PHYSICAL SCIENCES
Grade 12

MECHANICS REVISION

01 JULY 2014

Lesson Description

In this lesson we:

- Work through various examination questions relating to Mechanics.

Test Yourself

Question 1

The net force acting on an object is directly proportional to the …

A. mass of the object.
B. acceleration of the object.
C. change in momentum of the object
D. rate of change in momentum of the object.

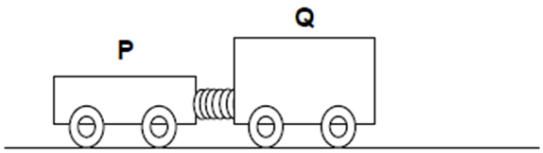
Question 2

A ball is thrown vertically upwards. Which ONE of the following physical quantities has a non-zero value at the instant the ball changes direction?

A. Acceleration
B. Kinetic energy
C. Momentum
D. Velocity

Question 3

Two trolleys, **P** and **Q** of mass *m* and *2m* respectively are at rest on frictionless horizontal surface. The trolleys have a compressed spring between them.



The spring is released and the trolleys move apart. Which ONE of the following statements is TRUE?

A. **P** and **Q** have equal kinetic energies
B. The speed of **P** is less than the speed of **Q**
C. The sum of the final kinetic energies of **P** and **Q** is zero
D. The sum of the final momentum of **P** and **Q** is zero

Question 4

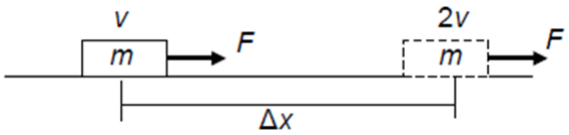
Two identical metal spheres, each of mass *m* and separated by a distance *r*, exert a gravitational force of magnitude *F* on each other. The distance between the spheres is now HALVED.

The magnitude of the force the spheres now exerts on each other is

A. ½ *F*
B. F
C. 2*F*
D. 4*F*

Question 5

An applied force *F* accelerates an object of mass *m* on a horizontal frictionless surface from a velocity *v* to a velocity *2v.*



The net work done on the object is equal to…

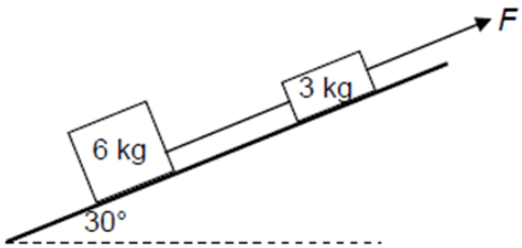
A. ½ mv^2
B. mv^2
C. $^3/_2mv^2$
D. $2mv^2$

Exam Questions

Question 1

(Adapted from DoE Exemplar Paper 1 – 2014)

A light inelastic string connects two objects of mass 6 kg and 3 kg respectively. They are pulled up an inclined plane that makes an angle of 30° with the horizontal, with a force of magnitude *F.* Ignore the mass of the string.



The coefficient of kinetic friction for the 3 kg object and the 6 kg object is 0,1 and 0,2 respectively.

1.1. State Newton's Second Law of Motion in words. (2)
1.2. How will the coefficient of kinetic friction be affect if the angle between the incline and the horizontal increases? Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)
1.3. Draw a labelled free-body diagram indicating all the forces acting on the 6 kg object as it moves up the inclined plane. (4)

1.4. Calculate the:

1.4.1. Tension in the string if the system accelerates up the inclined plane at 4 $m.s^{-2}$ (5)

1.4.2. Magnitude of *F* if the system moves up the inclined plane at CONSTANT VELOCITY (6)

1.4.3. How would the tension in the string, calculated in QUESTION 1.4.1, be affected if the system accelerates up a FRICITONLESS inclined plane at 4 $m.s^{-2}$? Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)

