

**Solution to Exercises
Chapter 2**

2.1

```
n = 0:7;  
a = 2*n-1;  
b = 2*n+1;  
aplusb = a+b  
aminusb = a-b  
atimesb = a'*b  
detatimesb = det(atimesb)  
atimesbtranspose = a*b'
```

Answers: aplusb = 0 4 8 12 16 20 24 28
aminusb = -2 -2 -2 -2 -2 -2 -2 -2
atimesb =
-1 -3 -5 -7 -9 -11 -13 -15
1 3 5 7 9 11 13 15
3 9 15 21 27 33 39 45
5 15 25 35 45 55 65 75
7 21 35 49 63 77 91 105
9 27 45 63 81 99 117 135
11 33 55 77 99 121 143 165
13 39 65 91 117 143 169 195
detatimesb = 0 atimesbtranspose = 552

2.2

```
x = sort([17 -3 -47 5 29 -37 51 -7 19], 'descend');  
xs = [x(find(sort(x, 'descend')<=0)), x(find(sort(x, 'descend')>0))]
```

Answer: w = -3 -7 -37 -47 51 29 19 17 5

2.3

```
y = [0, -0.2, 0.4, -0.6, 0.8, -1.0, -1.2, -1.4, 1.6];  
sy = sin(y);  
% (a)  
mx = max(sy(find(sy<0)))  
mn = min(sy(find(sy<0)))  
% (b)  
mp = sqrt(sy(find(sy>0)))
```

Answers: mx = -0.1987 mn = -0.9854 mp = 0.6240 0.8470 0.9998

2.4

```
v = logspace(log10(6), log10(106), 8)  
v5 = v(5)  
z = v(1:2:7)
```

Answers: v5 = 30.9607 z = 6.0000 13.6295 30.9607 70.3300

2.5

```
z = magic(5)
z(:,2) = z(:,2)/sqrt(3);
z(5,:) = z(5,:)+z(3,:);
z(:,1) = z(:,1).*z(:,4);
q = z-diag(diag(z))+diag([2 2 2 2 2]);
format long g
dq = diag(q*q')
format short
qmax = max(max(q))
qmin = min(min(q))
```

Answers: z =

```
17 24 1 8 15
23 5 7 14 16
4 6 13 20 22
10 12 19 21 3
11 18 25 2 9
dq = [486 104189 7300 44522 111024]'
qmax = 330 qmin = 1
```

2.6

```
w = magic(2);
wa = repmat(w, 2, 2)
wb = repmat(w, 3, 1)
wc = [repmat(w, 3, 1), repmat(w', 3, 1)]
wad = [w, w; w, w]
wbd = [w; w; w]
wcd = [w, w'; w, w'; w, w']
```

Answers: wa = % or wad

```
1 3 1 3
4 2 4 2
1 3 1 3
4 2 4 2
```

wb = % or wbd

```
1 3
4 2
1 3
4 2
1 3
4 2
```

wc = % or wcd

```
1 3 1 4
4 2 3 2
1 3 1 4
4 2 3 2
1 3 1 4
4 2 3 2
```

2.7

(a)

```
x = magic(3);
t = x(1,:);
x(1:2,:) = x(2:3,:);
x(3,:) = t;
x
```

Answers: x =

```
3 5 7
4 9 2
8 1 6
```

(b)

```
x = magic(3)
t = x(:,3);
x(:,2:3) = x(:,1:2);
x(:,1) = t;
x
```

Answers: x =

```
6 8 1
7 3 5
2 4 9
```

2.8

```
x = magic(5);
xf = fliplr(x);
xf = fliplr(xf-diag(diag(xf)))
```

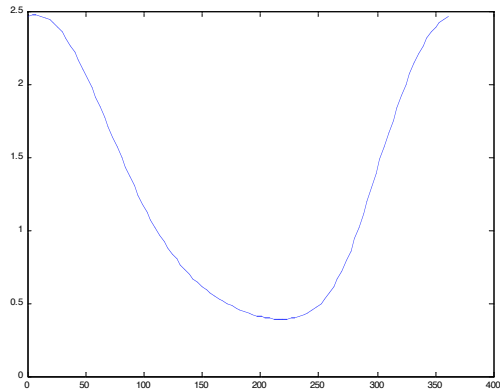
Answer: xf =

```
17 24 1 8 0
23 5 7 0 16
4 6 0 20 22
10 0 19 21 3
0 18 25 2 9
```

2.9

```
a = 1; b = 1.5; e = 0.3;
phi = linspace(0, 2*pi);
s = a*cos(phi)+sqrt(b^2-(a*sin(phi)-e).^2);
plot(phi*180/pi, s)
```

