

Name of the Student: _____

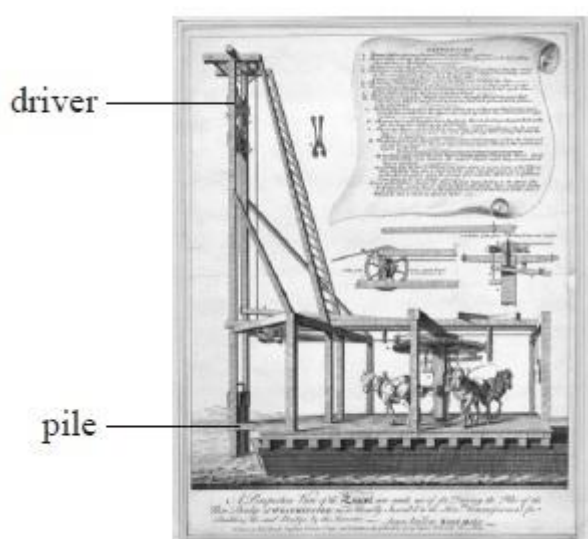
Max. Marks : 13 Marks

Time : 13 Minutes

Q1.

Pile drivers have been used for centuries to push piles into the ground for use as foundations of buildings and other structures. A large mass (the driver) is raised and then dropped onto an object (the pile) which is pushed into the ground.

The picture shows the pile driver that was used to build a London bridge in the 17th century.



(a) (i) The driver on the pile driver above had a mass of 810 kg and could be dropped a maximum distance of 6.0 m onto the pile.

Show that the energy transferred from the driver is about 50 kJ.

(2)

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(ii) In one instance, 40% of this energy is used usefully to drive in the pile. The pile moves 0.20 m into the ground.

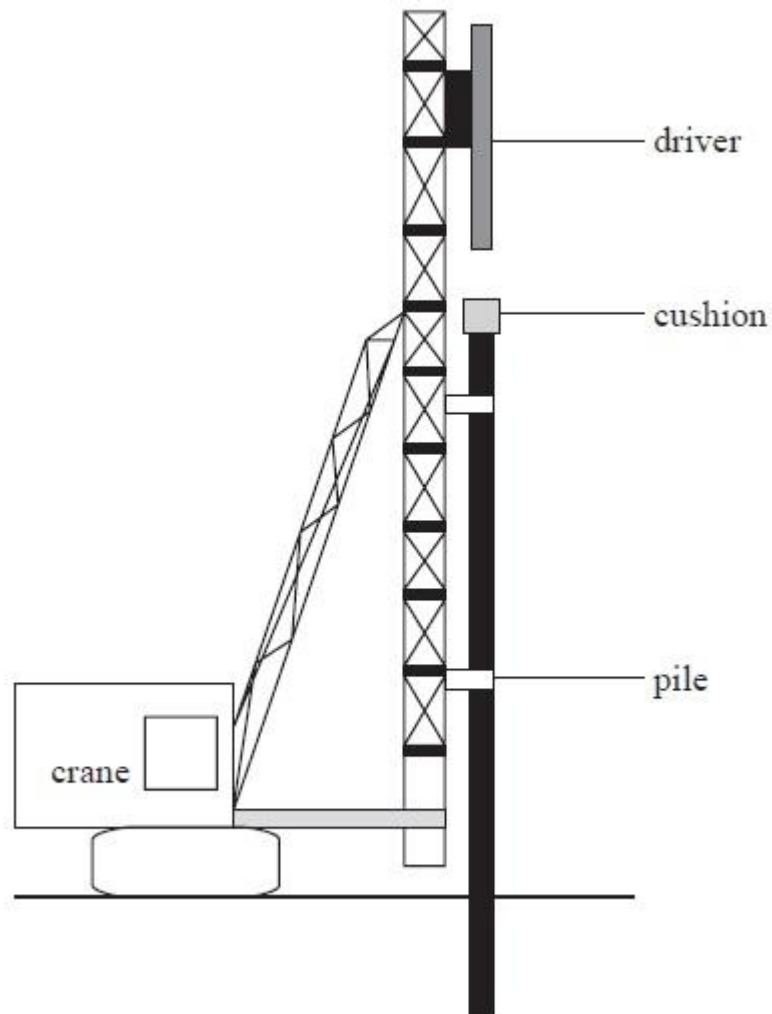
Determine the average resistive force acting on the pile as it moves through the ground.

