

---

```

%11.3 3c
fprintf("SECTION 11.3 NUMBER 3C\n");
p = @(x) (-(x+1));
q = @(x) (2);
r = @(x) ((1-x^2)*exp(-x));
a = 0;
b = 1;
h = .1;
y0 = -1;
y1 = 0;
[t, yApprox] = FiniteDifferenceLinear(p, q, r, a, b, h, y0, y1);
N = (b-a-h)/h;
for i = 1: N
    fprintf("i = %d t = %.2f yi = %.15f\n", i, t(i), yApprox(i));
end

fprintf("\n\n");

SECTION 11.3 NUMBER 3C
i = 1 t = 0.10 yi = -0.814229721703068
i = 2 t = 0.20 yi = -0.654773599432835
i = 3 t = 0.30 yi = -0.518308412475372
i = 4 t = 0.40 yi = -0.401904443119574
i = 5 t = 0.50 yi = -0.302980806647425
i = 6 t = 0.60 yi = -0.219265711250556
i = 7 t = 0.70 yi = -0.148761111240269
i = 8 t = 0.80 yi = -0.089711275448616
i = 9 t = 0.90 yi = -0.040574844868567


%11.3 7
fprintf("SECTION 11.3 NUMBER 7\n");
p = @(x) (0);
q = @(x) (1000/(3*10^7*625));
r = @(x) (100*x*(x-120)/(2*3*10^7*625));
a = 0;
b = 120;
h = 6;
y0 = 0;
y1 = 0;
[t, yApprox] = FiniteDifferenceLinear(p, q, r, a, b, h, y0, y1);
actual_f = @(x) (7.7042537*10^4*exp(2.309401*10^(-4)*x) +
    7.9207462*10^4*exp(-2.309401*10^(-4)*x) -4.1666666*10^(-3)*(x -
    120)*x - 1.5625*10^5);
N = (b-a-h)/h;
a_f = zeros(1, N);
fprintf("PART A\n");
for i = 1: N
    a_f(i) = actual_f(t(i));
    fprintf("i = %d t = %.2f w%d = %.15f y%d = %.15f abs value = %.15f\n", i, t(i), i, yApprox(i), i, a_f(i), abs(yApprox(i) - a_f(i)));
end

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end
max_error = max(abs(yApprox(1, 1:end) - a_f(1, 1:end)));
fprintf("\n\nPART B\n");
fprintf("max error = %.10f\n", max_error);
if (max_error > .02)
    fprintf("Max error not within .2 inches on interval\n");
else
    fprintf("Max error is within .2 inches on interval\n");
end

fprintf("\n\nPART C\n");
w_vec = zeros(1, 121);
for i = 0: 120
    w_vec(i+1) = actual_f(i);
end
max_w = max(w_vec);
fprintf("Max of real function = %.10f\n", max_w);
if (max_w < (1/300))
    fprintf("The actual function meets the standard\n");
else
    fprintf("The actual function does not meet the standard\n");
end

h = 1;
[t, yApprox] = FiniteDifferenceLinear(p, q, r, a, b, h, y0, y1);
max_approx = max(yApprox);
fprintf("Max of approximation function = %.10f\n", max_approx);

if (max_approx < (1/300))
    fprintf("The approximation function meets the standard\n");
else
    fprintf("The approximation function does not meet the standard\n\n");
end

fprintf("\n\n");

SECTION 11.3 NUMBER 7
PART A
i = 1 t = 6.00 w1 = 0.002298063067684 y1 = -0.000808968441561 abs
value = 0.003107031509245
i = 2 t = 12.00 w2 = 0.004530466547650 y2 = -0.000623377534794 abs
value = 0.005153844082444
i = 3 t = 18.00 w3 = 0.006638462726111 y3 = -0.000448122998932 abs
value = 0.007086585725044
i = 4 t = 24.00 w4 = 0.008570215650421 y4 = -0.000287524511805 abs
value = 0.008857740162226
i = 5 t = 30.00 w5 = 0.010280801029545 y5 = -0.000145325640915 abs
value = 0.010426126670460
i = 6 t = 36.00 w6 = 0.011732206147807 y6 = -0.000024694221793 abs
value = 0.011756900369599
i = 7 t = 42.00 w7 = 0.012893329791904 y7 = 0.000071777991252 abs
value = 0.012821551800652

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i = 8 t = 48.00 w8 = 0.013739982191195 y8 = 0.000142075208714 abs
value = 0.013597906982481
i = 9 t = 54.00 w9 = 0.014254884971252 y9 = 0.000184757576790 abs
value = 0.014070127394462
i = 10 t = 60.00 w10 = 0.014427671120687 y10 = 0.000198961119168 abs
value = 0.014228710001520
i = 11 t = 66.00 w11 = 0.014254884971252 y11 = 0.000184397940757 abs
value = 0.014070487030495
i = 12 t = 72.00 w12 = 0.013739982191195 y12 = 0.000141355936648 abs
value = 0.013598626254547
i = 13 t = 78.00 w13 = 0.012893329791904 y13 = 0.000070699054049 abs
value = 0.012822630737855
i = 14 t = 84.00 w14 = 0.011732206147807 y14 = -0.000026132853236 abs
value = 0.011758339001043
i = 15 t = 90.00 w15 = 0.010280801029545 y15 = -0.000147123908391 abs
value = 0.010427924937936
i = 16 t = 96.00 w16 = 0.008570215650421 y16 = -0.000289682415314 abs
value = 0.008859898065735
i = 17 t = 102.00 w17 = 0.006638462726111 y17 = -0.000450640596682 abs
value = 0.007089103322794
i = 18 t = 108.00 w18 = 0.004530466547650 y18 = -0.000626254797680 abs
value = 0.005156721345330
i = 19 t = 114.00 w19 = 0.002298063067684 y19 = -0.000812205369584 abs
value = 0.003110268437269