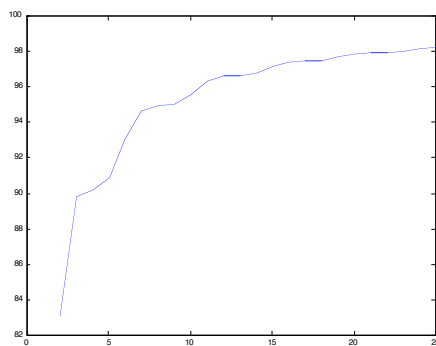
Answer:



2.10

```
n = 1:25;
a = n*pi/sqrt(19);
P = 100*(1+2*cumsum((sin(a)./a).^2))/4.3589;
plot(n(2:25), P(2:25))
```

Answer:



2.11

```
a = sqrt(2.8);
n = 1:100; % (1x100)
x = 1:0.5:5; % (1x9)
exact = a./sqrt(a^2+x.^2).*sin(pi*sqrt(a^2+x.^2))/sin(pi*a);
e = 100*(prod(1-(1./(n.^2-a^2)).*x.^2)-exact)./exact % prod works on columns
```

Answer: e = 1.0001 2.2643 4.0610 6.4176 9.3707 12.9670 17.2642 22.3330 28.2588

2.12

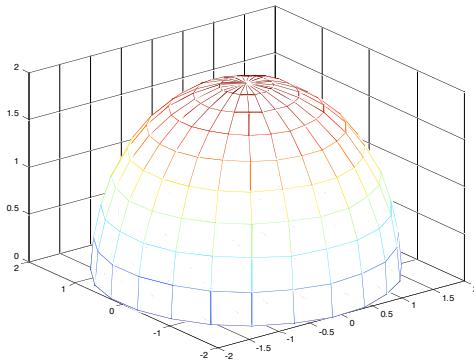
```
x = [72, 82, 97, 103, 113, 117, 126, 127, 139, 154, 159, 199, 207];
beta = 3.644;
delta = (sum(x.^beta)/length(x))^(1/beta)
```

Answer: delta = 144.2741

2.13

```
b = 2;
phi = linspace(0, pi/2, 10);
the = linspace(0, 2*pi, 24);
[p, t] = meshgrid(phi, the);
mesh(b*sin(p).*cos(t), b*sin(p).*sin(t), b*cos(p))
```

Answer:



2.14

```
x = linspace(0.1, 1, 5);
n = -25:25;
y = pi*x*sqrt(2);
exact = 2*pi^4./y.^3.*(sinh(y)+sin(y))./(cosh(y)-cos(y));
[xx, nn] = meshgrid(x, n);
apx = sum(1./(nn.^4+xx.^4));
format long g
comp = [apx' exact']
format short
```

Answer: comp =

10002.1644054971	10002.1644456719
91.7751642291914	91.7752044040698
12.9244097924593	12.9244499673344
4.40350416999114	4.40354434485533
2.15691498449604	2.15695515933427

2.15

```
k = 0:25; n = 2;
x = linspace(1, 6, 6);
[xx, kk] = meshgrid(x, k);
Jn = sum((-1).^kk.*(xx/2).^ (2*kk+n)./factorial(kk)./gamma(kk+1+n));
format long g
Comp = [Jn' besseli(n, x)]
format short
```

Answer: Comp =

0.1149034849319	0.114903484931901
0.352834028615638	0.352834028615638

0.486091260585891	0.486091260585891
0.364128145852073	0.364128145852073
0.0465651162777518	0.0465651162777523
-0.242873209960186	-0.242873209960185

2.16

```
n = 7; k = 1:(2*n-1);
ser = sum(cos(k*pi/n))
```

Answer: ser = -1.0000

2.17

```
n = 6; k = 1:n;
N1 = n*(2*n^2+3*n+1)/6
S1 = sum(k.^2)
N2 = n*(6*n^4+15*n^3+10*n^2-1)/30
S2 = sum(k.^4)
N3 = n^2*(2*n^4+6*n^3+5*n^2-1)/12
S3 = sum(k.^5)
```

Answers: N1 = 91 S1 = 91 N2 = 2275 S2 = 2275 N3 = 12201 S3 = 12201

2.18

```
N = 10; n = 0:N;
PieDiff = sum((4./(8*n+1)-2./(8*n+4)-1./(8*n+5)-1./(8*n+6)).*(1/16).^n) -pi
```

Answer: PieDiff = 0

2.19

```
k=1:300;
dn=0.5*cumsum(1./k);
On = find(dn>1);
d1 = On(1)
tw = find(dn>2);
d2 = tw(1)
th = find(dn>3);
d3 = th(1)
```

