**3-1. avtosarke (4 qula)**

avtomobilebis ukana xedvis sarkeebi Cveulebriv amozneqilia. davuSvaT A avtomobili moZraobs 40.0 km/sT siCqariT swor horizontalur gzaze. mas ukan miyveba 60.0 km/sT siCqariT moZravi B avtomobili. drois mocemuli momentisaTvis SemoviRoT aRniSvnebi:

x \_ B avtomobilis daSoreba A avtomobilis sarkisagan;

y \_ B avtomobilis daSoreba A avtomobilisagan, rogorc amas xedavs A avtomobilis mZRoli sarkeSi;

vx \_ B avtomobilis A-sTan miaxloebis siCqare;

vy \_ B avtomobilis A-sTan miaxloebis siCqare, rogorc amas xedavs A avtomobilis mZRoli sarkeSi.

a) gamosaxeT vy siCqare x, vx sidideebiT da ukana xedvis amozneqili sarkis simrudis R radiusiT.

b) daxazeT vy/ vx sididis x–ze damokidebulebis Tvisebrivi grafiki.

g) gamoTvaleT vy, Tu R=2.0 m da x=2.0 m.

**amoxsna:**

a) amozneqili sarkis formulis Tanaxmad (gavixsenoT, rom masSi gamopsaxuleba warmosaxviTia) gvaqvs

droiT gawarmoeba gvaZlevs

imis gaTvaliswinebiT, rom x da y orive mcirdeba, gvaqvs

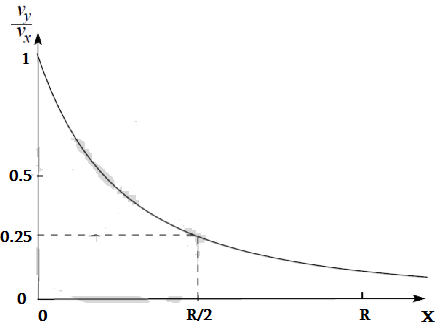
da

zedaSi Casma gvaZlevs

Tu zeda formulaSi SevitanT sarkis formulidan gansazRvrul y–s, miviRebT

b) roca x=0, maSin ; funqcia klebadia;

roca x→∞, maSin . grafiks Semdegi saxe eqneba:



g) vx=60km/sT\_40km/sT=20 km/sT.

**2. samkuTxa konstruqcia (5 qula)**

mcire zomis sami sxeuli erTmaneTTan SeerTebulia wvrili msubuqi ReroebiT da qmnis ABC samkuTxa konstruqcias. TiToeuli sxeulis masaa m, xolo TiToeuli Reros sigrZea L. es samkuTxedi misrialebs gluv horizontalur zedapirze. drois garkveul momentSi A wertilis siCqare mimarTulia AB–s gaswvriv da v–s tolia, xolo B wertilis siCqare igive momentSi mimarTulia BC–s gaswvriv. gansazRvreT C wertilis siCqaris moduli drois igive momentSi da Reroebis daWimulobis Zalebis modulebi.

**amoxsna:**

AB Reros sigrZis ucvlelobis gamo A da B wertilebis siCqareebis gegmilebi AB-ze erTmaneTis tolia: vBcos60°=v ⇒ vB=2v

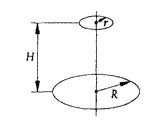
A wertilis siCqariT gadataniTad moZrav aTvlis sistemaSi drois mocemul momentSi ABC sistema brunavs A wertilis garSemo. B wertilisaTvis am brunvis siCqarea vB siCqaris gegmili AB-s marTob wrfeze anu vBsin60°=v . aseTive siCqare eqneba C wertils, oRond is mimarTuli iqneba AC–s marTobulad. zedapirTan dakavSirebul aTvlis sistemaSi C wertilis siCqares vipoviT siCqareTa SekrebiT. Sesakreb siCqareebs Soris kuTxea 30°, amitom

