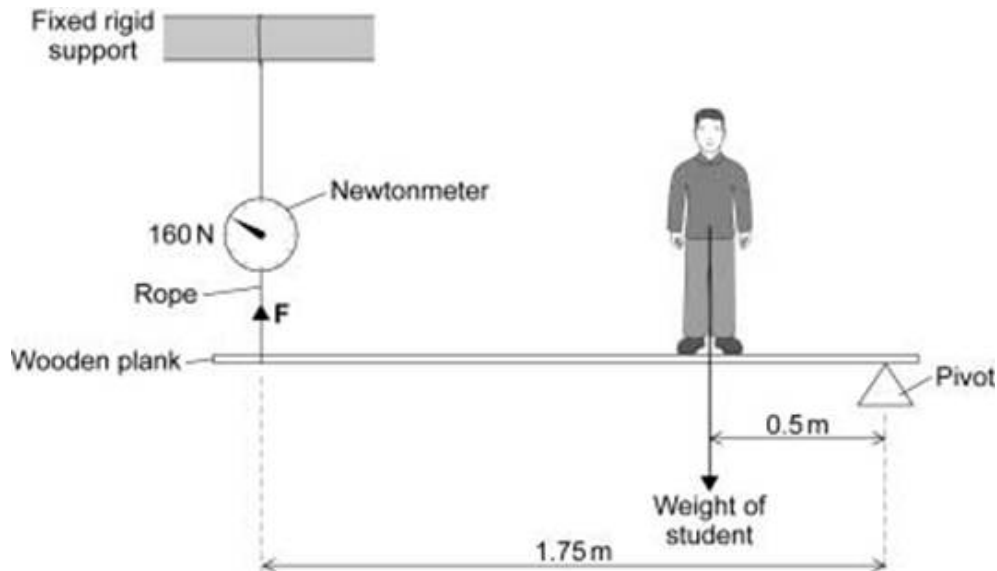
.....

.....

.....

(2)  
(Total 6 marks)

**Q6.** A student wants to weigh himself but the only balance available is a newtonmeter that measures up to 200 newtons.  
The diagram shows how the student solved the problem using moments.







- (a) Use the information in the diagram to calculate the weight of the student given by this method.

Write down the equation you use, and then show clearly how you work out your answer and give the unit.

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

Weight = .....

(5)

- (c) Even though all the measurements are accurate the student's weight obtained by this method is inaccurate.

Explain why.

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

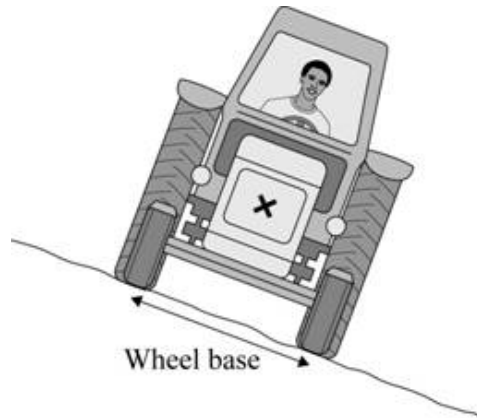
(2)

(Total 7 marks)



**Q7.** Tractors are often used on sloping fields, so stability is important in their design.

On the diagram, the centre of the **X** marks the *centre of mass* of the tractor.



(a) What is meant by the term *centre of mass*?

.....  
.....

(1)

(b) Explain how the design of the tractor could be changed in order to increase the tractor's stability.

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

(2)

(c) Explain why the tractor does not topple over. You may add to the diagram to help your explanation.

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

(3)

**(Total 6 marks)**