Answer: d1 = 4 d2 = 31 d3 = 227

2.20

```
N = 10; k = 0:N;
e = sum(1./factorial(k))-exp(1)
Jo = sum((-1).^k./factorial(k).^2)-besselj(0,2)
co = sum((-1).^k./factorial(2*k))-cos(1)
```

Answers: e = -2.7313e-008 Jo = 6.3838e-016 co = -1.1102e-016

2.21

```
K = 41; k = 1:2:K; y = pi/3; x = 0.75;  
SKdiff = sum(exp(-k*x).*sin(k*y)./k)-0.5*atan(sin(y)/sinh(x))
```

Answer: SKdiff = -2.2204e-016

2.22

```
K = 14; k = 0:K; a = 3; x = -2;  
axdiff = sum((x*log(a)).^k./factorial(k))-a^x
```

Answer: axdiff = 9.0230e-008

2.23

```
N = 500; k = 1:N; z = 10;  
c = pi*coth(pi*z)/(2*z)-1/(2*z^2)  
S1 = cumsum(1./(k.^2+z^2));  
K = find(abs(S1-c)<3e-3);  
N = K(1)
```

Answer: N = 333

2.24

```
w = [-1 -1;1 -1;-1 1;1 1]/2;  
orthw = w'*w  
q = [1 -1 -1 1;1 1 -1 -1;1 -1 1 -1;1 1 1 1]/2;  
orthq = q'*q
```

Answer: orthw =

```
1 0  
0 1
```

orthq =

```
1 0 0 0  
0 1 0 0  
0 0 1 0  
0 0 0 1
```

2.25

```
A = [2 -2 -4; -1 3 4; 1 -2 -3];  
T = A*A-A
```

Answer: T =

```
0 0 0  
0 0 0  
0 0 0
```

2.26

```
A = [1 2 2; 2 1 2; 2 2 1];
T = A*A-4*A-5*eye(3)
```

Answer: T =

```
0 0 0
0 0 0
0 0 0
```

2.27

```
A = [1 -1; 2 -1]; B = [1 1; 4 -1];
T = (A+B)^2-A^2-B^2
```

Answer: T =

```
0 0
0 0
```

2.28

```
A = [7 -2 1; -2 10 -2; 1 -2 7];
P = [1/sqrt(2) 1/sqrt(3) 1/sqrt(6); 0 1/sqrt(3) -2/sqrt(6); -1/sqrt(2) 1/sqrt(3) 1/sqrt(6)];
L = eig(A)
LL = diag(inv(P)*A*P)
```

Answers: L =

```
6.0000
6.0000
12.0000
LL =
6.0000
6.0000
12.0000
```

2.29

```
c = pi/180;
th1 = 30*c; th2 = 30*c; th3 = 30*c;
a1 = 1; a2 = 2; a3 = 3;
a01 = [cos(th1) -sin(th1) 0 a1*cos(th1); sin(th1) cos(th1) 0 a1*sin(th1); 0 0 1 0; 0 0 0 1];
a12 = [cos(th2) -sin(th2) 0 a2*cos(th2); sin(th2) cos(th2) 0 a2*sin(th2); 0 0 1 0; 0 0 0 1];
a23 = [cos(th3) -sin(th3) 0 a3*cos(th3); sin(th3) cos(th3) 0 a3*sin(th3); 0 0 1 0; 0 0 0 1];
t = a01*a12*a23;
thx3 = atan2(t(2,1), t(1,1))/c
thy3 = atan2(t(2,2), t(1,2))/c
qx = t(1,4)
qy = t(2,4)
```

Answers: thx3 = 90.0000 thy3 = 180 qx = 1.8660 qy = 5.2321

2.30

```
c = pi/180;
th1 = 15*c; th2 = 105*c; th3 = 145*c;
```

```

th4 = 0; th5 = 215*c; th6 = 55*c;
a2 = 0.431; a3 = 0.019; r4 = a2; r3 = 0.125;
T12 = [cos(th1) 0 sin(th1) 0; sin(th1) 0 -cos(th1) 0; 0 1 0 0; 0 0 0 1];
T23 = [cos(th2) -sin(th2) 0 a2*cos(th2); sin(th2) cos(th2) 0 a2*sin(th2); 0 0 1 0; 0 0 0 1];
T34 = [cos(th3) 0 sin(th3) a3*cos(th3); sin(th3) 0 -cos(th3) a3*sin(th3); 0 1 0 r3; 0 0 0 1];
T45 = [cos(th4) 0 sin(th4) 0; sin(th4) 0 -cos(th4) 0; 0 1 0 r4; 0 0 0 1];
T56 = [cos(th5) 0 sin(th5) 0; sin(th5) 0 -cos(th5) 0; 0 1 0 0; 0 0 0 1];
T67 = [cos(th6) 0 sin(th6) 0; sin(th6) 0 -cos(th6) 0; 0 1 0 0; 0 0 0 1];
T17 = T12*T23*T34*T45*T56*T67

