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Faculty of sciences
Field : Sciences of matter (SM)
1st year LMD   Semester 01.

جامعة محمد بوضياف -المسيلـة
كليـة العلـوم
ميدان : علوم المادة
السنة الأولى ل م د - السداسي 01

Physics 01: Mechanics of point particle.　　　　**University Year 2023-2024**

Tutorial N° 05 Practice: Work and Energy

EXERCISE 01

The constant forces $\overrightarrow{F_1} = \vec{\imath} + 2\vec{\jmath} + 3\vec{k}$ N and $\overrightarrow{F_2} = \overrightarrow{4\imath} - 5\vec{\jmath} - 2\vec{k}$ N act together on a particle during a displacement from position $\overrightarrow{r_2} = 7\vec{k}$ cm to position $\overrightarrow{r_1} = 20\vec{\imath} + 15\vec{\jmath}$ cm.

- Determine the total work done on the particle.

EXERCISE 02

The potential energy of an object is given by $E_p(x) = 5x^2 - 4x^3$ where E_p is in joules and x is in metres.

a- What is the force, $\vec{F}(x)$, acting on the object?

b- Determine the positions where the object is in equilibrium and state whether they are stable or unstable.

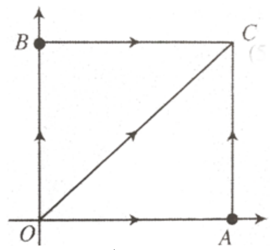
EXERCISE 03

A 40 kg box initially at rest is pushed 5 m along a rough horizontal floor with a constant applied horizontal force of 130 N. The coefficient of friction between the box and floor is 0.3. Find:

1- The work done by the applied force,
2- The energy lost due to friction,
3- The change in kinetic energy of the box,
4- The final velocity of the box.

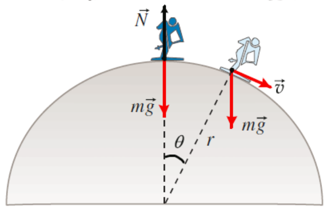
EXERCISE 04

A particle moves in x-y plane in figure under the influence of a friction force with magnitude 3 N. Calculate the work done by the friction force on particle as it moves along the following closed paths: (a) path OA and return path AO, (b) path OA followed by AC and the return path CO, (c) path OC followed by the return path CO (OA= OB= 5 m). What do you conclude?



EXERCISE 05

A skier of mass m starts sliding from rest at the top of a solid frictionless hemisphere of radius r. At what angle θ will the skier leave the sphere?



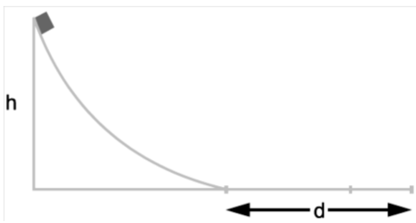
EXERCISE 06

A steel ball of mass m=5 g is projected vertically downward from a height h=14.8 m with an initial speed V_0 =10 m/s. The ball penetrates itself in sand to a depth d =20 cm. Neglect air resistance and take g to be 10 m/s^2.

1- Calculate the velocity of the ball when it reaches the surface of the sand?
2- What is the magnitude of the average force exerted by the sand on the ball?

EXERCISE 07

A ramp in an amusement park is frictionless. A smooth object slides down the ramp and comes down through a height $\boldsymbol{h}$, (Figure). What distance $\boldsymbol{d}$ is necessary to stop the object on the flat track if the coefficient of friction is $\boldsymbol{\mu}$.



EXERCISE 08

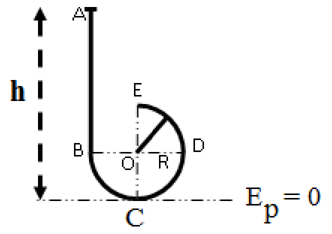
A ball of mass m is released from a height H without initial velocity. AB is a vertical surface and BCDE is a ¾ of a circle of radius R.

1- The ball moves without friction:

a- calculate the velocity of the ball at point B.

b- calculate the velocity of the ball at point C.

c- For what value of h does the ball reaches the point E with a velocity $\sqrt{2gR}$.



2- Assuming that the motion takes place with a constant tangential friction force F_f in the BCDE part only. What is the value of F_f if the ball just reaches point E (the velocity at point E is zero).

EXERCISE 09

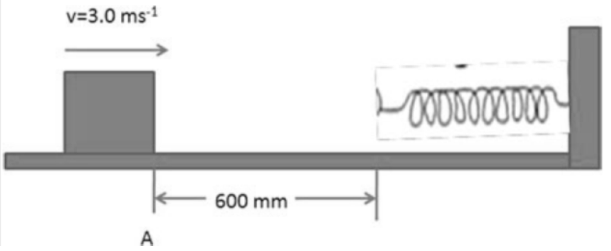
A spring is used to stop a crate of mass 50 kg which is sliding on a horizontal surface. The spring has a spring constant $k = 20\ kN/m$ and is initially in its equilibrium state. In position A shown in the top diagram the crate has a velocity of 3.0m/s. The compression of the spring when the crate is instantaneously at rest (position B in the bottom diagram) is 120 mm.

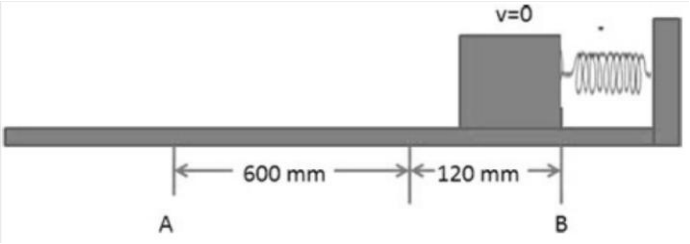
(a) What is the work done by the spring as the crate is brought to a stop?

(b) Write an expression for the work done by friction during the stopping of the crate (in terms of the coefficient of kinetic friction).

(c) Determine the coefficient of friction between the crate and the surface.

(d) What will be the velocity of the crate as it passes again through position A after rebounding off the spring ?





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