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Student number

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Name _____

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GCSE PHYSICS

Topic Paper: 5.4 Moments, levers and gears (physics only)
Part 3

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

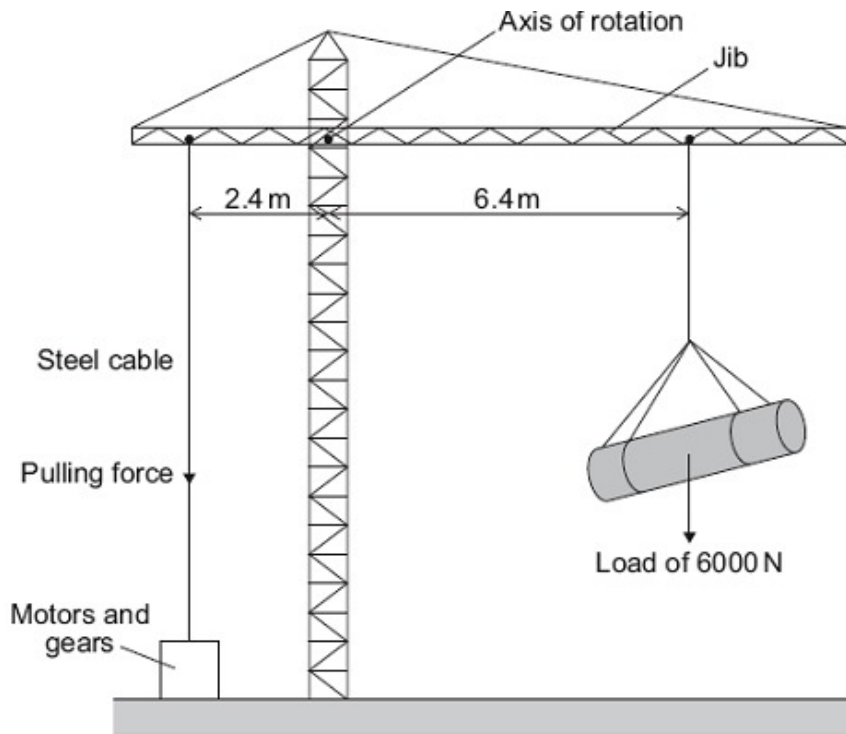
- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
 - is clear, logical, sensibly structured
 - fully meets the requirements of the question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



46 Marks



Q16. 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).

$\text{moment} = \text{force} \times \text{perpendicular distance from the line of action of the force to the axis of rotation}$
--

(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.

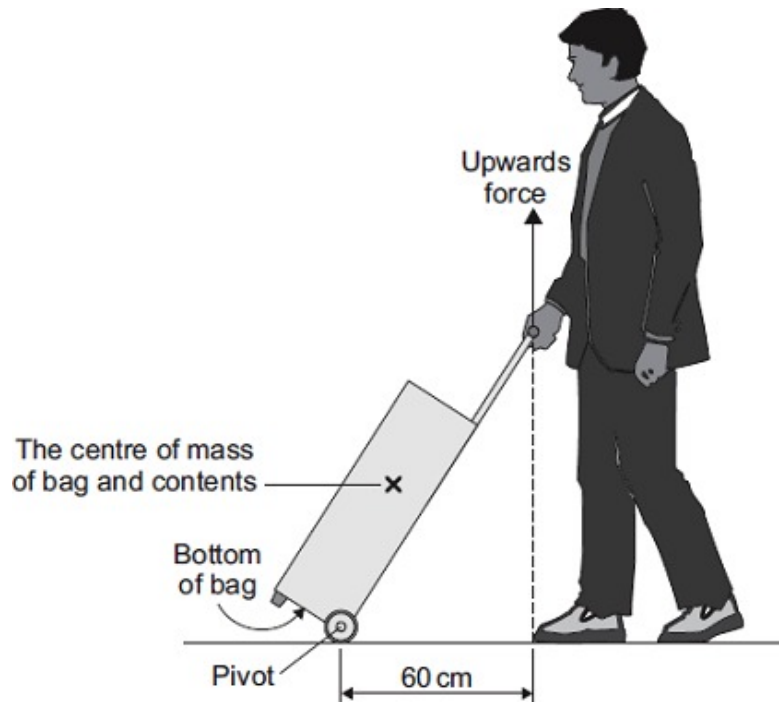
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Pulling force = N

(2)

(Total 5 marks)

Q17. The diagram shows a man standing in an airport queue with his wheeled bag.



