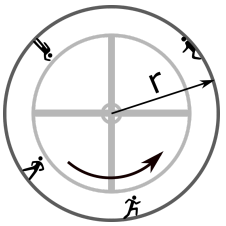
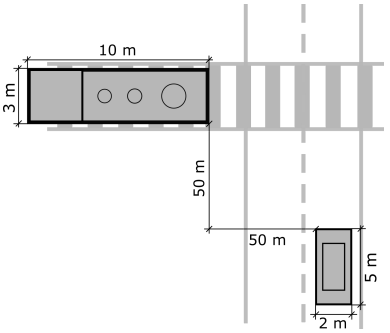
1. kolokvij iz fizike - 29. 11. 2017

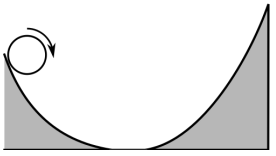
1.) Vesoljska postaja v obliki obroča ustvarja občutek težnosti, tako da se vrti okrog svoje osi. S kolikšno kotno hitrostjo se mora vrteti postaja s polmerom r = 30 m, da astronavti na obodu obroča čutijo pospešek enak 9,81 m/s^2? Kolikšen je najmanjši polmer postaje, da se pospeška stopal in vrha glave astronavta razlikujeta za manj od 10 %? Astronavt je visok 180 cm.



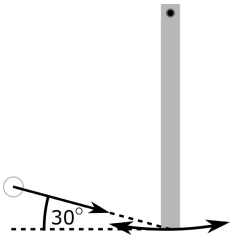
2.) Avto in vlak se približujeta cestnemu prehodu čez železniško progo s hitrostjo 45 km/h. S kolikšnim pospeškom mora pospešiti voznik avta, da bo tire prečkal pred vlakom in se izognil trku? Vse razdalje so označene na skici. Kaj pa če voznik vlaka opazi avto in začne zavirati s pojemkom 1 m/s^2?



3.) Poln valj zakotalimo z začetno hitrostjo težišča 18 km/h po leseni klančini z višine 1 m. Kako visoko se lahko valj dvigne na nasproti ležeči klančini, če se valj ves čas kotali? Kako visoko pa se lahko dvigne, če nasproti ležečo klančino premažemo z oljem, tako da je na njej koeficient trenja zanemarljiv?

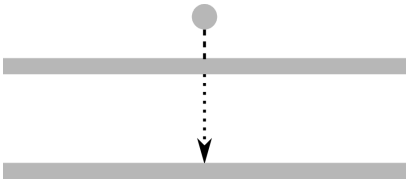


4.) Palica z maso 2 kg in dolžino 1 m je vrtljivo obešena za zgornji konec. V spodnji konec palice pod kotom 30° glede na vodoravnico prileti 0,5 kg težka kepa snega, ki se sprime s palico. S kolikšno kotno hitrostjo se giblje palica tik po trku, če je bila hitrost kepe pred trkom enaka 2 m/s? Izračunaj še, s kolikšnim nihajnim časom zaniha palica po trku, če privzameš, da je kepa majhna (vendar ne lahka!)



5.) Na palici z dolžino 0,5 m je enakomerno razporejen naboj 10^{-8} As. Na simetrali palice se na oddaljenosti 20 cm nahaja kroglica z nabojem -10^{-6}As. Nato palico premaknemo vzdolž simetrale za 30 cm. Koliko dela smo pri tem opravili?

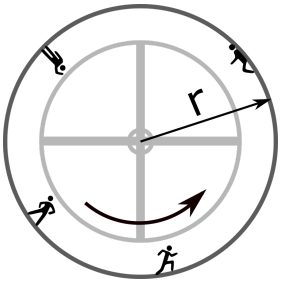
$\varepsilon_0 = 8{,}85\ 10^{-12}$ As/Vm.



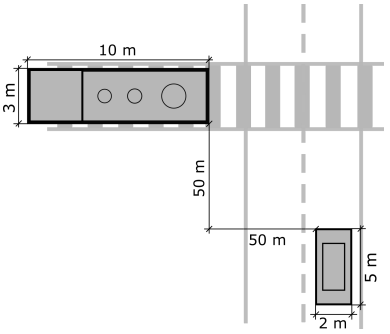
V pomoč: $\int \frac{dx}{\sqrt{a^2+x^2}} = ln\,(x + \sqrt{a^2 + x^2})$.

