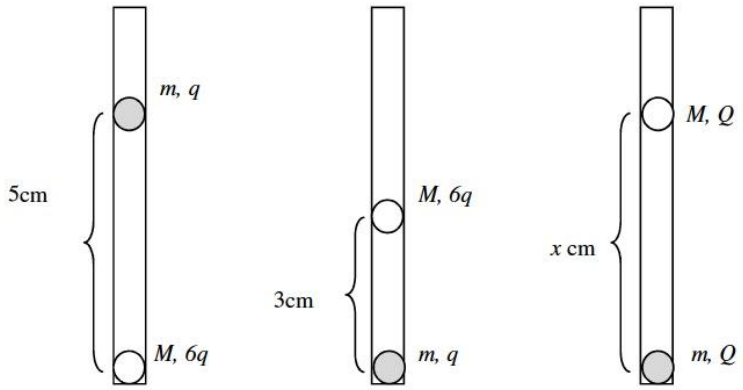
Physics Form 10

English

Use g = 9.82 m/s^2

Task 1. Two small lightweight balls with charges q_1 and q_2 are placed in a vertical glass tube. The balls have masses *m* and *M*. In the first case, the electrostatic repulsion keeps the balls in equilibrium at a distance of 5 cm. The tube is then turned upside down and the distance between the balls decreases to 3 cm. In the third case, the charges on the balls are equalised after they have been in electrical contact with each other. Neglect friction



case 1 case 2 case 3

(a) Determine the ratio between the masses *M/m* (3 points)

(b) Determine the distance *x* between the balls in case 3 (3 points)

Task 2. A juggler has 3 oranges to juggle with. The oranges are thrown into the air so that at their highest point each orange is 1.8 m above the juggler's hands. It takes 0.3 s to transfer an orange from one hand to the other, after which it is immediately thrown up again. Assume that the oranges travel more or less vertically and that they pass each other in the air without colliding.

(a) Calculate the speed of each ball immediately after it leaves the juggler's hand and moves straight upwards. (2 points)

(b) Calculate the time for an orange to reach its highest point. (2 points)

(c) Assume that the intervals between the oranges are the same. If one orange is at its highest position, where at the other two? (2 points)

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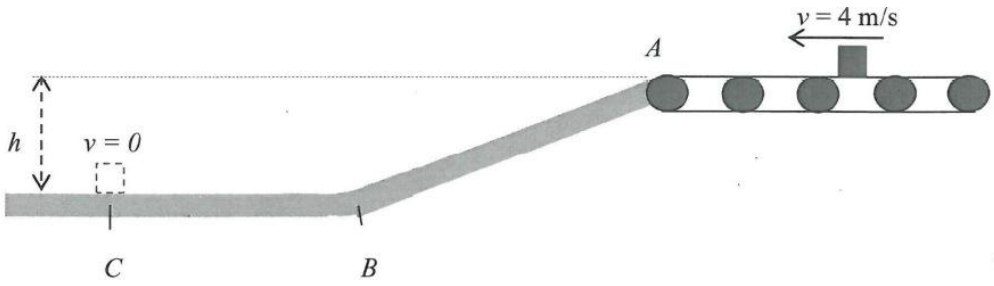
Task 3. A small box with mass m = 2kg is transported with a speed of v = 4 m/s on a conveyor belt. The box leaves the belt at point *A* and then slides at the same constant speed (4 m/s) down a smooth sloping ramp which at point *B* changes into a flat horizontal surface. The box stops at point *C* where it is taken care of by a waiting person. The box is influenced on its journey from *A* to *C* by friction and the frictional force is equal to *F* along *BC* and to $F\sqrt{3}/2$ along AB. *A* is at a height h = 0.8 m above *B* and the length of the ramp *AB* is 1.6 m.

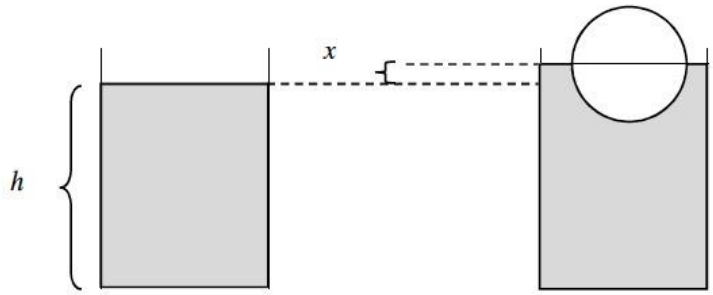


(a) The friction between the box and the base means that mechanical energy is converted to heat, so-called frictional heat. Calculate how much energy is converted to frictional heat during the passage from *A* to *B* (2 points)

(b) Determine the numerical value of *F* (2 points)

(c) How far from *B* is the point *C* where the box stops ? (2 points)

Task 4. A spherical ball with radius *R* is placed in a cylinder full of water with radius 1.5*R*. Half the sphere is below the surface of the water. The height of the water surface in the absence of the ball is *h* metres. When the ball is placed in the water, the surface rises *x* metres. The density of water is ρ_{water} = 1000 kg/m^3. The volume of the sphere is $4\pi R^3/3$. Give the answers in terms of *R*.



(a) Calculate the increase in height x of the water in the cylinder when the ball is introduced (2 points)

(b) Calculate the increase in pressure on the base of the cylinder when the ball is introduced (2 points)

(c) Calculate the minimum height h of water which is necessary so that the sphere does not touch the bottom (2 points)