N_^gZvgh_ jhkmjKl\ggh_k^lgh_hgZhZ_evgh_ mjq^gb_
\ukr_ jhhgZhZby
©Khe_gkdbcjhkmjKl\ggucmgb\jkbl_l [a]

HOgZ_fZbqkdhjhgZZbaZ

Kl_gZ[a]
Ijhj_dl hjhmqgh -
f_lhbqkdhc gZl_
_____ X:Mklbf_gdh
©23[a] bxgy 2022]

gZ_gb_ihjhlhdb **01.03.02**
gZ_gghklvi jhnb ev):
Nhfjgl mqgby ± hgZ
Dlk ± 2
K_f_klj ± 4
k_jh agZguo_bgbp ± 3gh\ ± 108

Nhfjglqlghklb agZ ± k_f_klj

Ijhjfmjgl b:
hdlhj nbabdh-fZ_fbqkdbogZmd ijhn_kkhj kmeh\
kljbcij_ihZ_ev LgZ

HjggZk_gbbdZ_jh
© [a] bxgy jhlhdhe‹ 10

Z\^mxsbcdZ_jhcBBBBBBBBBBBB kmeh\

Khe_gkd
2022

1.

2.

-9.	
-1.	
-3.	

3

1. **.** Ihgjbyfh^eb eKkbnbdZbyfh^e_c
kghgu_ wlZu fZ_fZbqkdhjh fh^ebjhZby eKkbnbdZby wdhghfbdh -
fZ_fZbq _kdbofh^e_ckhpbeZvgh -wdhghfbqkdbo ijhp_kkh\ .

2.

3. -
Nmgdpbb \wdhghfbd_ b khpbhehjbb Nmgdpbb kijhkZb ijeh`gbyNmgdpbb
Lhjgdbklijeu \khpbeZvgh -wdhghfbqkdhc kn_j_ Gijju\gh_ gqke_gb_
ijhp_glh\IZmlbghhjgyfh^ev jgdZ Ifu_ b ihegu_ ajZ lu \fh^eb
E_hglv_Z

4. -

Kmlghr_gbyf_mkj_gbfbbij_^evgufb
\ebq gZb Ihgjb_h[wekZlbqghklbnmgdpbbWekZlbqghklvkijhkZij_eh`gby
Fh^ebmijZ_gbywKZb

5.

6. -

Ij_^evgu_ihdaZZ_eb wdhghfbdb ZilbfbajZbb ijhbahkl\gguo
ba^jd Nmgdpbyihe_aghklb s^u nmgdpbc ihe_agh klb jDu_ [ajZebqy
Z ihlj_bl_evkdhjh \uhjZ ;x^lgh_ fgh`klh Ghdekkbqkdy Z
ijhbahkl\ggyZmgdpby

7. -

b Kehm . Fh^ev
wdhghfbqkdhjhpbdeKmwevkhgZ -ObdkZ.

4

‹ i	fi	k qZk			
			E dp		y
1.	b	2	2	0	±
2.	Z b _	18	2	6	10
3.	\ -	16	2	4	10
4.	\ -	22	2	10	10

5.		14	2	2	10
6.	-	22	4	8	10
7.	-	14	2	2	10
		108	16	32	60

5

:

1. [illegible]
   -fZ_fZbqkdbo fh^e_c khpbZvgh -
   wdhghfbqk dboihp_kkh\
2. [illegible] . F^ev f_mgZ^ghc lhjeb ;ZgkhU_ fh^eb \ gZba_
   wdhghfbqkdboihdZZ_e_c
3. [illegible] -wdhghfbqkdbo ihp_kkh\ .
   Nmgdpbb kihkZ ij_eh`_gbyZh_kgZp_gZZmlbghhZg ZhZ^ev igdZ
   Nmgdpbbhohha^j_dbihp_ebNmgdpbbLhigdbklZNmgdpbbZij_^e_gby
   hohh\
4. [illegible]
   . kckhZweZlbgh klb
   =hf_lpqkdbc kfuke weZlbghklb nmgdpbb WeZlbghklv kihkZ ij_eh`_gby
   Khlghr_gby f_m kj_gbfb b ij_^evgufb \ebqgZb \ wdhghfbd_ . H
   hdZZ_evklZ g_dhlhjo wdhghfbqkdbo aZhgh\ k ihfhsvx f_lhh\
   bnn_j gpbZvghlhbkqke_gbyNmgdpbbih lj_e_gbyk[j`_gby
5. [illegible]
   .
6. [illegible]
   .
7. [illegible]
8. [illegible] -
   wdhghfbqkdboihp_kkh\ .