(a) The man applies an upward force to the handle of his bag to stop the bag from falling. The moment of this force about the pivot is 36 Nm.

Calculate the upward force the man applies to the handle of his bag.

Use the correct equation from the Physics Equations Sheet.

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Force = N

(2)

(b) When the man lets go of the bag handle, the bag falls and hits the floor.

Explain why.

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(2)



- (c) During his holiday the man visits the Foucault Pendulum in Paris, France.
The pendulum makes 10 complete swings every 160 seconds.

Calculate the frequency of the pendulum and give the unit.

Use the correct equation from the Physics Equations Sheet.

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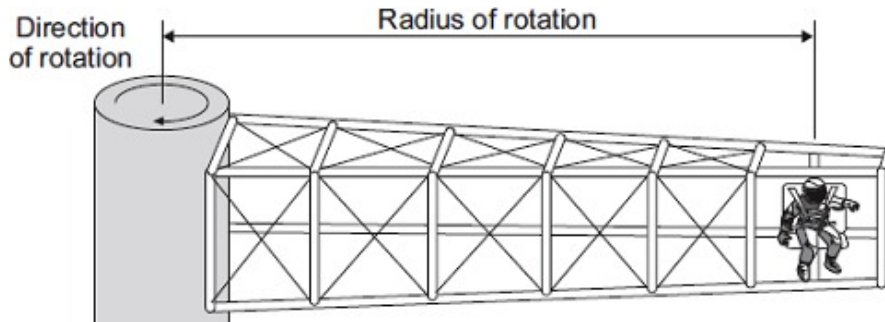
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Frequency =

(3)
(Total 7 marks)

- Q18.** The diagram shows a 'G-machine'. The G-machine is used in astronaut training.



The G-machine moves the astronaut in a horizontal circle.

- (a) When the G-machine is rotating at constant speed, the astronaut is accelerating.

State the name and direction of the force causing the astronaut to accelerate.

Name of force

Direction of force

.....

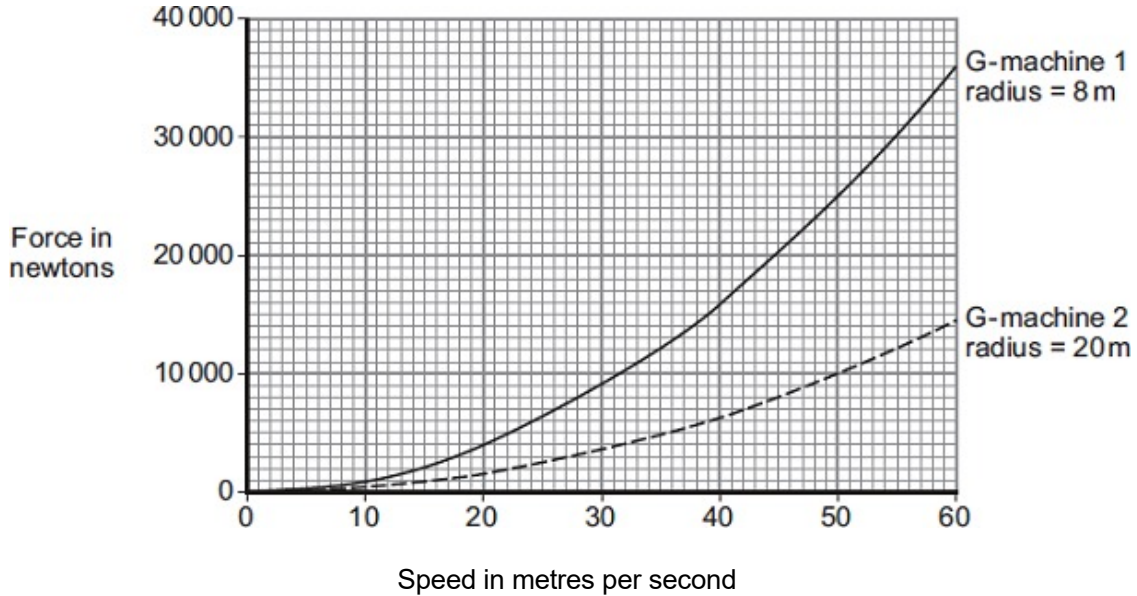
(2)