(3)

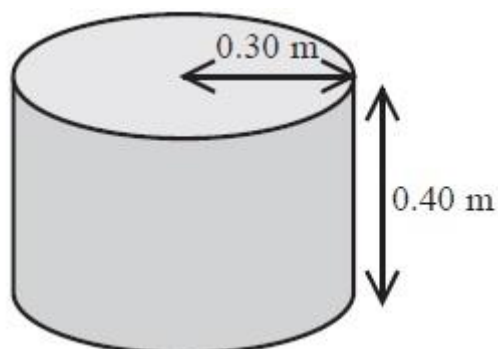
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Average resistive force = ...

(b) In order to protect the driver on modern pile drivers, a cushion made of wood is placed on the pile.



The cushion is a cylindrical piece of wood of Young modulus = 120 MPa



The cushion is compressed when hit by the driver.

(i) The maximum compressive force applied to the wood during impact is 7.0×10^5 N. Show that the compression of the cushion is about 0.01 m.

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(ii) Calculate the energy stored in the cushion under compression.

(2)

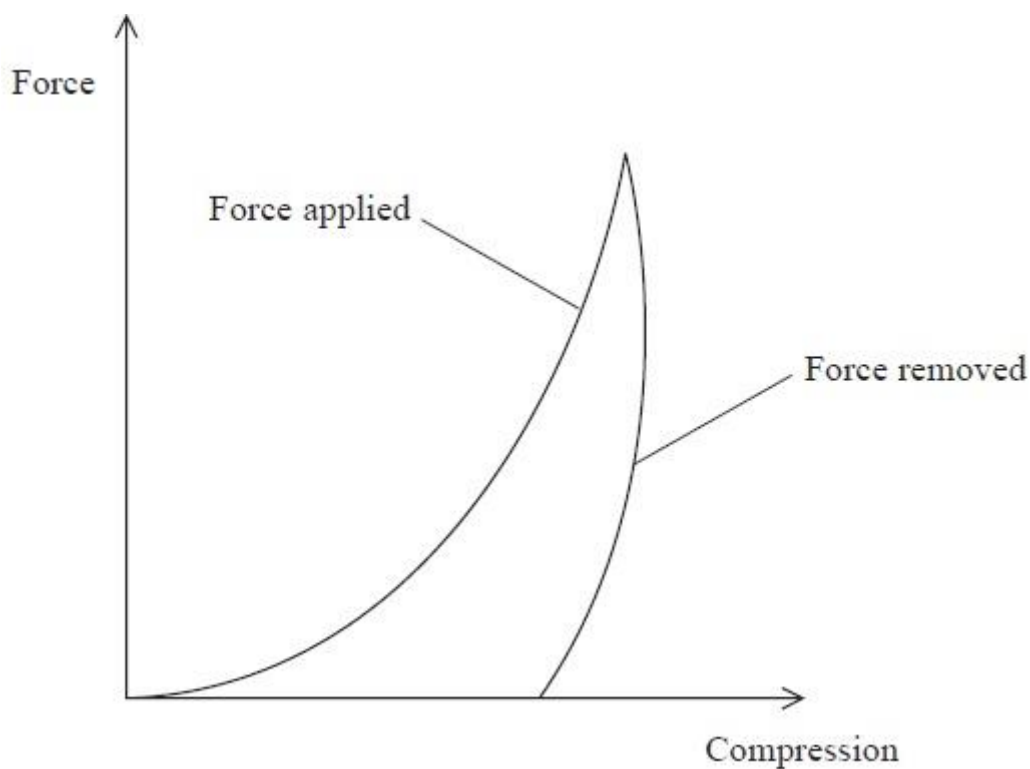
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Energy stored = ...

*(iii) The graph shows how the compression of the wooden cushion varies with force, as the force is applied and removed during an impact.



Use the graph to explain the following:

1. the wooden cushion has to be replaced after a few hundred impacts,

(2)

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2. with each impact the temperature of the wooden cushion rises slightly.

(1)

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(Total for Question = 13 marks)