- :

[illegible] www.cdo.smolgu.ru). Z
agZbvj_rZlkyZqkbkihevahZb_fK PTC Mathcad 15.0 beb MS Excel.

-2.

1. <[illegible]
2. [illegible] j

3. [illegible]
4. [illegible]
   wdhghfbqkdbckfukewlbodhwnnbpb_glh\'
5. [illegible]
   ibf_jmZb_mkehbijh^mdlbghklbfZppu : Zba_klgu"
6. [illegible]

AZbeyZ\blhjghc bkZnklhy_evghc ZlZu

1. Z
   - b
   - b ± ijh^mdpbx -lhbZ

   Zlv \uimkdZfhc ijh^mdpbb b^l gZgmlj gg__ ihlj e_gb_ h klZvgyZlv
   \yylkydhg_guf ijh^mdlhf Lj [m_lky\ybv Zij ^e_gb_ ijh^mdpbb f_^m
   p_oZbb ^ms_cgZmlj gg__ihlj e_gb_bhsb_h[_fu\uimkdZfhcijh^mdpbb
   _kebfZppuifuoaZ. A bdhg_ghljhijh^m dlZ Y bf_xlb^

$$A=\begin{pmatrix} \frac{1}{2} & \frac{1}{10} \\ \frac{1}{4} & \frac{1}{5} \end{pmatrix},\ Y=\begin{pmatrix} 225 \\ 150 \end{pmatrix}.$$

Jrbl_aZkj_klZb MS Excel b PTC Mathcad.

. Z\ Z

Z

1. [illegible]
2. Z -wdhghfbqkdbokbkl_fZ
3. Z
4. Z

AZbeyZ\blhjghc bkZnklhy evghc ZlZu

1. Z

   : b_dlhjghfuh^Z_gghcklhbfhklbihdhZchlZeb

$$A=\begin{pmatrix} 0{,}2 & 0{,}1 & 0{,}2 \\ 0{,}1 & 0{,}3 & 0{,}2 \\ 0{,}2 & 0{,}2 & 0{,}3 \end{pmatrix};\qquad v=\begin{pmatrix} 10 \\ 2 \\ 6 \end{pmatrix}.$$

   Lj [m_lky
   ZZlbZh_kgu_p_gu
   [hij ^eblv gZkdhevdh ijhp_glh\ha^Zlml Zh_kgu_ p_gu dZc hlZeb
   _kebijhbahrehm_ebqgb_ghfuh^Z_gghcklhbfhklbi_jchlZebgZ
   Jrbl_aZkj_klZb MS Excel beb PTC Mathcad.

2. Z

$$\begin{pmatrix} 0{,}2 & 0{,}3 & 0{,}2 & 0{,}2 \\ 0{,}4 & 0{,}3 & 0{,}1 & 0{,}2 \\ 0{,}3 & 0{,}3 & 0{,}5 & 0{,}2 \\ 0{,}1 & 0{,}1 & 0{,}2 & 0{,}4 \end{pmatrix}.$$

Zbl_k^luwlbokl_mh^e_lhjxsb_kZgkbhZghc[a^nbpblghc
lhj\ebijmkehbbdhkmffZ^lhk_oklZZmke^g_^

-5.