```

#### PART B

max error = 0.0031102684

Max error is within .2 inches on interval

#### PART C

Max of real function = 0.0001989611

The actual function meets the standard

Max of approximation function = 0.0143996756

The approximation function does not meet the standard

```

%12.1 3a
fprintf("SECTION 12.1 NUMBER 3A\n");
a = 0; %left endpoint of x
b = 1; %right endpoint of x
c = 0; %left endpoint of y
d = 1; %right endpoint of y
f = @(x,y) 0; %right-hand side function

g1 = @(x,y) 0; %u(x, c) BC
g2 = @(x,y) x; %u(x, d) BC
g3 = @(x,y) 0; %u(a, y) BC
g4 = @(x,y) y; %u(b, y) BC
#define step size
h = .2;

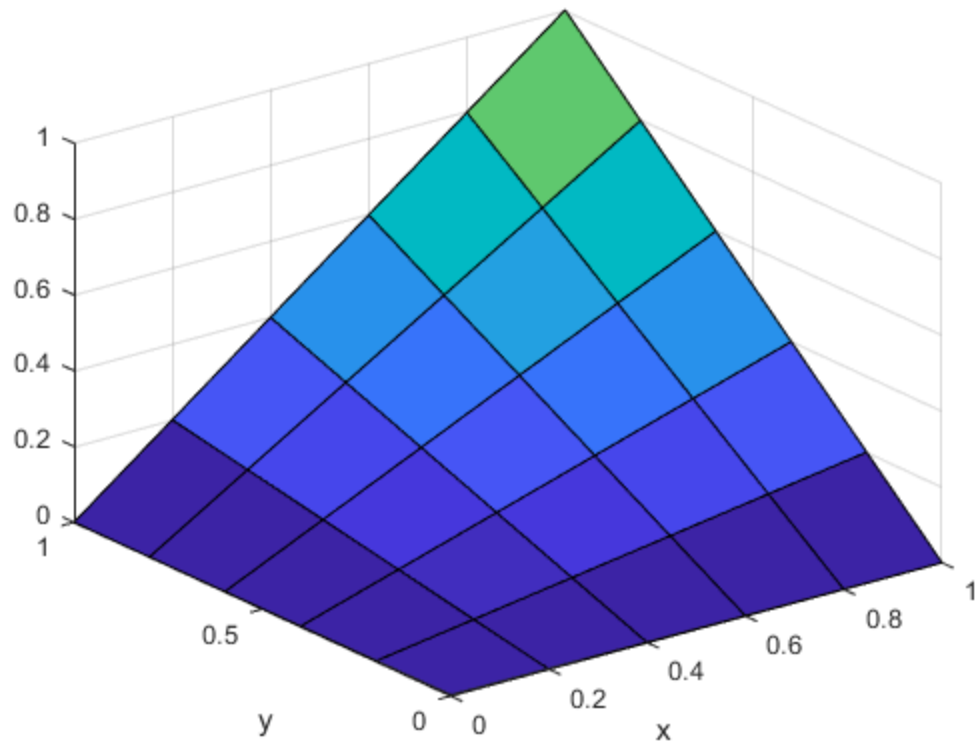
```