(b) The force causing the astronaut to move in a circle is measured.

The graph shows how the speed of the astronaut affects the force causing the astronaut to move in a circle for two different G-machines.

The radius of rotation of the astronaut is different for each G-machine.



(i) State **three** conclusions that can be made from the graph.

- 1
-
- 2
-
- 3
-

(3)

(ii) The speed of rotation of G-machine 1 is increased from 20 m/s to 40 m/s.

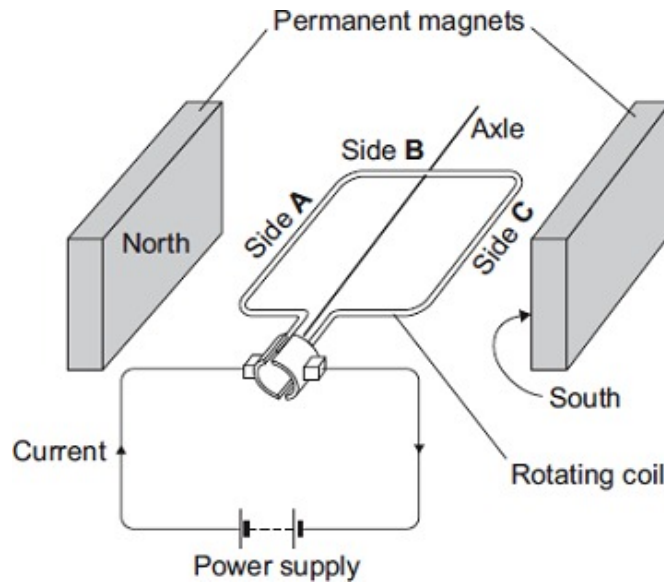
Determine the change in force on the astronaut.

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Change in force = N

(1)

(c) Each G-machine is rotated by an electric motor. The diagram shows a simple electric motor.



(i) A current flows through the coil of the motor.

Explain why side **A** of the coil experiences a force.

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.....

.....

.....

(2)

(ii) Draw arrows on the diagram to show the direction of the forces acting on side **A** of the coil and side **C** of the coil.

(1)

(iii) When horizontal, side **B** experiences no force.

Give the reason why.

.....

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(1)

(d) While a G-machine is rotating, the operators want to increase its speed.

What can the operators do to make the G-machine rotate faster?

.....

.....

(1)



(e) The exploration of space has cost a lot of money.

Do you think spending lots of money on space exploration has been a good thing?

Draw a ring around your answer.

Yes

No

Give a reason for your answer.

.....
.....

