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Name _____

Date _____

Attempt/Time taken _____

GCSE PHYSICS

Topic Paper: 5.4 Moments, levers and gears (physics only)
Part 2

Time allowed: 50 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

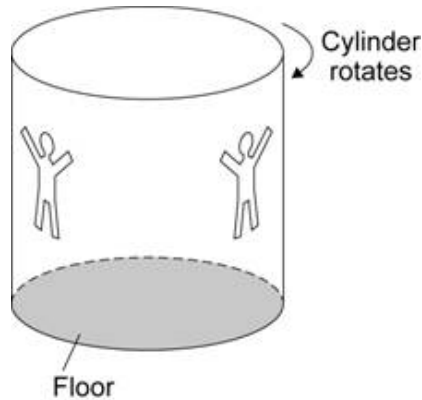
- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
 - is clear, logical, sensibly structured
 - fully meets the requirements of the question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



45 Marks



Q8. The fairground ride called 'The Rotor' is a large cylinder which rotates. When the cylinder reaches its maximum speed the floor drops away and the riders inside the cylinder are left against the cylinder wall.



(a) Explain how the cylinder is rotating at a constant speed but at the same time the riders inside the cylinder are accelerating.

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(3)

(b) In which direction do the riders accelerate?

.....

(1)

(c) What name is given to the resultant force that causes the riders to accelerate?

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(1)

(d) At the end of the ride the floor goes back into place and the cylinder slows down and stops.

How does the resultant force on the riders change as the cylinder slows down?

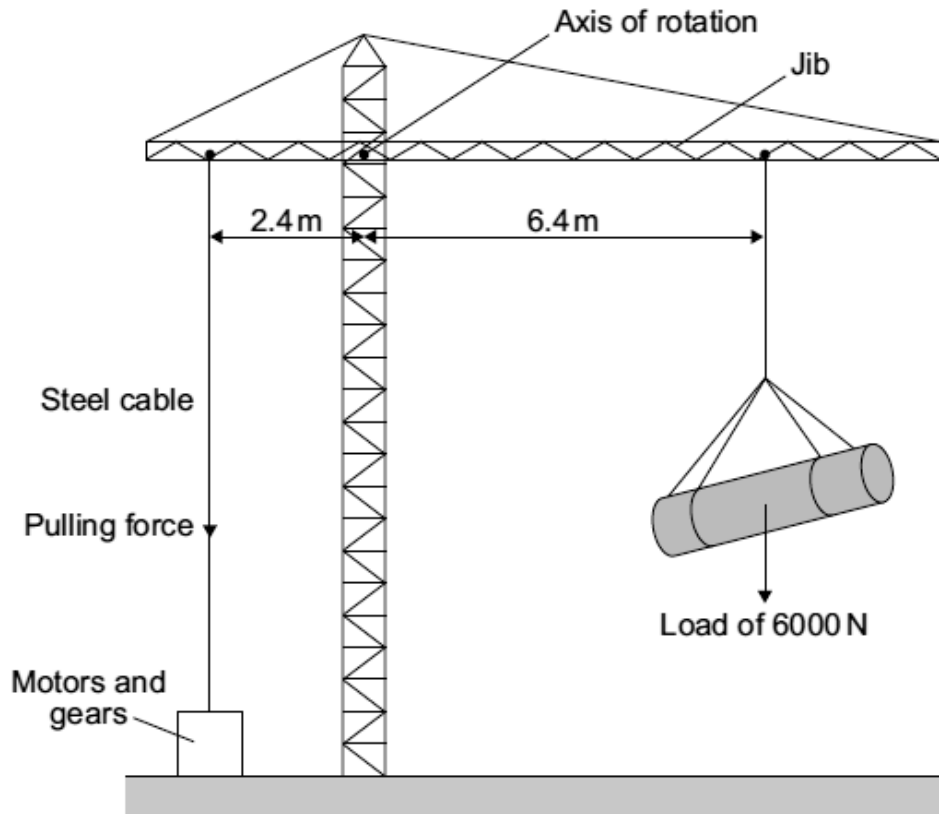
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(1)

(Total 6 marks)



Q9. The diagram shows a design for a crane. The crane is controlled by a computer.



The purpose of the motors and gears is to change the pulling force in the steel cable. This is done so that the jib stays horizontal whatever the size of the load or the position of the load.

Use the equation in the box to answer questions (a) and b).

moment = force ×	perpendicular distance from the line of action of the force to the axis of rotation
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(a) Calculate the moment caused by the load in the position shown in the diagram.