radganac zedapiri gluvi da horizontaluria, amitom ABC sistemis masaTa centris siCqare da brunvis kuTxuri siCqare ar icvleba . amasTan ABC sistemis nebismier wertilTan dakavSirebul gadataniTadD moZrav aTvlis sistemaSi brunvis kuTxuri siCqare erTnairia. mas vipoviT, magaliTad, A wertilis garSemo B-s brunvis ganxilviT:

masaTa centrTan dakavSirebuli gadataniTad moZravi aTvlis sistema inerciulia. mis mimarT ABC sistemis brunvis ganxilviT vipoviT Reroebis daWimulobis Zalebs, romlebic erTmaneTis tolia:

saidanac

**3. ori rgoli (6 qula)**

wvrili mavTulisagan damzadebuli ori rgoli moTavsebulia erTmaneTisagan H manZilze ise, rom maT aqvT saerTo simetriis RerZi (ix. nax.). rgolebis radiusebia R da r, amasTan R>>r. rgolebSi denis Zalebia Sesabamisad I1 da I2.

a) daasabuTeT, rom R radiusis rgolis RerZze centridan H manZilze magnituri velis induqcia ganisazRvreba formuliT:

, sadac I rgolSi denis Zalaa, xolo μ0 magnituri mudmivaa.

**karnaxi.** bio-savaris kanonis Tanaxmad, mcire Δℓ sigrZis deniani elementis mier Seqmnili magnituri velis induqciis moduli elementisadmi α kuTxiT r manZilze moicema formuliT:

b) gansazRvreT rgolebis urTierTqmedebis Zalis moduli.

**amoxsna:**

a) simetriis gamo, saZebni induqcia mimarTulia RerZis gaswvriv, amitom dagvWirdeba mcire elementebis mier Seqmnili induqciis veqtorebis dagegmileba RerZze da maTi Sekreba.

α

R

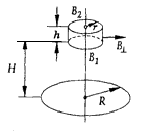
H

Δℓ

ΔB

rgolis mcire Δℓ sigrZis elementis mier Seqmnili magnituri velis induqcia bio-savaris kanonis Tanaxmad iqneba

misi mimarTuleba miTiTebulia naxatze.

b) patara rgolis wertilebSi didi rgolis mier Seqmnil magnitur vels aqvs RerZis gaswvrivi da RerZis marTobuli mdgenelebi. rgolze moqmed Zalas gansazRvravs es ukanaskneli. mis sapovnelad ganvixiloT mcire cilindri, romlis radiusi emTxveva mcire rgolis radiuss, xolo h simaRle gacilebiT naklebia H–ze (ix. nax.). am cilindris gverdiT zedapirSi magnituri nakadi toli ineba fuZeebSi nakadebis sxvaobis.

gverdiT zedapirSi nakadis povnisas ar gaviTvaliswinebT RerZis marTobuli mdgenelis cvlilebas. aseve fuZeebSi nakadis povnisas TiToeuli fuZis wertlebSi magnituri induqciis RerZis gaswvriv mdgenels ar ganvasxvavebT centrSi mniSvnelobisagan.

2πrhB⊥=πr2(B1\_B2)

B2\_B1=(dB/dH)h ⇒

**4. ciklebis mqk (10 qula)**

am amocanaSi Tqven ganixilavT ramdenime cikls, romelTa muSa sxeuli erTatomiani idealuri airis erTi molia. yvela maTgani moTavsebulia erTsa da imave temperaturul intervalSi: T0 minimaluri temperaturidan T1 maqsimalur temperaturamde. sxva sityvebiT rom vTqvaT, (P, V) diagramaze yvela gansaxilveli cikli moTavsebulia or izoTermas Soris zolSi. yuradReba miaqcieT, rom RerZebze gdazomilia fardobiTi sidideeebi (P/P0, V/V0), sadac (P0, V0) airis parametrebia romeliRac mdgomareobaSi. yvela procesi wonasworulad iTvleba.

Tqven mogiwevT ciklebis mqk-is daTvla da maTi β=T1/T0 temperaturaTa fardobaze damokidebulebis analizi.