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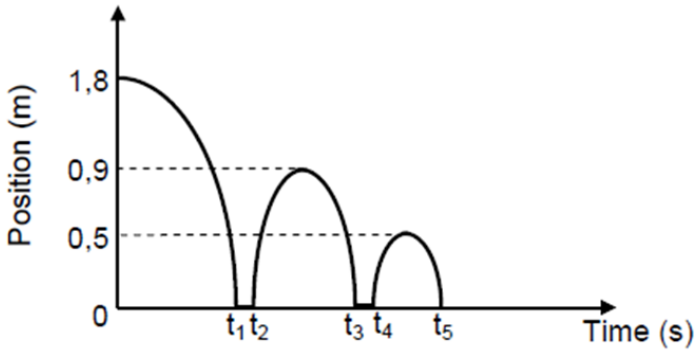
Question 2

(Adapted from DoE Exemplar Paper 1 – 2014)

A ball of mass 0,5 kg is projected vertically downwards towards the ground from a height of 1,8 m at a velocity of 2 $m.s^{-1}$. The position-time graph for the motion of the ball is shown below.



2.1. What is the maximum vertical height reached by the ball after the second bounce? (1)

Calculate the:

2.2. Magnitude of the time t_1, indicated on the graph. (5)

2.3. Velocity with which the ball rebounds from the ground during the first bounce. (4)

The ball is in contact with the ground for 0,2 s during the first bounce.

2.4. Calculate the magnitude of the force exerted by the ground on the ball during the first bounce if the ball strikes the ground at 6,27 $m.s^{-1}$. (4)

2.5. Draw a velocity-time graph for the motion of the ball from the time that it is projected to the time when it rebounds to a height of 0,9 m.

Clearly show the following on your graph:

- The time when the ball hits the ground
- The velocity of the ball when it hits the ground
- The velocity of the ball when it rebounds from the ground. (3)

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Question 3

(Adapted from DoE Exemplar Paper 1 – 2014)

Two boys, each of mass m, are standing at the back of a flatbed trolley of mass 4m. The trolley is at rest on a frictionless horizontal surface.

The boys jump off simultaneously at one end of the trolley with a horizontal velocity of 2 $m.s^{-1}$. The trolley moves in the opposite direction.

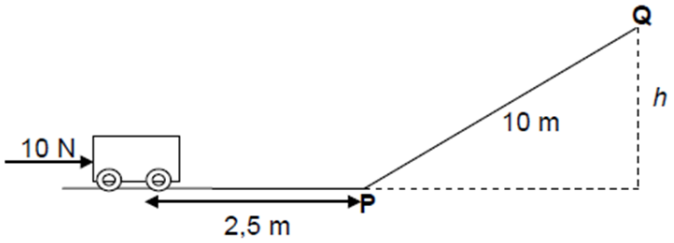
3.1. Write down the *principle of conservation of linear momentum* in words. (2)
3.2. Calculate the final velocity of the trolley. (5)
3.3. The two boys jump off the trolley one at a time. How will the velocity of the trolley compare to that calculated in QUESTION 3.2? Write down only GREATER THAN, SMALLER THAN or EQUAL TO. (1)

[8]

Question 4

(Adapted from DoE Exemplar Paper 1 – 2014)

A 3 kg trolley is at rest on a horizontal frictionless surface. A constant horizontal force of 10 N is applied to the trolley over a distance of 2,5 m.



When the force is removed at point **P**, the trolley moves a distance of 10 m up the incline until it reaches the maximum height at point **Q.** While the trolley moves up the incline, there is a constant frictional force of 2 N acting on it.

4.1. Write down the name of a non-conservative force acting on the trolley as it moves up the incline. (1)
4.2. Draw a labelled free-body diagram showing all the forces acting on the trolley as it moves along the horizontal surface. (3)
4.3. State the WORK-ENERGY THEOREM in words. (2)
4.4. Use the work-energy theorem to calculate the speed of the trolley when it reaches point **P.** (4)
4.5. Calculate the height, *h*, that the trolley reaches at point **Q.** (5)

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