Show clearly how you work out your answer and give the unit.

.....
.....

Moment =

(3)



(b) Calculate the pulling force that is needed in the steel cable to keep the jib horizontal.

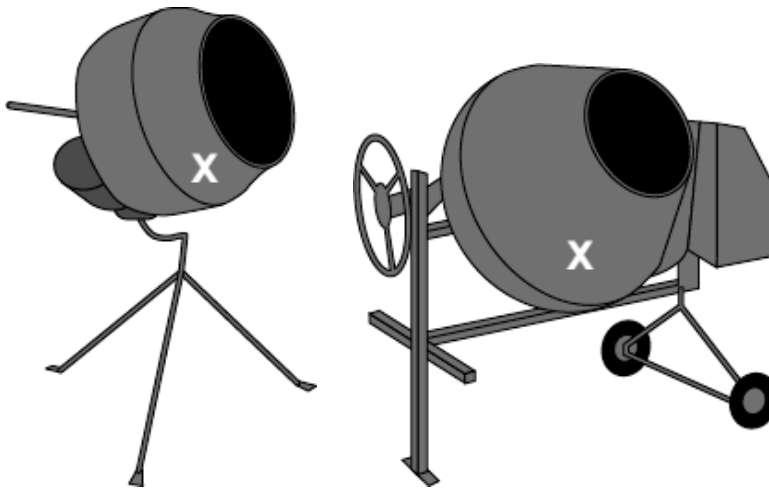
Show clearly how you work out your answer.

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Pulling force = N

(2)
(Total 5 marks)

Q10. The diagrams show two concrete mixers.



Concrete mixer A Concrete mixer B

On each diagram, the centre of the white **X** marks the centre of mass of the concrete mixer and its contents.

(a) Complete the sentence to explain what the term *centre of mass* means.

The centre of mass of a concrete mixer and its contents is

.....

.....

(1)



(b) Both diagrams are drawn to the same scale.

Concrete mixer **B** is more stable than concrete mixer **A**.

The two features which make concrete mixer **B** more stable are:

1

.....

2

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(2)

(c) Use the terms 'line of action of the weight' and 'resultant moment' to explain why a stable concrete mixer does not fall over when it is given a small push.

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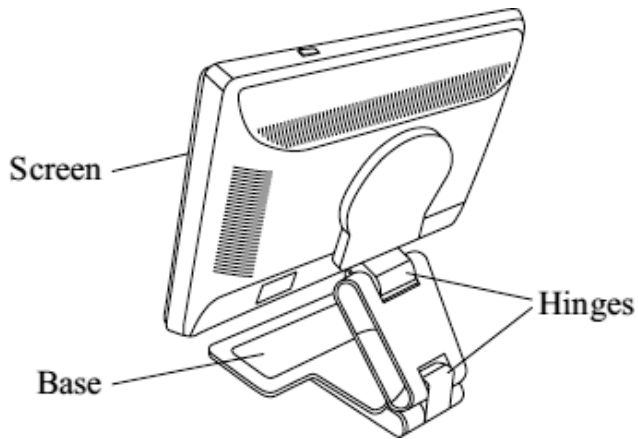
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(2)

(Total 5 marks)



Q11. The diagram shows a back view of a computer monitor.



(a) In normal use, the monitor is *stable*.

(i) Explain the meaning, in the above sentence, of the word *stable*.

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.....

(2)

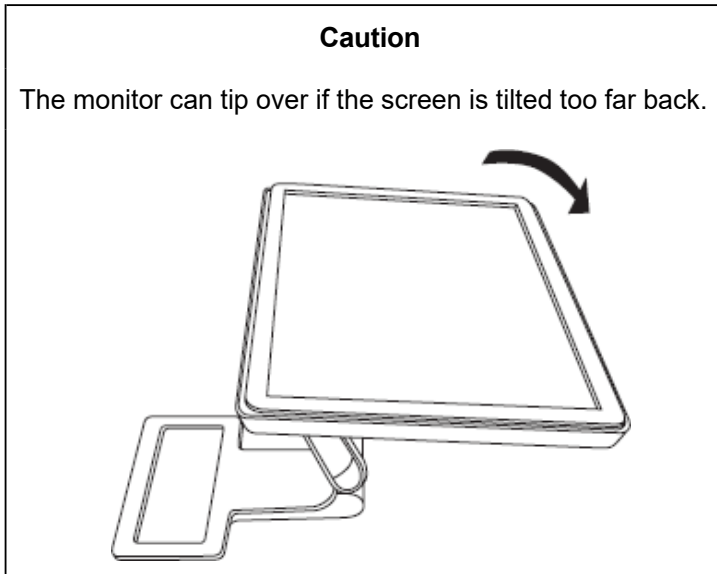
(ii) State the relationship between the total clockwise moment and the total anticlockwise moment about any axis of the monitor when it is *stable*.