```

Answer: T17 =

```

0.2418 -0.5540 0.7966 -0.4729
0.9128 -0.1485 -0.3804 -0.2561
0.3290 0.8192 0.4698 0.5459
0 0 0 1.0000

```

2.31

```

x = [17 31 5; 6 5 4; 19 28 9; 12 11 10];
H = diag(x*inv(x'*x)*x')

```

Answer: H = 0.7294 0.9041 0.4477 0.9188

2.32

```

% square
n = 1:2:401;
tau = linspace(-0.5, 0.5, 200);
plot(tau, 4/pi*(1./n)*sin(2*pi*n*tau))

% sawtooth
n = 1:200;
tau = linspace(-1, 1, 200);
plot(tau, 0.5+1/pi*(1./n)*sin(2*pi*n*tau))

% sawtooth
n = 1:200;
tau = linspace(-1, 1, 200);
plot(tau, 0.5-1/pi*(1./n)*sin(2*pi*n*tau))

% triangular
n = 1:200;
tau = linspace(-1, 1, 200);
plot(tau, 0.5*pi-4/pi*((1./(2*n-1)).^2)*cos(pi*(2*n-1)*tau))

% rectified sine wave
n = 1:200;
tau = linspace(-1, 1, 200);
plot(tau, 2/pi+4/pi*((1./(1-4*n.^2))*cos(2*pi*n*tau)))

% half sine wave
n = 2:2:106;
tau = linspace(-2, 2, 200);
plot(tau, 1/pi+.5*sin(pi*tau)-2/pi*(1./(n.^2-1)*cos(pi*n*tau)))

% exponential
n = 1:250;
tau = linspace(0, 4*pi, 350);
plot(tau, (exp(2*pi)-1)/pi*(0.5+((1./(1+n.^2))*cos(n*tau)-(n./(1+n.^2))*sin(n*tau))))

% trapezoidal
n = 1:2:105;

```

```
tau = linspace(-2, 2, 200);
plot(tau, 64*((sin(n*pi/4)./(pi*n).^2)*sin(pi*n*tau)))
```

2.33

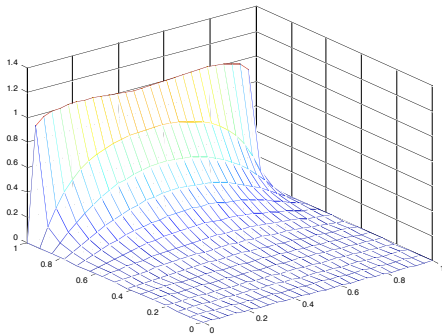
```
a = sqrt(3); n = 1:25;
t = (10:10:80)*pi/180;
c = pi/sinh(pi*a)/2;
b = 1./(n.^2+a^2);
e1 = 100*(b*cos(n*t)./(c*cosh(a*(pi-t))/a-0.5/a^2)-1)
e2 = 100*(n.*b*sin(n*t)./(c*sinh(a*(pi-t))-1)
```

Answers: e1 = -1.2435 0.8565 0.8728 -1.9417 -0.9579 -8.1206 0.7239 1.1661
e2 = 8.0538 10.4192 -8.9135 -5.4994 12.9734 -0.5090 -17.2259 11.2961

2.34

```
n = (1:2:51)*pi; a = 2;
eta = 0:1/14:1; xi = 0:1/14:1;
temp = meshgrid(1./(n.*sinh(n*a)), eta);
z = 4*(temp.*sinh(a*n*eta))*sin(n*xi);
mesh(xi, eta, z)
```

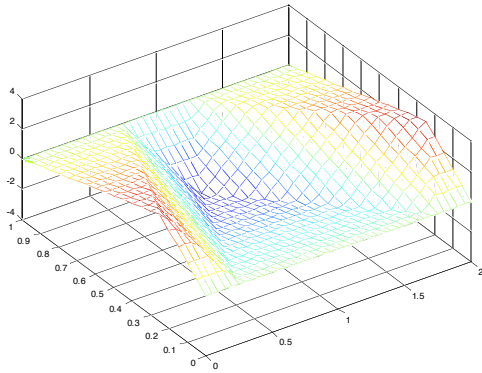
Answer:



2.35

```
n = (1:50)*pi; eta = 0:0.05:1;
tau = 0:0.05:2; a = 0.25;
temp = meshgrid(sin(a*n)./n.^2, eta);
z = 2*pi/a/(1-a)*temp.*sin(n*eta)*cos(n*tau);
mesh(tau, eta, z)
```

Answers:



2.36

```
A = [1 3 4; 31 67 9; 7 5 9];
B = [11 34 6; 7 13 8; 43 10 53];
DADB = det(A)*det(B)
DAB = det(A*B)
```

Answer: DADB = -3832062 DAB = -3832062

2.37

```
syms x y
x1 = -1; y1 = 1; x2 = 0; y2 = 0; x3 = 1; y3 = 1;
p = det([x^2+y^2 x y 1; x1^2+y1^2 x1 y1 1; x2^2+y2^2 x2 y2 1; x3^2+y3^2 x3 y3 1]);
p = factor(p)
```

Answer: $p = 2*(x^2 + y^2 - 2*y)$

2.38

```
syms x y
x1 = -1; y1 = 1; x2 = 1; y2 = 1; x3 = 2; y3 = 2;
p = det([x^2 x y 1; x1^2 x1 y1 1; x2^2 x2 y2 1; x3^2 x3 y3 1]);
p = factor(p)
```

Answer: $p = 2*(x^2 - 3*y + 2)$

2.39

```
A = [16, 32, 33, 13; 5, 11, 10, 8; 9, 7, 6, 12; 34, 14, 15, 1];
c = [91, 16, 5, 43];
supw = A\c' % or supw = linsolve(A, c')
determin = det(A)
invA = inv(A)
```

Answers: supw = [-0.1258 -8.7133 11.2875 -0.0500]'

determin = 7680

invA =

```
-0.0177   -0.0023   0.0180   0.0333
-0.3344   1.2352   -0.4695   0.1000
```

```
0.3500 -1.1375 0.3875 -0.1000
0.0333 -0.1500 0.1500 -0.0333
```

2.40

```
a = 0.005; b = 0.0064; c = 0.008;
E1 = 2.1e9; E2 = 0.21e9;
nu1 = 0.4; nu2 = 0.4; Uo = 0.00025;
Matrix = [1, a^2, 0, 0; 1, b^2, -1, -b^2; ...
          -(1+nu1), (1-nu1)*b^2, (1+nu2)*E1/E2, -(1-nu2)*b^2*E1/E2;...
          0, 0, -(1+nu2), (1-nu2)*c^2];
y = [0, 0, 0, -Uo*E2*c]';
AB = Matrix\y;
hoop1 = -AB(1)/b^2+AB(2)
hoop2 = -AB(3)/b^2+AB(4)
% check
urc = -(1+nu2)*AB(3)/E2/c+(1-nu2)*c*AB(4)/E2

Answers: hoop1 = -6.3013e+007 hoop2 = -1.1790e+007 urc = -2.5000e-004
```

2.41

```
syms i1 i2 i3 R V1 V2 V3
Q1 = 'V1-6*R*i1+4*R*(i2-i1)=0,';
Q2 = 'V2+2*R*(i3-i2)-3*R*i2-4*R*(i2-i1)=0,';
Q3 = '-V3-R*i3-2*R*(i3-i2)=0';
[i1 i2 i3] = solve([Q1 Q2 Q3])

Answer: i1 = 1/182/R*(23*V1 + 12*V2 - 8*V3)
          i2 = 1/91/R*(6*V1 + 15*V2 - 10*V3)
          i3 = 1/91/R*(4*V1 + 10*V2 - 37*V3)
```

2.42

```
Either
syms s t V1 V2 V3 U real
A = [2*s+t -s 0; -s 2*s+t -s; 0 -s s+t];
B = [s*U 0 0]';
V=inv(A)*B

or
syms s t V1 V2 V3 U real
[V1 V2 V3] = solve((2*s+t)*V1-s*V2-s*U, -s*V1+(2*s+t)*V2-s*V3, -s*V2+(s+t)*V3, V1, V2, V3);
V1 = factor(V1)
V2 = factor(V2)
V3 = factor(V3)
gives

Answer: V1 = (U*s*(s^2 + 3*s*t + t^2))/(s^3 + 6*s^2*t + 5*s*t^2 + t^3)
          V2 = (U*s^2*(s + t))/(s^3 + 6*s^2*t + 5*s*t^2 + t^3)
          V3 = (U*s^3)/(s^3 + 6*s^2*t + 5*s*t^2 + t^3)
```