1. $Q^D = q(p)$ ij_ehˋ_gby $Q^S = q(p)$).
   Ip\ˋbl_ipf_ju
2.
3. $TC = TC(q)$ ˋohZ
   $TR = TR(q)$ipjueb $\pi = \pi(q)$).
4.
   j
5. $Q^D = q(p)$
6. nmgdpbc Lhjgdbkl_eyfZhp_gguo lhjZ\lhjZ\i_jhc
   \lhjhcg_hjhˋbfhklbbij_f^_lhj hkdhrb"

Agbeyˋbl hjghc bkZmklhly_evghc jZlu

1. f_kpydhebqklh ihevahZ_e_c ih hijhkZbl_e_c khklZl Zg_glh\Zjp
   Zg_glkdhc ieZ_\ jm[\f_kpy ± Zg_glh\Nbdkbjhgu_ ba^jlb
   h[embˋgbyjhˋdexqgbckhklZyljm[\f_kpyZ_j f_ggu_ ± jmhZ
   ihˋdexqgb_Zbl_nmgdpbxijpuebij_ˋhejZbg_cgmxaZkbfhklvf_ˋm
   hqkehfZg_glh\b_ebqghc Zg_glkdhc ieZu Zhh fZkbfZvgh_ agqgb_
   ipjueb"
2. b _b $x = \dfrac{J(J+2)}{J^2+4}$.
   Zbl_nmgdpbbLhjgdbkl_eyhjZi_jhclhjhcg_hjhˋbfhklbbij_f^ _lh\
   jhkdhrb J_ebamcl_ hkghgu_ wlZu bkke_hgZbynmgdpbb kj_klZb Mathcad b
   ihkljhcl_bojZbdb K_eZl_wdhghfbqkdb_\uh^u

-8.

-wdhghfbqkdbo bkke_hgZbyjrZlky
kj_klZbˋbnn_jgpbeZvghljhbkqke_gbynmgdpbch^ghci_j _f_gghc"

2. $y = f(x)$ lhq_ x_0.
3. $y = f(x)$ lhq_ x_0?
4.
5. $y = f(x)$ lhq_ x_0.

6. [illegible]
7. [illegible]
8. [illegible] $F = F(x)$ [illegible]
9. [illegible] $AF = AF(x)$?
10. [illegible]
    $F = F(x)$ [illegible]
11. [illegible] [illegible] $MF = MF(x)$?
12. [illegible] $MF(x)$ [illegible] $AF(x)$.
13. [illegible] $MF(x)$ [illegible] $AF(x)$.
14. [illegible] $F = F(x)$ [illegible]
    [illegible] Δ [illegible]
    [illegible] $E_x(F) = \dfrac{MF(x)}{AF(x)}$.
15. [illegible]
16. [illegible]

[illegible]

1. [illegible] $p = \sqrt{3600 - q^2}$ [illegible]
   $p = 50$ [illegible] 11%?
2. [illegible]
   [illegible] $TC(q) = 4000 + 100q + 0{,}1q^2$ [illegible]
   [illegible] q [illegible]
   [illegible]

-10. [illegible]

[illegible]

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. [illegible]

[illegible]

[illegible]

[illegible] ±

3. H bfbapZbyjnbahkl_gguoba^j_d

1.
2.
3.
4.

Zbeyblhghc bkZnkhlhy_evghc jZlu

1. P_L

khklZyl jmZp_gZ\bgbpu dZblZ Z P_K ± jm[hbhbfuc h[_f \uimkdZh^mdpbb khklZyl _^I^ebl_ij dZhf khhlghr_gbb ljmZb dZblZZnbfZbgbfbabjm_l aZju Ihklhcl_ khhl_lkl\mxsb_ bahdZlm b bahdhklm

14.

1. $U = U(x_1, x_2)$ gZfgh`kl_ ihlj_bl_evkdbogZjhbZ (x_1, x_2).
2. $U = U(x_1, x_2)$ knhfmebjmcl_ hij^ e_gb_ ij^evghc ihe_aghklbdZhij^mdlZ
3.
4.
5. $U = U(x_1, x_2)$. I_j_bkebl_bohkgh\gu_kh\cckl\ Z
6. $U = U(x_1, x_2)$

AZbeyblhghc bkZnkhlhy_evghc jZlu

$U = x_1^{\ 2} + x_2^{\ 2}$ 1^ x_1, x_2 ± h[_f ihlj_e_gbyj_hl b lhjhl lhjZ khhl_lkl_ggh

15.