.....
.....

(1)



- (b) The instruction booklet explains that the screen can be tilted. It also includes a warning.



Explain why the monitor will tip over if the screen is tilted too far back.

Include the words *centre of mass*, *weight* and *moment* in your explanation.

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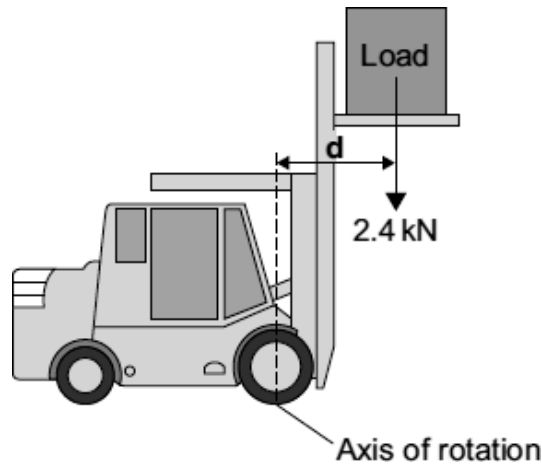
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(3)
(Total 6 marks)



Q12. The diagram shows a fork-lift truck with a load of 2.4 kN. The clockwise moment caused by this load is 2880 Nm.



(a) Use the equation in the box to calculate the distance **d**.

moment=force×	perpendicular distance from the line of action of the force to the axis of rotation
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Show clearly how you work out the answer and give the unit.

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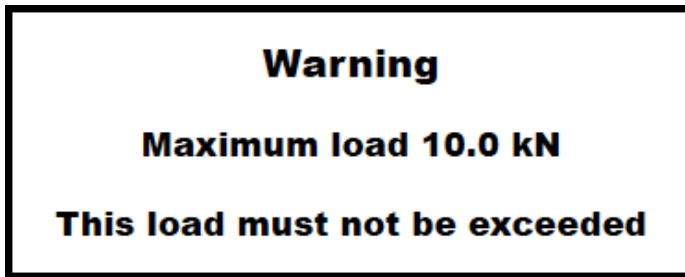
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Distance **d** =

(3)

(b) This warning notice is in the driver's cab.



Explain in terms of moments why the maximum load must not be exceeded.

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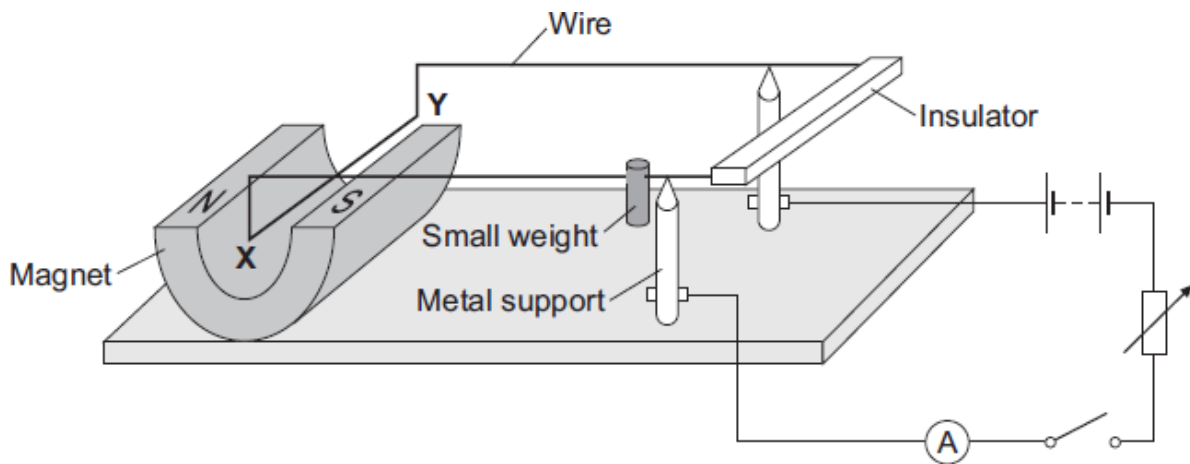
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(2)
(Total 5 marks)

Q13. The diagram shows a device called a current balance.