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```
u = FiniteDifferenceElliptical(a, b, c, d, f, g1, g2, g3, g4, h, h);
realF = @(x, y) x*y;
x = a+h;
y = c+h;
r = (b-a-h)/h;
c = (d-c-h)/h;
for i = 1: r
    for j = 1: c
        fprintf("x = %.2f y = %.2f u = %.5f actual solt = %.5f\n", x,
            y, u(round((i-1)*c + j)), realF(x, y));
        x = x + h;
    end
    x = a + h;
    y = y + h;
end
```

*SECTION 12.1 NUMBER 3A*

```
x = 0.20 y = 0.20 u = 0.04000 actual solt = 0.04000
x = 0.40 y = 0.20 u = 0.08000 actual solt = 0.08000
x = 0.60 y = 0.20 u = 0.12000 actual solt = 0.12000
x = 0.80 y = 0.20 u = 0.16000 actual solt = 0.16000
x = 0.20 y = 0.40 u = 0.08000 actual solt = 0.08000
x = 0.40 y = 0.40 u = 0.16000 actual solt = 0.16000
x = 0.60 y = 0.40 u = 0.24000 actual solt = 0.24000
x = 0.80 y = 0.40 u = 0.32000 actual solt = 0.32000
x = 0.20 y = 0.60 u = 0.12000 actual solt = 0.12000
x = 0.40 y = 0.60 u = 0.24000 actual solt = 0.24000
x = 0.60 y = 0.60 u = 0.36000 actual solt = 0.36000
x = 0.80 y = 0.60 u = 0.48000 actual solt = 0.48000
x = 0.20 y = 0.80 u = 0.16000 actual solt = 0.16000
x = 0.40 y = 0.80 u = 0.32000 actual solt = 0.32000
x = 0.60 y = 0.80 u = 0.48000 actual solt = 0.48000
x = 0.80 y = 0.80 u = 0.64000 actual solt = 0.64000
```



```

%%12.1 3a
fprintf("SECTION 12.1 NUMBER 7\n");
a = 0; %left endpoint of x
b = 6; %right endpoint of x
c = 0; %left endpoint of y
d = 5; %right endpoint of y
f = @(x,y) -1.5/1.04; %right-hand side function

g1 = @(x,y) x*(6-x); %u(x, c) BC
g2 = @(x,y) 0; %u(x, d) BC
g3 = @(x,y) y*(5-y); %u(a, y) BC
g4 = @(x,y) 0; %u(b, y) BC
%define step size
h = .4;
k = 1/3;

u = FiniteDifferenceElliptical(a, b, c, d, f, g1, g2, g3, g4, h, k);
disp(length(u));
x = a+h;
y = c+k;
r = (b-a-h)/h;
c = (d-c-k)/k;
for i = 1: r
    for j = 1: c
        fprintf("%.15f x = %.2f y = %.2f\n", u(round((i-1)*c + j)), x,
y);
    
```

---

```
        x = x + h;  
    end  
    x = a + h;  
    y = y + k;  
end
```

SECTION 12.1 NUMBER 7  
196