(1)
(Total 12 marks)

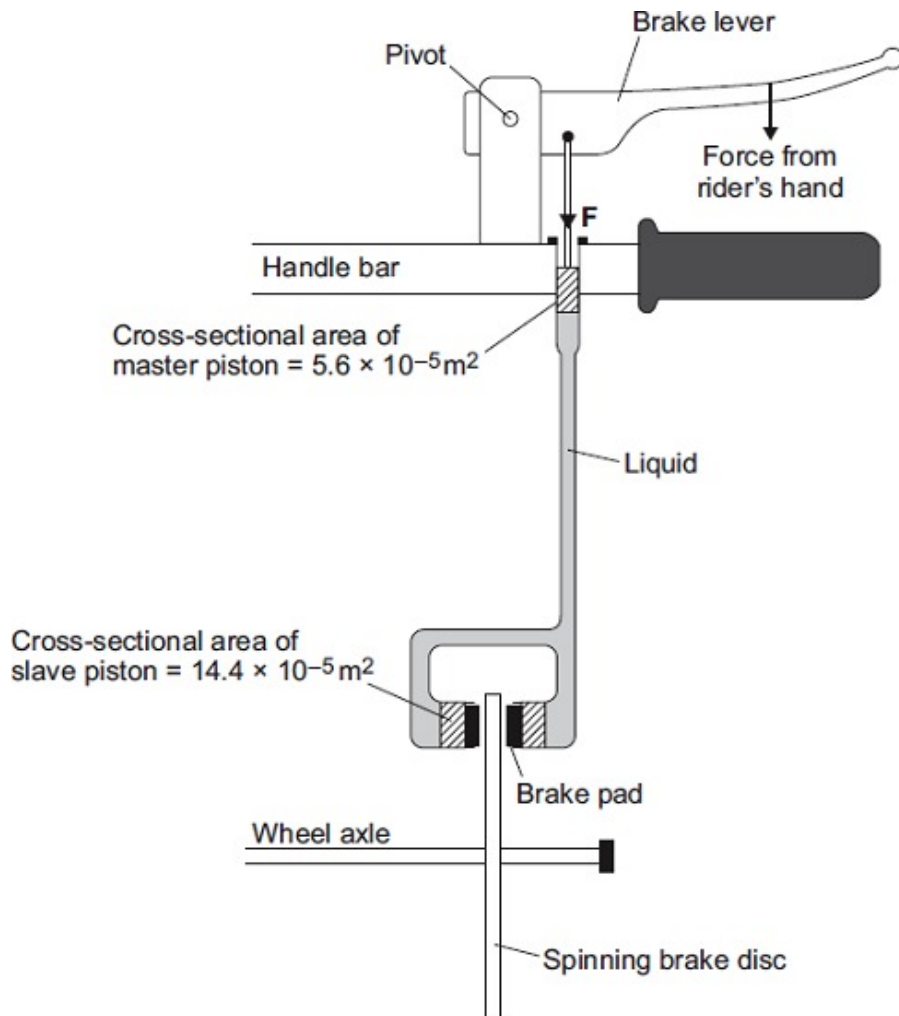


Q19. Mountain bike riders use brakes to slow down.



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Some mountain bikes have hydraulic brakes.



(a) What property of a liquid enables a hydraulic brake system to work?

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(1)



(b) When the rider's hand pulls on the brake lever, the master piston applies a pressure of 1.5×10^6 pascals to the liquid.

Using information from the diagram, calculate the force **F** exerted on the liquid by the master piston.

Use the correct equation from the Physics Equations Sheet.

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Force **F** = N

(2)

(c) The pressure in the liquid applies a force to move each slave piston.

How does the size of this force compare to the force **F** applied by the master piston?

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Give a reason for your answer.