1st colloquium in physics, 29/11/2017

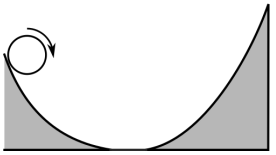
1.) A space station in the shape of a ring creates the illusion of gravity for its occupants by spinning around its axis. What is the angular velocity of the rotation of the space station with a radius of r = 30 m if the astronauts feel an acceleration of 9.81 m/s^2? What is the minimum radius of the space station if the difference between the acceleration at the legs of the astronaut and at the top of his head cannot exceed 10%? The height of the astronaut is 180 cm.



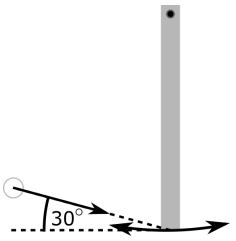
2.) A car and a train are approaching a railway crossing with the velocity of 45 km/h. Calculate the required acceleration of the car for the car crossing the rails in front of the train and thus avoid crashing? All the distances are marked on the picture. How does the result change if the train start deccelerating at a rate of 1 m/s^2?



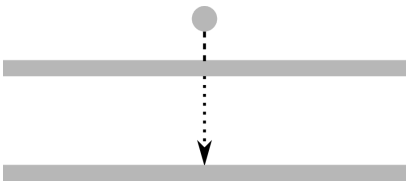
3.) A cylinder is rolled off a wooden ramp from a height of 1 m with an initial speed of 18 km/h. What height does the cylinder reach on the opposite up-hill slope if the cylinder is rolling? How does the maximum height change if the up-hill ramp is sprayed with oil so that the cylinder slides on the opposite ramp without friction?



4.) A thin rod with mass of 2 kg and length of 1 m is pivoted about a horizontal axis at one end. The lower end of the rod is struck by a 0.5 kg snowball travelling at an angle of 30^o with respect to the horizontal. What is the angular velocity of the rod immediately after the impact if the initial snowball velocity was 2 m/s and the snowball remains attached to the rod? Calculate also the period of rod's motion after the impact, assuming that the snowball is small (but not light!).



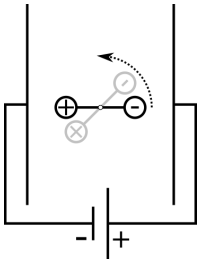
5.) Electric charge of 10^{-8} As is distributed uniformly on a thin rod of length 0.5 m. A small sphere with a charge of -10^{-6} As is placed along the perpendicular bisector of the rod at a distance of 20 cm. How much work is done by moving the rod for 30 cm along the bisector?
$\varepsilon_0 = 8.85\ 10^{-12}$ As/Vm.



Hint: $\int \frac{dx}{\sqrt{a^2+x^2}} = ln\,(x + \sqrt{a^2 + x^2})$.

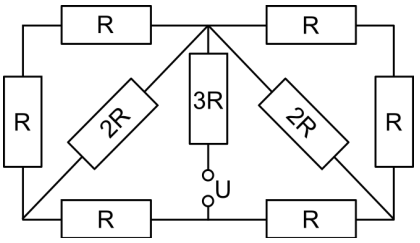
2. kolokvij iz fizike - 19. 01. 2018

1.) Paličico dolžine 10 μm, ki ima na koncih pritrjena nasprotno enaka naboja $e = \pm 10^{-12}$ C, vstavimo med dve vzporedni prevodni plošči, kot to prikazuje skica. Na plošči priključimo napetost 100 V, razdalja med ploščama je 2 mm, površina plošč pa 1 cm^2. Kolikšen naboj se nabere na ploščah? Koliko dela moramo opraviti, če paličico zavrtimo za kot 90^o glede na njeno ravnovesno lego?



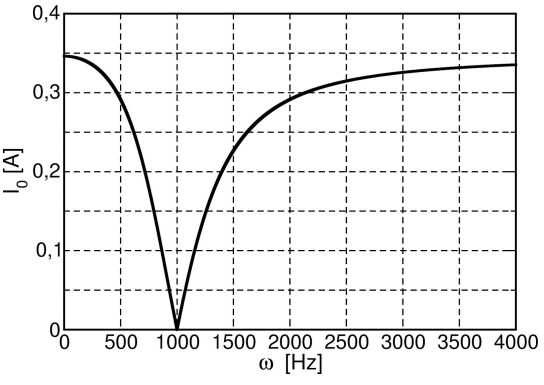
$\varepsilon_0 = 8{,}85\ 10^{-12}$ As/Vm.

2.) Iz upornikov sestavimo vezje (glej sliko) in nanj priključimo napetost U = 12 V. Izračunaj tok skozi upornik z upornostjo 3R, če je R = 10 Ω. Kolikšna moč se troši na tem uporniku?