```
3.195805124102801 x = 0.40 y = 0.33  
4.482965617358827 x = 0.80 y = 0.33  
5.637778133469956 x = 1.20 y = 0.33  
6.629124217376447 x = 1.60 y = 0.33  
7.438872186173971 x = 2.00 y = 0.33  
8.054665833534745 x = 2.40 y = 0.33  
8.466695958290025 x = 2.80 y = 0.33  
8.665740823242842 x = 3.20 y = 0.33  
8.641298386529883 x = 3.60 y = 0.33  
8.378759151791048 x = 4.00 y = 0.33  
7.853555993513862 x = 4.40 y = 0.33  
7.016542883499777 x = 4.80 y = 0.33  
5.752137305443056 x = 5.20 y = 0.33  
3.744042069359335 x = 5.60 y = 0.33  
4.340596759394256 x = 0.40 y = 0.67  
5.311954425537769 x = 0.80 y = 0.67  
6.208253468375317 x = 1.20 y = 0.67  
6.986855096870411 x = 1.60 y = 0.67  
7.618707240793241 x = 2.00 y = 0.67  
8.082325958905752 x = 2.40 y = 0.67  
8.360052390057721 x = 2.80 y = 0.67  
8.435310828493348 x = 3.20 y = 0.67  
8.289924340316407 x = 3.60 y = 0.67  
7.900524107462330 x = 4.00 y = 0.67  
7.232597152439842 x = 4.40 y = 0.67  
6.229709004272960 x = 4.80 y = 0.67  
4.794972815921657 x = 5.20 y = 0.67  
2.771039519002829 x = 5.60 y = 0.67  
5.263858257167230 x = 0.40 y = 1.00  
5.985232626253445 x = 0.80 y = 1.00  
6.665656986853903 x = 1.20 y = 1.00  
7.260566230167405 x = 1.60 y = 1.00  
7.736006490453600 x = 2.00 y = 1.00  
8.065109140468088 x = 2.40 y = 1.00  
8.225107583772536 x = 2.80 y = 1.00  
8.194756529587188 x = 3.20 y = 1.00  
7.951794808010838 x = 3.60 y = 1.00  
7.470046554532791 x = 4.00 y = 1.00  
6.715830273740980 x = 4.40 y = 1.00  
5.643953934461339 x = 4.80 y = 1.00  
4.196236204198554 x = 5.20 y = 1.00  
2.314373959961096 x = 5.60 y = 1.00  
5.938834412251991 x = 0.40 y = 1.33  
6.468691604685648 x = 0.80 y = 1.33  
6.977806391850213 x = 1.20 y = 1.33
```

---

7.422977115722480  $x = 1.60$   $y = 1.33$   
7.768874119616439  $x = 2.00$   $y = 1.33$   
7.986227297971237  $x = 2.40$   $y = 1.33$   
8.049743044207917  $x = 2.80$   $y = 1.33$   
7.936043667302805  $x = 3.20$   $y = 1.33$   
7.621682576837739  $x = 3.60$   $y = 1.33$   
7.081267798147784  $x = 4.00$   $y = 1.33$   
6.285954222760716  $x = 4.40$   $y = 1.33$   
5.203271024863632  $x = 4.80$   $y = 1.33$   
3.800874875680897  $x = 5.20$   $y = 1.33$   
2.059450885873771  $x = 5.60$   $y = 1.33$   
6.352018556385858  $x = 0.40$   $y = 1.67$   
6.742123757617710  $x = 0.80$   $y = 1.67$   
7.123130629369594  $x = 1.20$   $y = 1.67$   
7.453892490486635  $x = 1.60$   $y = 1.67$   
7.699516343549210  $x = 2.00$   $y = 1.67$   
7.830413656823278  $x = 2.40$   $y = 1.67$   
7.820824397015858  $x = 2.80$   $y = 1.67$   
7.647223287809142  $x = 3.20$   $y = 1.67$   