(a)(i) When the switch is closed, the part of the wire labelled **XY** moves upwards.

Explain why.

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(2)



(ii) What is the name of the effect that causes the wire **XY** to move?

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(1)

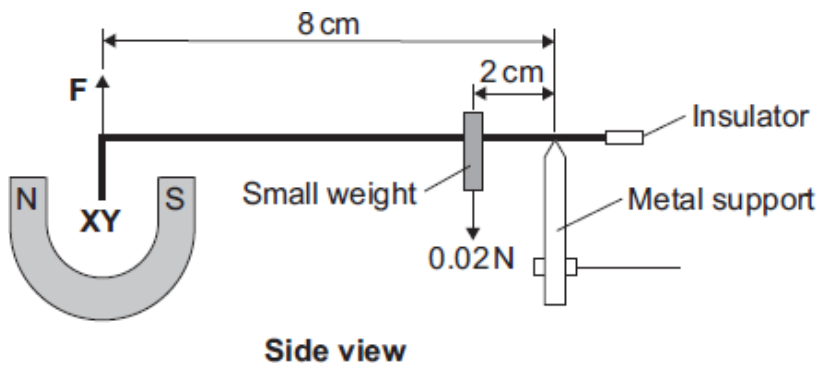
(iii) An alternating current (a.c.) is a current which reverses direction. How many times the current reverses direction in one second depends on the frequency of the alternating supply.

Describe the effect on the wire **XY** if the battery is replaced by an a.c. supply having a frequency of 5 hertz.

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(2)

(b) The diagram shows how a small weight can be used to make the wire **XY** balance horizontally.



Use the data in the diagram and the equation in the box to calculate the force, **F**, acting on the wire **XY**.

$\text{moment} = \text{force} \times$	perpendicular distance from the line of action of the force to the axis of rotation
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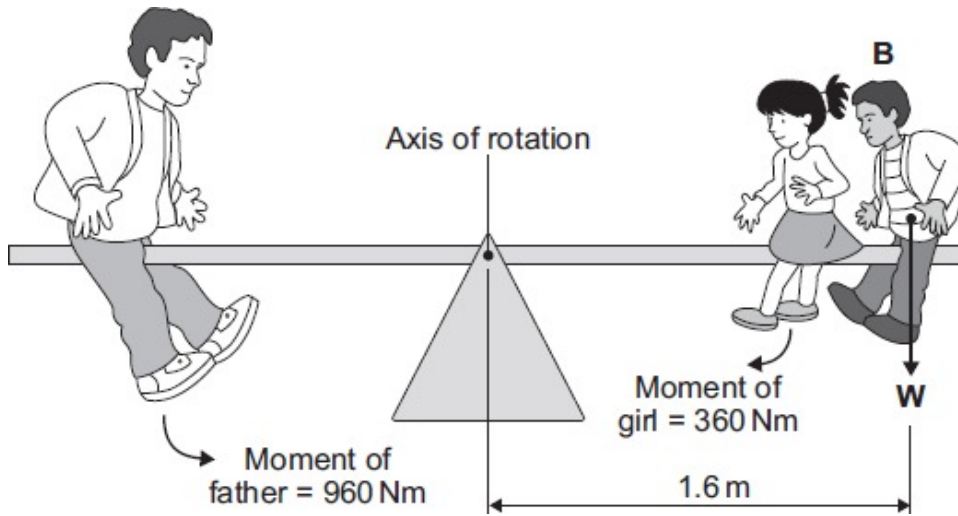
Show clearly how you work out your answer.

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Force = N

(3)
(Total 8 marks)

Q14. The diagram shows a father and his two children sitting on a playground see-saw. The see-saw is not moving.



(a) What is the total clockwise moment of the two children about the axis of rotation?

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Explain the reason for your answer.

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(3)

(b)(i) What is the clockwise moment of the boy, **B**, about the axis of rotation?

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Moment = Nm

(1)



(ii) Use the information in the diagram and the equation in the box to calculate the weight, **W**, of the boy, **B**.

moment = force ×	perpendicular distance from the line of action of the force to the axis of rotation
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Show clearly how you work out your answer.

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Weight of boy **B** = N

(2)
(Total 6 marks)

Q15. The London Eye is one of the largest observation wheels in the world.



©Angelo Ferraris/Shutterstock

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.

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.....

(2)



(b) In which direction is the resultant force on each capsule?

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(1)

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

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.

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(1)

(Total 4 marks)