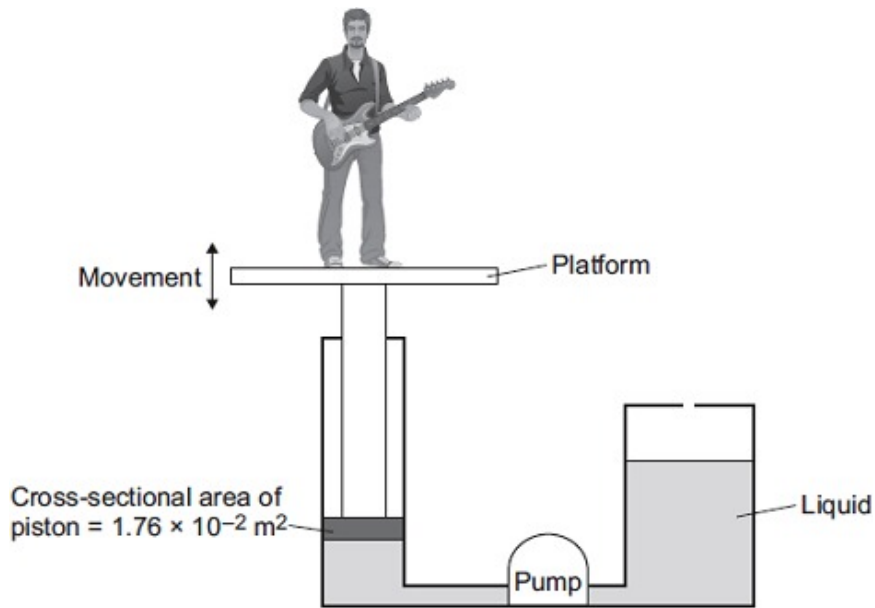
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(2)
(Total 5 marks)

Q20. Musicians sometimes perform on a moving platform.

Figure 1 shows the parts of the lifting machine used to move the platform up and down.

Figure 1



(a) What type of system uses a liquid to transmit a force?

.....

(1)

(b) The pump creates a pressure in the liquid of 8.75×10^4 Pa to move the platform upwards.

Calculate the force that the liquid applies to the piston.

Use the correct equation from the Physics Equations Sheet.

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Force = N

(2)

(c) The liquid usually used in the machine is made by processing oil from underground wells. A new development is to use plant oil as the liquid.

Extracting plant oil requires less energy than extracting oil from underground wells.

Suggest an environmental advantage of using plant oil.

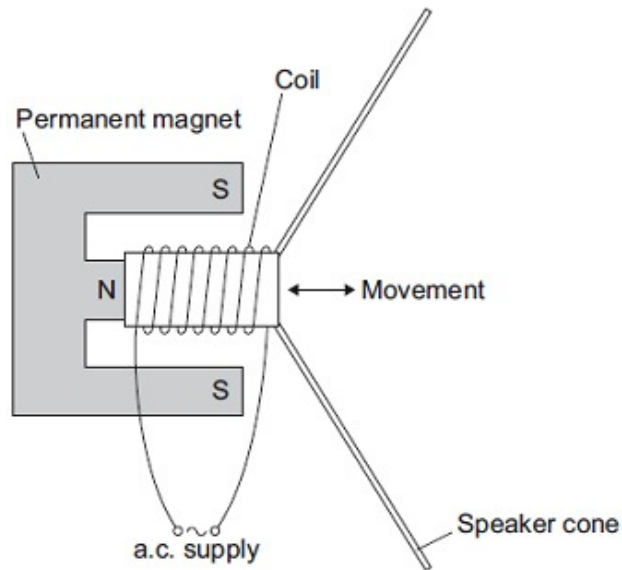
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(1)

(d) Musicians often use loudspeakers.

Figure 2 shows how a loudspeaker is constructed.

Figure 2



The loudspeaker cone vibrates when an alternating current flows through the coil.

Explain why.

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(4)
(Total 8 marks)



Q21. (a) **Figure 1** shows a sheet of card.

Figure 1



Describe how to find the centre of mass of this sheet of card.

You may draw diagrams as part of your answer.

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(5)



(b) **Figure 2** shows a person in his wheelchair.

Figure 2



AndreyPopov/iStock/Thinkstock

(i) Tipping the wheelchair at a large angle may cause it to become unstable and to topple over.

Explain why.

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(2)

(ii) Some disabled athletes use a wheelchair in sports.

State **two** ways of changing the design of the wheelchair in **Figure 2** so that it is more stable when used by a disabled athlete.

1

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2

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(2)
(Total 9 marks)