7.286854803120299  $x = 3.60$   $y = 1.67$   
6.716618607690660  $x = 4.00$   $y = 1.67$   
5.912678563521237  $x = 4.40$   $y = 1.67$   
4.851531835782349  $x = 4.80$   $y = 1.67$   
3.513772157018398  $x = 5.20$   $y = 1.67$   
1.891785477083863  $x = 5.60$   $y = 1.67$   
6.496346824904500  $x = 0.40$   $y = 2.00$   
6.793885009260521  $x = 0.80$   $y = 2.00$   
7.087930646754582  $x = 1.20$   $y = 2.00$   
7.339176642536029  $x = 1.60$   $y = 2.00$   
7.514115876501256  $x = 2.00$   $y = 2.00$   
7.584317357987574  $x = 2.40$   $y = 2.00$   
7.525148368453863  $x = 2.80$   $y = 2.00$   
7.314401053028376  $x = 3.20$   $y = 2.00$   
6.931125509374420  $x = 3.60$   $y = 2.00$   
6.354904035204089  $x = 4.00$   $y = 2.00$   
5.565840357081992  $x = 4.40$   $y = 2.00$   
4.545636366956898  $x = 4.80$   $y = 2.00$   
3.280127208757253  $x = 5.20$   $y = 2.00$   
1.763149634674051  $x = 5.60$   $y = 2.00$   
6.368714503202384  $x = 0.40$   $y = 2.33$   
6.618369576996063  $x = 0.80$   $y = 2.33$   
6.864761075082957  $x = 1.20$   $y = 2.33$   
7.069998325632410  $x = 1.60$   $y = 2.33$   
7.202683931162980  $x = 2.00$   $y = 2.33$   
7.236822299402669  $x = 2.40$   $y = 2.33$   
7.150281435014405  $x = 2.80$   $y = 2.33$   
6.923337815706844  $x = 3.20$   $y = 2.33$   
6.537572915375684  $x = 3.60$   $y = 2.33$   
5.975262435900048  $x = 4.00$   $y = 2.33$   
5.219373231876515  $x = 4.40$   $y = 2.33$   
4.254276835436766  $x = 4.80$   $y = 2.33$   
3.067181445610434  $x = 5.20$   $y = 2.33$   
1.649916622085857  $x = 5.60$   $y = 2.33$   
5.969372380139744  $x = 0.40$   $y = 2.67$

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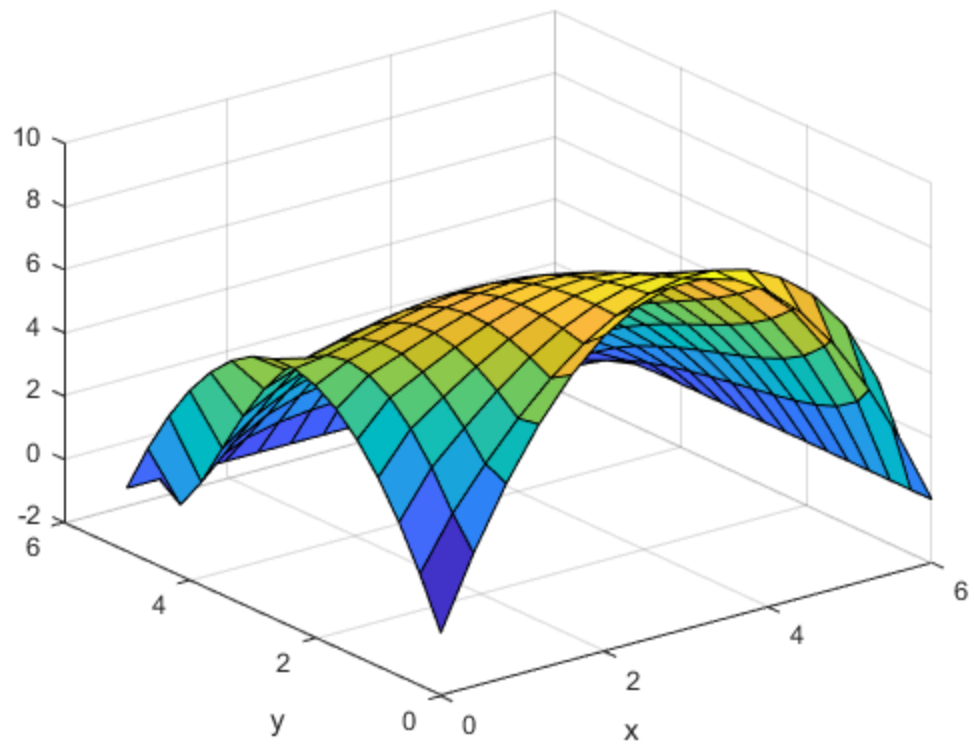
---

6.215348489669156 x = 0.80 y = 2.67  
6.451976520179550 x = 1.20 y = 2.67  
6.642602422978441 x = 1.60 y = 2.67  
6.759029992346360 x = 2.00 y = 2.67  
6.779237242676483 x = 2.40 y = 2.67  
6.685048025725012 x = 2.80 y = 2.67  
6.460326628639672 x = 3.20 y = 2.67  
6.089796669752188 x = 3.60 y = 2.67  
5.558430330374673 x = 4.00 y = 2.67  
4.851344068318022 x = 4.40 y = 2.67  
3.954147066533985 x = 4.80 y = 2.67  
2.853635885392629 x = 5.20 y = 2.67  
1.538566177289714 x = 5.60 y = 2.67  
5.302657296918202 x = 0.40 y = 3.00  
5.590906250592035 x = 0.80 y = 3.00  
5.854424862218416 x = 1.20 y = 3.00  
6.058635622986213 x = 1.60 y = 3.00  
6.180827141798305 x = 2.00 y = 3.00  
6.205279422462657 x = 2.40 y = 3.00  
6.119577565800260 x = 2.80 y = 3.00  
5.912354772605410 x = 3.20 y = 3.00  
5.572087573849498 x = 3.60 y = 3.00  
5.086548916759209 x = 4.00 y = 3.00  
