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Самостоятельная работа № 1

Тема: **Уравнения в частных производных 1-го порядка (часть 2)**

Вариант 1

1. Решите уравнения:

   1) $xz\,\dfrac{\partial u}{\partial x} + yz\,\dfrac{\partial u}{\partial y} + xye^{z^2}\,\dfrac{\partial u}{\partial z} = 0;$

   2) $(x + 2u - u^2)\,\dfrac{\partial u}{\partial x} + (y + 3u^2 - u^3)\,\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $2ye^{y^2}\,\dfrac{\partial u}{\partial x} + \cos x\,\dfrac{\partial u}{\partial y} = 0, \quad u(0, y) = e^{y^2};$

   2) $x\,\dfrac{\partial u}{\partial x} = u, \quad u(2, y) = \sin y.$

Вариант 2

1. Решите уравнения:

   1) $\dfrac{xz}{3}\,\dfrac{\partial u}{\partial x} + yz\,\dfrac{\partial u}{\partial y} + x^3y(z^2 + 1)^2\,\dfrac{\partial u}{\partial z} = 0;$

   2) $(x + e^{2u})\,\dfrac{\partial u}{\partial x} + (y + 2e^{3u})\,\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $4y\,\dfrac{\partial u}{\partial x} + e^x\,\dfrac{\partial u}{\partial y} = 0, \quad u(x, 0) = \sin e^x;$

   2) $x\,\dfrac{\partial u}{\partial y} = u^2, \quad u(x, 0) = x.$

Вариант 3

1. Решите уравнения:

   1) $ye^{x^2+z}\dfrac{\partial u}{\partial x} + xy\dfrac{\partial u}{\partial y} + x\dfrac{\partial u}{\partial z} = 0;$

   2) $(x-1)\dfrac{\partial u}{\partial x} + (y+1-u)\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $6y^2\dfrac{\partial u}{\partial x} + \operatorname{ch} x\dfrac{\partial u}{\partial y} = 0, \quad u(0,y) = 8y^9;$

   2) $e^x\dfrac{\partial u}{\partial y} = u^2, \quad u(x,1) = e^x.$

Вариант 4

1. Решите уравнения:

   1) $(x-2z)\dfrac{\partial u}{\partial x} + (y-2z)\dfrac{\partial u}{\partial y} + 3z\dfrac{\partial u}{\partial z} = 0;$

   2) $(x+u-1)\dfrac{\partial u}{\partial x} + (y-u)\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $\sqrt{y}\dfrac{\partial u}{\partial x} + e^x\dfrac{\partial u}{\partial y} = 0, \quad u(x,1) = e^x - 1;$

   2) $\dfrac{\partial u}{\partial y} = u^2\cos x, \quad u(x,0) = \dfrac{2}{\sin 2x}.$

Вариант 5

1. Решите уравнения:

   1) $xz\,\dfrac{\partial u}{\partial x} + yz\,\dfrac{\partial u}{\partial y} + xy(z^2+1)\,\dfrac{\partial u}{\partial z} = 0;$

   2) $(2e^u - x)\,\dfrac{\partial u}{\partial x} + (3e^{2u} - y)\,\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $x\cos y\,\dfrac{\partial u}{\partial x} - 2\sin y\,\dfrac{\partial u}{\partial y} = 0, \quad u(1,y) = \sin^2 y;$

   2) $x\,\dfrac{\partial u}{\partial x} + y\,\dfrac{\partial u}{\partial y} = u, \quad u(x,1) = x.$

Вариант 6

1. Решите уравнения:

   1) $\dfrac{xz}{2}\,\dfrac{\partial u}{\partial x} + yz\,\dfrac{\partial u}{\partial y} + x^2y(z^4+1)\,\dfrac{\partial u}{\partial z} = 0;$

   2) $(e^u - x)\,\dfrac{\partial u}{\partial x} + (u^2 + 2u - y)\,\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $x\sin 2y\,\dfrac{\partial u}{\partial x} + \cos^2 y\,\dfrac{\partial u}{\partial y} = 0, \quad u(x,\pi) = x^2;$

   2) $x^2\,\dfrac{\partial u}{\partial x} + u\,\dfrac{\partial u}{\partial y} = 0, \quad u(x,-2) = x.$

Вариант 7

1. Решите уравнения:

   1) $\dfrac{xz}{3}\dfrac{\partial u}{\partial x} + yz\dfrac{\partial u}{\partial y} + x^3y(z^4+1)\dfrac{\partial u}{\partial z} = 0;$

   2) $(u - x + 2)\dfrac{\partial u}{\partial x} + (2u - y + 1)\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $\operatorname{ch} x \sin y \dfrac{\partial u}{\partial x} + \operatorname{sh} x \cos y \dfrac{\partial u}{\partial y} = 0, \quad u(x, \pi) = -\operatorname{ch} x;$

   2) $u\dfrac{\partial u}{\partial x} + e^{-y}\dfrac{\partial u}{\partial y} = 0, \quad u(x, \ln 2) = x.$

Вариант 8

1. Решите уравнения:

   1) $xy\dfrac{\partial u}{\partial x} + xe^z\sqrt{1-y^4}\dfrac{\partial u}{\partial y} + y\dfrac{\partial u}{\partial z} = 0;$

   2) $(\cos u + \sin u - x)\dfrac{\partial u}{\partial x} - (\cos u + \sin u + y)\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $3x\cos y\dfrac{\partial u}{\partial x} - \sin y\dfrac{\partial u}{\partial y} = 0, \quad u\left(x, \dfrac{\pi}{2}\right) = \sin x;$

   2) $e^x\dfrac{\partial u}{\partial x} - u\dfrac{\partial u}{\partial y} = 0, \quad u(0, y) = y + 1.$

Вариант 9

1. Решите уравнения:

   1) $\dfrac{xz}{2}\dfrac{\partial u}{\partial x} + z\operatorname{tg} y\dfrac{\partial u}{\partial y} + x\sin y\dfrac{\partial u}{\partial z} = 0;$

   2) $(\cos u - \sin u - x)\dfrac{\partial u}{\partial x} + (\sin u - \cos u - y)\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $(1+y^2)\operatorname{arctg} y\dfrac{\partial u}{\partial y} - x\dfrac{\partial u}{\partial x} = 0, \quad u(1,y) = \operatorname{arctg}^2 y;$

   2) $u\dfrac{\partial u}{\partial x} - y^2\dfrac{\partial u}{\partial y} = 0, \quad u(x,1) = x+1.$

Вариант 10

1. Решите уравнения:

   1) $yz\operatorname{ctg} x^2\dfrac{\partial u}{\partial x} + xy\dfrac{\partial u}{\partial y} + xz\dfrac{\partial u}{\partial z} = 0;$

   2) $2u(u^2 - x)\dfrac{\partial u}{\partial x} + (u^3 + 3u^2 - y)\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $\dfrac{\partial u}{\partial x} - \operatorname{arctg} x\dfrac{\partial u}{\partial y} = 0, \quad u(0,y) = y^2;$

   2) $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} = u, \quad u(x,1) = x^2.$

Вариант 11

1. Решите уравнения:

   1) $\dfrac{xy}{2}\dfrac{\partial u}{\partial x} + x^2 z(y^2+1)\dfrac{\partial u}{\partial y} + yz\dfrac{\partial u}{\partial z} = 0;$

   2) $(2\cos u - \sin u - 2x)\dfrac{\partial u}{\partial x} + (2\sin u + \cos u - 2y)\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $2\ln y\dfrac{\partial u}{\partial x} + y\,\mathrm{tg}^2\, x\dfrac{\partial u}{\partial y} = 0, \quad u(\pi, y) = (\pi + \ln^2 y)^2;$

   2) $x\dfrac{\partial u}{\partial x} + 2y\dfrac{\partial u}{\partial y} = 4u, \quad u(1, y) = y.$

Вариант 12

1. Решите уравнения:

   1) $xz\dfrac{\partial u}{\partial x} + z\dfrac{\partial u}{\partial y} + xe^y(z^2+1)\dfrac{\partial u}{\partial z} = 0;$

   2) $(3e^u - 2x)\dfrac{\partial u}{\partial x} + (e^{-u} - 2y)\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $\sin y\dfrac{\partial u}{\partial x} + 3\sin^2 x\cos^2 y\cos x\dfrac{\partial u}{\partial y} = 0, \quad u(0, y) = \cos y;$

   2) $3x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} = 6u, \quad u(x, 1) = x^3.$

Вариант 13

1. Решите уравнения:

   1) $xz\,\dfrac{\partial u}{\partial x} + z\,\mathrm{tg}\,y\,\dfrac{\partial u}{\partial y} + x\sin y\,\dfrac{\partial u}{\partial z} = 0;$

   2) $2(u + u^2 - x)\,\dfrac{\partial u}{\partial x} - 2(u + u^2 + y)\,\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $\sqrt{x}y \ln y\,\dfrac{\partial u}{\partial x} + e^{\sqrt{x}}\,\dfrac{\partial u}{\partial y} = 0, \quad u(x,1) = 2e^{\sqrt{x}};$

   2) $x\,\dfrac{\partial u}{\partial x} - y\,\dfrac{\partial u}{\partial y} = 2u, \quad u(2,y) = \sin y.$

Вариант 14

1. Решите уравнения:

   1) $xy\,\dfrac{\partial u}{\partial x} - xz(y^2+1)^2\,\dfrac{\partial u}{\partial y} + yz\,\dfrac{\partial u}{\partial z} = 0;$

   2) $(4 + 3u - 3x)\,\dfrac{\partial u}{\partial x} + (6u - 1 - 3y)\,\dfrac{\partial u}{\partial y} = 1.$

2. Решите задачи Коши:

   1) $(x^2+1)\,\dfrac{\partial u}{\partial x} + \sqrt{y}\,\dfrac{\partial u}{\partial y} = 0, \quad u(0,y) = \sqrt{y};$

   2) $x\,\dfrac{\partial u}{\partial x} + 5y\,\dfrac{\partial u}{\partial y} = 10u, \quad u(-1,y) = y^3.$
