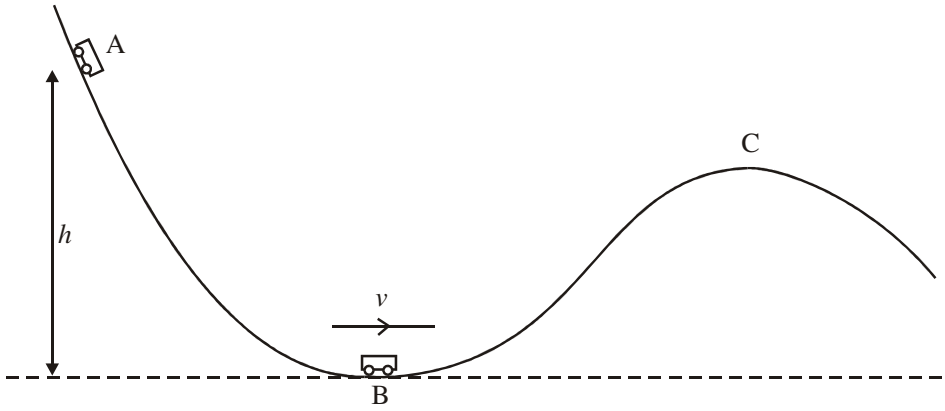
Date:

Name:

HFS HW Three

Total Marks 40

1. The diagram shows a small vehicle which is free to move in a vertical plane along a curved track.



The vehicle of mass *m* is released from rest from point A. It runs down to point B, a distance *h* vertically below A. Its speed at point B is *v*.

Write down expressions for

(i) the gravitational potential energy lost by the vehicle as it runs from A to B,

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(ii) the kinetic energy of the vehicle at B.

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(1)

Hence derive an expression for the speed *v*.

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(2)

State one assumption you have made in your derivation.

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(1)

Would you expect the vehicle to pass point C? Explain your answer.

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(2)

(Total 6 marks)

2. An athlete of mass 55 kg runs up a flight of stairs of vertical height 3.6 m in 1.8 s. Calculate the power that this athlete develops in raising his mass.

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Power = ...

(3)

One way of comparing athletes of different sizes is to compare their power-to-weight ratios. Find a unit for the power-to-weight ratio in terms of SI base units.

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(2)

Calculate the athlete's power-to-weight ratio.

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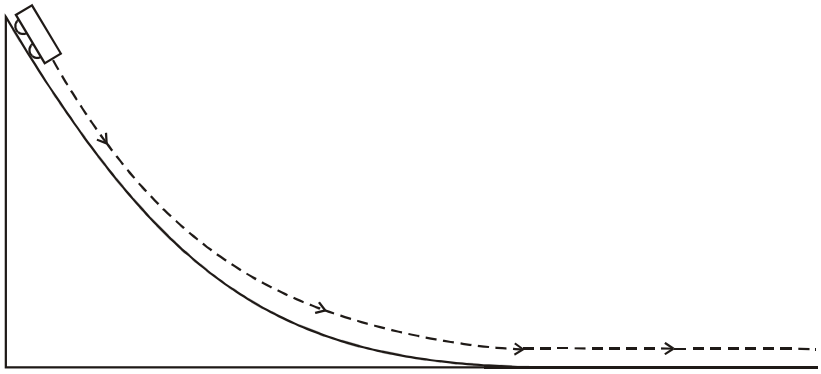
Power-to-weight ratio = ...

(2)

(Total 7 marks)

3. A Physics teacher is demonstrating conservation of energy. She sets up a curved runway and releases an initially stationary trolley from the top.



She tells the class that, as the trolley runs down the slope, its gravitational potential energy is converted into kinetic energy. Explain why this is only approximately true.

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(1)

Describe an experiment she could perform to find out what percentage of the gravitational potential energy lost is actually converted to kinetic energy. Your answer should include:

(i) any additional apparatus required (add this to the diagram opposite),

(ii) how the apparatus is used,

(iii) how the results are analysed.

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(6)

(Total 7 marks)

4. (a) A car of mass m is travelling in a straight line along a horizontal road at a speed u when the driver applies the brakes. They exert a constant force F on the car to bring the car to rest after a distance d.

(i) Write down expressions for the initial kinetic energy of the car and the work done by the brakes in bringing the car to rest.

Kinetic energy .....

Work done .....

(1)

(ii) Show that the base units for your expressions for kinetic energy and work done are the same.

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(2)

(b) A car is travelling at 13.4 m s^{-1}. The driver applies the brakes to decelerate the car at 6.5 m s^{-2}. Show that the car travels about 14 m before coming to rest.

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(3)

(c) On another occasion, the same car is travelling at twice the speed. The driver again applies the brakes and the car decelerates at 6.5 m s^{-2}. The car travels just over 55 m before coming to rest. Explain why the braking distance has more than doubled. You may be awarded a mark for the clarity of your answer.

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(4)

(Total 10 marks)

5. Twin engine aircraft use less fuel than those with four engines. Recent improvements in engine reliability mean that they are now considered safe for long commercial flights over water. An aircraft powered by two Rolls-Royce Trent engines demonstrated its endurance by flying nonstop round the world. During this flight it used 1.7×10^5 litres of aviation fuel.

Each litre of fuel releases 38 MJ when combined with oxygen in the air.

Calculate the total amount of energy released during the flight.

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Energy = …….....…….....

(2)

The flight lasted 47 hours. Calculate the average input power to the engines.

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Power = …….....…….....

(2)

The distance covered by the aircraft was 41000 km. Calculate the aircraft's average speed.

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Speed = ……...…….....

The *maximum* thrust of each engine is 700 kN. Multiply the total maximum thrust by the average speed and comment on your answer.

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(6)

(Total 10 marks)