1.
2.
3.
4.

$U(x_1, x_2) = x_1^{\alpha} x_2^{\beta}$ [$U(x_1, x_2) = a_1 x_1 + a_2 x_2$\ $U = \min\left\{\frac{x_1}{a_1}, \frac{x_2}{a_2}\right\}$.

AZbeyblhghc bkZnkhlhy_evghc jZlu

p_gZdlZn_ey $p_{\text{}} = 20$ jm[aZdlZklhbfhklv mkeh\ghc _\bgbpu jmlbo ijhmdlh\blZby $p_{\text{}} = 60$ jm[Nmgdpbjhe_aghklbbf__lb^ $U(x_1, x_2) = \sqrt{x_1 x_2}$.

16. *b*

1.
2.
3. b
4. -
5.
6.
7.
8.
9.
10. -Obdk

1. ± $q^D(p) = -p + 200$ ± $q^S(p) = 3p + 40$ $\lambda = \frac{1}{10}$ $p = p(t)$ $p(1) = 200.$
2. $a = 1{,}25$ $m = 0{,}95$ $n = 0{,}1.$

6.

K

bf bam bkp bam bkp bam bkp

3		
4		
5		

(*) kafhg[bZeZ

RdeZp_gbZ[lu

ii	[l_gdZ	Deb qklhZeh\
1	Hebgh	4,75-5
2	Ohjrh	3,75-4,5
3	M\e_lhl_evgh	3-3,5
4	G\e_lhl_evgh	f_g__ 3

III.

I_j qgv aZbc eykZnklhy_evghc[lu ijh\lkyiegZ eZ[guo aZbc

D[l_jbhp_gbZ by aZbeykZnklhy evghc [lu

G[uhp_gbZ[lu

ii	Kndlmigk[vZlu	Deb qklhZeh\ *)
1	Zb_	Ze
2	Zb_	Ze
3	Zb_	Ze

(*) kafhg[bZeZ

RdeZp_gbZ[lu

ii	[l_gdZ	Deb qkl\ hZeh\
1	Hebgh	2,75-3
2	Ohjrh	1,75-2,75
3	M\e_lhl_evgh	1-1,5
4	G\e_lhl_evgh	f_g__ 1

I[h

1. Ihgjbyfh^ebeEKkbnbdZbyfh^e_c
2. kghgu_ wlZu fZ_fZbq kdhh fh^ebjhZbyeEKkbnbdZbywdhghfbdh -fZ_fZbqkdbofh^e_ckhpbeZvgh -wdhghfbqkdboihp_kkh\
3. Nhfmebjhdaa[ZZkhhjhZZbaE^evE_hglv_Z
4. Ebg_cgyh^evhf_gE^evf_\ngjhghclhjheb
5. NmgdpbbkihkZij_eh`gbyh\kgy_gZ
6. IZlbghhjhgyh^evjugdZ
7. Nmgdpbbh\ohbZa^j_dbihpueb
8. NmgdpbbLhgdbklZ
9. Nmgdpbbkij_^e_gbyhoh\
10. Gjjugh_gqke_gb_ihp_glh\
11. kghgu_ wdhghfbqkdb_ aq j_rZfu_ f_lhZb bnn_j gpbZvghjh bkqke_gbymgdpbch^ghci_j f_gghc
12. Ihgyb_ weklbghklb nmgdpbb kcklZweklbghklb =hf_lpqkdbc kfuke weklbghklbnmgdpbb
13. WeklbghklvkihkZij_eh`gby
14. Khlghr_gbf_\mkj^gbfbbij_^evgufb\ebqgZbwdhghfbd_
15. hE^ebmiyZ_gbymZZb