4.442656413717685 x = 4.40 y = 3.00  
3.626562246219295 x = 4.80 y = 3.00  
2.623879621367153 x = 5.20 y = 3.00  
1.419942970911137 x = 5.60 y = 3.00  
4.379581326171796 x = 0.40 y = 3.33  
4.760425122793133 x = 0.80 y = 3.33  
5.085411824346635 x = 1.20 y = 3.33  
5.325918834180463 x = 1.60 y = 3.33  
5.469594298628757 x = 2.00 y = 3.33  
5.510706508806351 x = 2.40 y = 3.33  
5.444858811638726 x = 2.80 y = 3.33  
5.266658091362981 x = 3.20 y = 3.33  
4.968880705511956 x = 3.60 y = 3.33  
4.542252118325757 x = 4.00 y = 3.33  
3.975401192804985 x = 4.40 y = 3.33  
3.254796652489127 x = 4.80 y = 3.33  
2.364608152176320 x = 5.20 y = 3.33  
1.286556854218449 x = 5.60 y = 3.33  
3.224473654206619 x = 0.40 y = 3.67  
3.755031859292834 x = 0.80 y = 3.67  
4.170109247425296 x = 1.20 y = 3.67  
4.459264359991018 x = 1.60 y = 3.67  
4.630155478960680 x = 2.00 y = 3.67  
4.692324271726036 x = 2.40 y = 3.67  
4.651723849816081 x = 2.80 y = 3.67  
4.509768844926600 x = 3.20 y = 3.67  
4.263755807740353 x = 3.60 y = 3.67  
3.907408427457649 x = 4.00 y = 3.67  
3.431130355918136 x = 4.40 y = 3.67  
2.821845787986679 x = 4.80 y = 3.67  
2.062430249861319 x = 5.20 y = 3.67



---

1.130907063017110  $x = 5.60$   $y = 3.67$   
1.892512200592618  $x = 0.40$   $y = 4.00$   
2.634350181977057  $x = 0.80$   $y = 4.00$   
3.149959715301469  $x = 1.20$   $y = 4.00$   
3.480104648628398  $x = 1.60$   $y = 4.00$   
3.668669754727677  $x = 2.00$   $y = 4.00$   
3.745942018551803  $x = 2.40$   $y = 4.00$   
3.729174240203732  $x = 2.80$   $y = 4.00$   
3.626168400017753  $x = 3.20$   $y = 4.00$   
3.438196022295978  $x = 3.60$   $y = 4.00$   
3.161726197077119  $x = 4.00$   $y = 4.00$   
2.789096784654000  $x = 4.40$   $y = 4.00$   
2.308256662908903  $x = 4.80$   $y = 4.00$   
1.701590765495936  $x = 5.20$   $y = 4.00$   
0.943871917219441  $x = 5.60$   $y = 4.00$   
0.520455735417566  $x = 0.40$   $y = 4.33$   
1.509127721952076  $x = 0.80$   $y = 4.33$   
2.084505552405893  $x = 1.20$   $y = 4.33$   
2.411755533724203  $x = 1.60$   $y = 4.33$   
2.587707642000597  $x = 2.00$   $y = 4.33$   
2.662830576780535  $x = 2.40$   $y = 4.33$   
2.662093461660062  $x = 2.80$   $y = 4.33$   
2.596765261875470  $x = 3.20$   $y = 4.33$   
2.470364453579457  $x = 3.60$   $y = 4.33$   
2.281434323131619  $x = 4.00$   $y = 4.33$   
2.024504691942613  $x = 4.40$   $y = 4.33$   
1.689724082729764  $x = 4.80$   $y = 4.33$   
1.261035001224852  $x = 5.20$   $y = 4.33$   
0.712220609595488  $x = 5.60$   $y = 4.33$



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