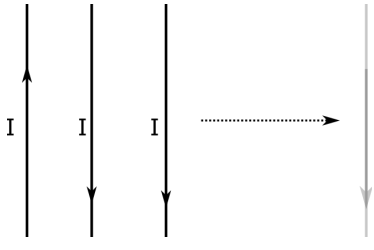


3.) Iz bakrene žice s presekom 1 mm^2 in specifičnim uporom 0,017 Ωmm^2/m naredimo okroglo zanko s polmerom 20 cm. Zanko postavimo med dva elektromagneta, ki ustvarjata homogeno magnetno polje z gostoto 0,4 T v smeri pravokotno na zanko. V trenutku odklopimo napajanje magnetov, zaradi česar se magnetno polje zmanjša kot $B(t) = B_0 e^{-t/\tau}$, kjer je τ = 5 s. Kolikšen tok teče po vodniku 10 sekund po tem, ko smo odklopili napajanje?

4.) Kondenzator s kapaciteto C in tuljavo z induktivnostjo L vežemo vzporedno, nato pa ju zaporedno preko upornika z upornostjo R priključimo na izmenično napetost z amplitudo 18 V. Z zaporedno vezanim ampermetrom z upornostjo (R_n = 2 Ω) merimo amplitudo toka skozi upornik v odvisnosti od frekvence izmenične napetosti. Izmerjena odvisnost je prikazana na sliki. Določi vrednosti parametrov R, L in C.

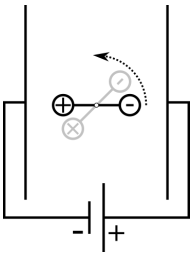


5.) Trije dolgi vzporedni ravni vodniki ležijo v isti ravnini na oddaljenosti 1 cm drug od drugega. Po vseh treh teče enosmerni tok 1 A v različnih smereh, kot je prikazano na skici. Koliko dela na dolžinsko enoto žice opravimo, da premaknemo tretji vodnik za 10 cm iz začetne lege stran od ostalih dveh vodnikov, kot kaže skica?

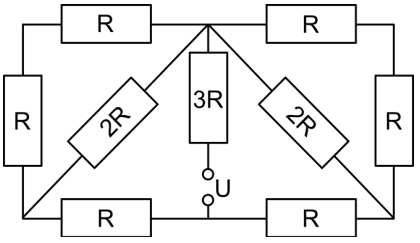


2nd colloquium in physics, 19/01/2018

1.) A positive and a negative charge (e = ± 10^{-12} C) are attached to both ends of a rod and placed between two parallel conducting plates, as shown in figure. Rod length is 10 μm, distance between the two plates is 2 mm, plate surface is 1 cm^2, voltage applied to the plates is 100 V. What is the total charge that is collected on both plates? How much work is done if we rotate the rod by 90 degrees from its initial equilibrium position? ε_0 = 8,85 10^{-12} As/Vm.

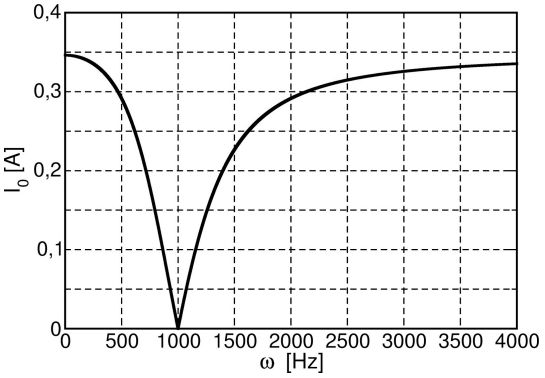


2.) Resistors are connected as shown in Figure. Find the current through the 3R resistor if the applied voltage is U = 12 V and R = 10 Ω. Calculate the power consumed on this (3R) resistor.



3.) A copper wire with a crosssection of 1 mm^2 and specific resistance of 0,017 Ωmm^2/m is used to make a circular loop with a radius of 20 cm. The loop is placed between two electromagnets in a homogenous magnetic field with density of 0,4 T, which is perpendicular to the loop. At one moment the magnets are switched off and the magnetic field drops as $B(t) = B_0 e^{-t/\tau}$, where τ = 5 s. Calculate the electrical current in the loop 10 seconds after we turned off the magnets.

4.) A capacitor (C) is connected in parallel to a coil (L). They are further connected in series to a resistor (R), an alternating voltage source with the amplitude of 18 V, and an ammeter with resistance of R_n = 2 Ω.
The amplitude of the current through the resistor as a function of voltage frequency is shown in figure. Determine the values R, L and C.



5.) Three long parallel wires lie in the same plane at a distance of 1 cm from one another. A direct current of 1 A runs through all three wires in different directions, as shown in the sketch. How much work is done per unit length of wire, if we move the third wire by 10 cm from the starting position away from the other two wires, as shown in the sketch?