16. Nmgdpbbihlj f_gby bk[j`gby
17. ebke_gb_ hf[_fZuims_gghc ijh^mdpbb jDu_ Ehj_gp ZDwnnbpb_gl
bgbbkdhgl bjhZby
18. Ihgjb_ ijhbahlkl\gghc nmgdpbb bs^u ijhbahlkl\gguo nmgdpbc
Ij^evgu_bkj_gb_agZgbijhbahlkl\gghcnmgdpbb
19. Nmgdpbjihe_aghklbb__khcklZ
20. jDu_[ajZebqbbokhcklZx^lg h_fgh`klh
21. ikl j_bl_evkdhh\uhjZ
22. F^ev_kl_kl\gghhjhklF^evZvlmkZ
23. F^evN_jpxevklZ
24. F^evWgkzmklgZhe_gbgZh\kghcp_gubfh^evKehm
25. F^evwdhghfbqkdhhjhpbdeKmwevkhgZ -ObdkZ

gZ pakg hhaZby

1. gZko_fZ hlZe_hhfgkaZlqlguci_bh^

Ijhbahlb_ hlZeb	Ihlj_eyxsb_hlZeb			Dg_guc ijh^mdl	ehhc \uimkd
	1.	2.	3.		
1.	233	51	292	200	776
2.	155	255	0	100	510
3.	233	51	146	300	730

Kklv ko_fm f_hlZe_hh gkaZlqlguci_bh^keb ba\klgh dh ih

dZc ba hlZe_c ieZbjm_lkyhkl dhg_gh ijh^mdlZgZ p_1 %, p_2 b $\frac{p_1+p_2}{2}$ %

khhl\lkl\gghIbwlhfij_hZlkyhdhwnnbpb_gluifuoaZj Zg_f_gxlky

p_1 ± dhebqklh [md\\iheghf bf_gb klm^glZ p_2 ± dhebqklh [md\\
nZbebbklm^glZ

2. Ba\klgh dh gZh\kgxp_gZgZg_dhlhjuc lhZgZ jm[gZh\kgh_
dhebqklh ± 1000 _^gvhhd_gZh\kbyweKlbghklvkihkZhp_g_gZ $-\frac{a}{10}$
b weKlbghklv ij_eh`gbyih p_g_ gZ $\frac{b}{10}$ Hj_^ebl_ nmgdpbb kihkZb
ij_eh`gbykqlkZoebg_cgufb

3. Ba\klgZmgdpbyLhjgdbklZ $x=\frac{a\left(J-b^2\right)}{J+b}$ eyhgZ\lhjc g_hphbfhklb ey
g_dhlhjhcklgZu
Kklv l_khhl\lkl\mxsb_nmgdpbbLhjgdbklZyfZhp_gguolhgZlhgZ\
i_jhcg_hphbfhklbbij_f_lhjhkdhrb
[pdZhfhoh^gKZ_e_gbkihkgZhp_ggu_lhgZfZ kbfZ_g"

4. Nmgdpbyij_^evguo aZnbfu bf__l b^ $MC(q)=10a+q$ P_gZ_bgbpu
ijh^mdpbbihklhgggZgZ $600+10b$ jm[
Hj_^ebl_h[_fuimkdZhlhjucihaheblfZkbfbabjhZvjp[ev
Kklv l_nmgdpbxiheguoaZ _kebihklhggu_aZuZgu

5. Ihlj_bl_ev bf__l hafhghklv ihlgZblv ^g_gZphj_l_gb_ x _bgbp
i_jhh lhZb y _bgbp lhjhh lhZgbl_ hilbfeZvguc gZj lhgZ\

$$U(x,y)=(x-30)^{\frac{1}{2}}\cdot(y-20)^{\frac{1}{3}}$$
$$p_1=8,\ p_2=3.$$

Gfuhp_gbZbyl_lZ

ii	kndlmgkvbe_lZ	Deb qklhZeh\
1	IZevguchl_lgkZihk	Ze

kafhgZbyZeZ

RdZZp_gbZbZlu

ii	I_gdZ	Debqklhe\
1	gh	2-4
2	G_ agh	f_g__ 2

7.

1. k HKZ_fZbdZwdhghfbd_ fZ_fZbqkdb_ f_lhû b fh^eb mqgbd eyZZ\k ; I Qiigh\hl_lkl_gguc j_Zlhj K k ² 2-_ ba^bkijb^hi ² FkdZBaZ_evklh XZl ² k ² ukr__ hZhgZb_ ² ISBN 978-5-9916-3138-9. ² L_dkl we_dlhggucW;KZl kZl@ ² URL: https://urait.ru/bcode/426162.

