Physics Form 12

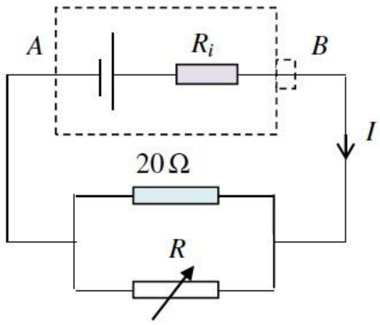
English

Use g = 9.82 m/s^2

Task 1. A 12-volt battery has an internal resistance R_i = 2 Ω and is connected to a circuit with a variable resistance *R* as shown in the figure.

a) Develop an expression for the power developed in the variable resistance, expressecd in terms of *R*, i.e. calculate *P(R).* (4 points)

b) Determine the value of *R* which gives the maximum power development in *R*.
(4 points)



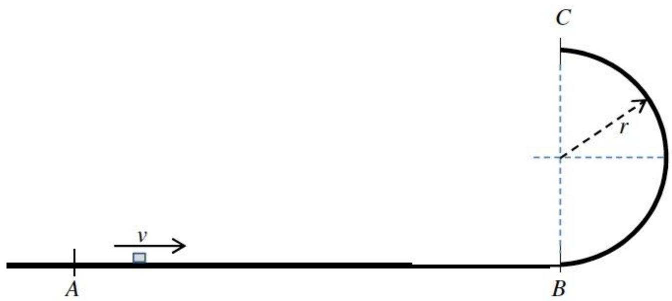
Task 2.
An ice-hockey puck moves without friction along an ice track from *A* to *C*, as shown in the figure. The ice track consists of a horizonal part from *A* to *B* and a semi-circular part with radius *r* from *B* to *C*. From the point *C*, the puck becomes a projectile and the puck lands at a point on the horizotal part of the rack. The movement takes place in the vertical plane and r = 0.5 m.

a) Show that the maximum normal force (the force which the track exerts on the puck) arises immediately after the puck has passed position *B* and begins to perform the circular part of its movement. (2 points)

b) Assume that the maximum normal force is *N* = 10 *mg*, where *m* is the mass of the puck, and calculate the magnitude of the puck's velocity at point *B*. (2 points)

c) Calculate the puck's v
elocity at the point *C* (2 points)

d) Calculate the distance from *B* of the point where the puck lands on the horizontal part of the track. (2 points)



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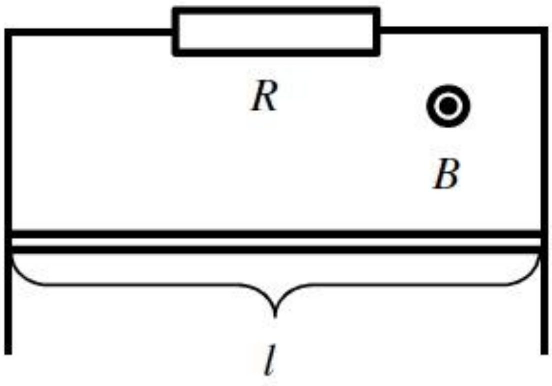
English

Task 3

A conductor of length *L* and mass *m* can slide down a pair of parallel vertical rails which are joined together with a resistor with resistance *R*, as shown in the figure. Neglect friction between the conductor and the rails and the resistance of the conductor. The circuit is placed in a horizontal magnetic field with strength *B* which is direct perpendicularly out of the plane. Express your answers in terms of the data given.

a) Determine the direction of flow of current in the circuit and the magnitude of the current in terms of the speed when the conductor falls straight down under the influence of gravity. (4 points)

b) What final speed can the conductor attain if the rails are sufficiently long? (4 points)



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English

Task 4 A harmonic oscillator consists of a weight *A* with mass 1.0 kg and two lightweight, identical linear springs. A small weight *B* with mass 0.2 kg is placed on top of A, as shown in Figure 1. The weight *A* is fitted so that it can move vertically without friction. Figure 2 shows the force *(kraft*) as a function of the elongation *(förlängning*) of one of the springs.

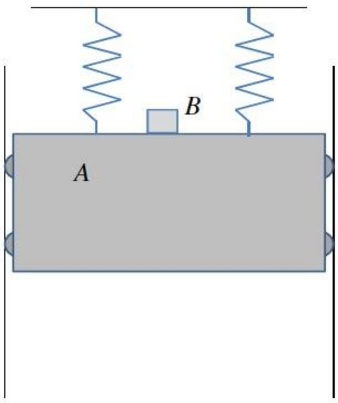
(a) How far are the springs elongated in the equilibrium position? (2 points)

Assume that a dynamometer (spring-balance) is attached with a string to *A* and that this is slowly pulled downwards until the dynamometer shows the force *F*, as indicated in Figure 3. In this position, the weight is held still for a moment and the string is then cut.

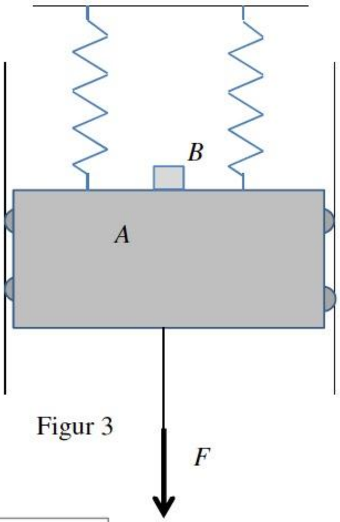
b) What is the amplitude of the resulting oscillation if the spring is cut when *F* = 5.0 N? (2 points)

c) Calculate the magnitude of the maximum acceleration during this movement ? (2 points)

d) Determine the largest permissible value of *F* if the requirement is that *B* shall remain in contact with *A* throughout the oscillation which follows after the string is cut (2 points)



Figur 1



Figur 3