**karnaxi.** idealuri airisaTvis adiabatis gantolebaa , sadac γ adiabatis maCvenebelia. is tolia mudmivi wnevis pirobebSi airis moluri (kuTri) siTbotevadobisa Sefardebisa mudmivi moculobis pirobebSi molur (kuTr) siTbotevadobasTan. erTatomiani airisaTvis moluri siTbotevadobebia da .

grafikebis asagebad geZlevaT calke furceli.

**1. kvadratuli cikli.**

moyvanil diagramaze cikls kvadratis saxe aqvs. (P0, V0) mdgomareobas gamosaxavs wertili 1. cikli ori izobarisa da ori izoqorisagan Sedgeba.

gamoTvaleT am ciklis mqk. gamoTvaleT am ciklis mqk-is zRvruli mniSvneloba, roca β→∞.



**2. samkuTxa cikli.**

moyvanil diagramaze cikls marTkuTxa samkuTxedis saxe aqvs. (P0, V0) mdgomareobas gamosaxavs wertili 1.

gamoTvaleT am ciklis mqk. gamoTvaleT am ciklis mqk-is zRvruli mniSvneloba, roca β→∞.

**3. mrudwirul-samkuTxa cikli.**

cikli Sedgeba 1-2 izoqorisgan, 2-3 adiabatisgan da 3-1 izobarisgan. (P0, V0) mdgomareobas gamosaxavs wertili 1.

3.1. gamoTvaleT am ciklis mqk. gamoTvaleT am ciklis mqk-is zRvruli mniSvneloba, roca β→∞.

3.2. aageT grafikebis furcelze am ciklis mqk-is 1/β sidideze damokidebulebis grafiki (es ufro mosaxerxebelia, vidre β–ze damokidebulebis grafiki, vinaidan β icvleba 1-dan usasrulobamde, xolo 1/β \_ erTidan nulamde).

**4. karnos cikli.**

aageT grafikebis furcelze karnos ciklis mqk-is 1/β sidideze damokidebulebis grafiki.

**amoxsna:**

**1. kvadratuli cikli.**

radganac cikli kvadratulia, amitom P3/P0=V3/V0. amasTan P3 V3/P0V0=T1/T0=β . aqedan gamomdinareobs, rom da . advili dasanaxia, rom meore da meoTxe mdgomareobebSi temperaturaa . airi siTbos iRebs 1\_2 da 2\_3 ubnebze:

ciklis dros Sesrulebuli muSaobaa

margi qmedebis koeficientia

roca β→∞, maSin η→0.4

**2. samkuTxa cikli.**

advili dasanaxia, rom aq da

airi siTbos iRebs 1\_2 ubanze, romelsac vipoviT Termodinamikis I kanonis gamoyenebiT:

roca β→∞, maSin η→0.25

**3. mrudwirul-samkuTxa cikli.**

airi siTbos iRebs 1\_2 izoqoruli procesis dros.

aq muSaobis gamoTvlis nacvlad mosaxerxebelia Q2 gacemuli siTbos raodenobis gamoTvla. siTbos gacema xdeba 3\_1 izobaruli procesis dros. dagvWirdeba T3 temperaturis gansazRvra. 1\_2 izoqoruli procesis dros temperatura β-jer gaizarda, amitom P2=βP0 . gamoviyenoT adiabatis gantoleba (P, T) cvladebSi 2\_3 procesisaTvis:

V=RT/P ⇒ (1\_γ)/γ= \_2/5

⇒

mqk-Tvis miiReba

roca β→∞, maSin η→1

grafikis asagebad mosaxerxebelia mqk-s gamosaxulebas mivceT Semdegi saxe:

am damokidebulebis grafiki moyvanilia grafikis furcelze (mrudi 3).

**4. karnos cikli.**

karnos ciklis mqk-s formulaa . Sesabamisi grafikia wrfe. is moyvanilia grafikis furcelze (mrudi 4).