2. Z: GWdhghfbdh -fZ_fZbqkdb_ f_lhû b ihdegZu_ fh^eb mqgbd eyZZ\k bfkljZmju :ZBH jehZN_^hk__\ ih^jZpb_c <N_^hk__Z ² 4-_ ba^ihi ² FkdZBaZ_evklh XZl ² k ² ;ZZZfkljdZfbqkdbcdmk ² ISBN 978-5-9916-3698-8. ² L_dkl we_dlhggucW;KZl kZl@ ² URL: https://urait.ru/bcode/406453.

3. mhgZ B G Hghû fZ_fZbqkdh^ fh^ebhgZby khpbZvgh -wdhghfbqkdbo ihp_kkh\mqgbd b iZlbdmf eyah\B G hgZ ² FkdZ BaZ_evklh XZl ² k ² ukr__ hZhgZb_ ² ISBN 978-5-534-00501-1. ² L_dkl we_dlhggucW;KZl kZl@ ² URL: https://urait.ru/bcode/450960.

4. R_ZbgZ Z fZbdZwdhghfbd_ mqgh_ihkh^_eyah\H R_ZbgZ^hgZmghcj_Zpb_c L R_ZbgZ ² FkdZBaZ_evklh XZl 2020. ² 192 k ² ukr__ hZhgZb_ ² ISBN 978-5-534-02894-2. ² L_dkl we_dlhggucW;KZl kZl@ ² URL: https://urait.ru/bcode/453747.

7.2.

1. D_cg_j = WdhghfbdZF^ebhgZb_ Z_fZbdZBaZgu_ ljnû = D_cg_j hkkb ckdZZZfby gZmd P_glZvguc wdhghfbdh -fZ_fZbqkdbc bgklblml - PWBJG

2. Ihk_lh BZ_fZbqkdb_f_lhûbfh^eb\wdhghfbd_aZbj_r_gby ± BaZ_evklh:©vnZ -Ij_kk[a]

3. Zkh\ HLheklhiy_gdh :<Qj_fguo X GZ_fZbqkdb_ f_lhû \ wdhghfbd_ - Fehbk_bk - 2009.

4. Zuobg B Z_fZbdZwdhghfbd_ Mqgh_ihkh^_ B Z u obg ± F BNJ -F

5. EgdZl_jZ_fZbqkdyZwdhghfbdZ - K_lkdh_jZh]

7.3. -

1. kkl_fZbklZpbhgghh^ h[mqgbyKhe_gkdhh^ hkmjZl_gghh^ mgb_kbl_lZ http://moodle.smolgu.ru

2. We_dlhggh -bebhl_gZbkl_fZmgb_kbl_lZ http://biblioteka.smolgu.ru
3. Zbhgevguchldjulucmgb_kbl_l http://www.intuit.ru
4. Zhe_evgucfZ_fZbqkdbckZl http://exponenta.ru
5. Hhkkbckdbcfe_fZbqkdbcihjZ http://www.mathnet.ru
6. Zevgwe_dlhggZebhl_dZ .

8. -

±

dhfivxl_gucdeZ kk.

± dhfivxl_guc dekk khklmihf d

k_lbBgl_g_lbWBhe=M .

9.

Microsoft Open License (Windows XP, 7, 8, 10, Server, Office 2003-2016), ebp_gaby 66975477 hl 03.06.2016 ([_kkhgh).

Hqsbfkyh[_ki_qghklmi d W;Zl ZZ_hklmi \we_dlhggmx bgnhfZbhggh -hZhe_evgmxkj^mmgb_kbl_lZ

PTC Mathcad 15.0 (Ebp_gaby 449732)

ДОКУМЕНТ ПОДПИСАН
ЭЛЕКТРОННОЙ ПОДПИСЬЮ

Сертификат: 03B6A3C600B7ADA9B742A1E041DE7D81B0
Владелец: Артеменков Михаил Николаевич
Действителен: с 04.10.2021 до 07.10.2022