Key to MATLAB Exercise 2 - Solving Linear Systems of Equations

1. >> A=round(10*rand(5))
   >> B=round(20*rand(5))-10
   a) >> det(A) ans =5972
      >> det(A') ans = 5972 Yes
   b) >> det(A+B) ans = 36495
      >> det(A)+det(B) ans = 26384 No
   c) >> det(A*B) ans = 121900464
      >> det(A)*det(B) ans = 121900464 Yes
   d) >> det(A')*det(B') ans = 121900464
      >> det(A'*B') ans = 121900464 Yes
   e) >> det(inv(A)) ans = 1.6745e-004
      >> inv(det(A)) ans = 1.6745e-004 Yes
   f) >> det(A*inv(B)) ans = 0.2926
      >> det(A)*inv(det(B)) ans = 0.2926 Yes
2. >> A=round(10*rand(6)).
   a) >> A=round(10*rand(6)); B=A;B(2,:)=A(1,:);B(1,:)=A(2,:);
      >> det(A) ans = 4636
      >> det(B) ans = -4636
      Interchanging two rows of a matrix changes the sign of the determinant.
   b) >> C=A; C(3, :)=4*A(3, :)
      >> det(C) ans = 18544
      >> det(A)*4 ans = 18544
      Multiplying a single row of a matrix by a scalar has the effect of multiplying the value of the determinant by that scalar.
   c) >> D=A; D(5, :)=A(5, :)+2*A(4, :)
      >> det(A) ans =4636
      >> det(D) ans=4636
      Adding a multiple of one row to another does not change the value of the determinant.
3.
   a) >> A=[1 2; 2 -2]; b=[4;2]; x=A\b
      x =
       2
       1
      >> A*x
      ans =
       4
       2
      >> det(A) ans =-6
      Or
      >> A=[1 2; 2 -2]; b=[4;2]; x=inv(A)*b
      Or

```
>> A=[1 2; 2 -2]; b=[4;2]; c=[A b]; d=rref(c); x=d(:, end)
```

Same does below. Omited.

b)
```
>> A=[2 3; 5 1]; b=[-1;4]; x=A\b
x =
1
-1
>> A*x
ans =
  -1
   4
>> det(a)
ans = -13
```

c)
```
>> A=[4 2 -1;3 -1 2;11 3 0]; b=[2;10;8]; x=A\b
Warning: Matrix is close to singular or badly scaled.
                Results may be inaccurate. RCOND = 5.139921e-018.
x =
   1.0e+016 *
    -0.4053
     1.4862
     1.3511
>> A*x
ans =
        0
        8
        8
>> det(a)
ans = 0
```

It isn't the solution, because det(a)=0。

d)
```
>> A=[1 3 1; 2 1 1; -2 2 -1];    b=[1;5;-8]; x=A\b
x =
        2
       -1
        2
>> A*x
ans =
        1
        5
       -8
>> det(A)
ans =
        3
```

4.

```
>> A=[1 2 3; 2 3 4; 5 4 6]; b=[0;0;1];
>> format rational
```

```
>> A1=det([b A(:, 2:3)]); A2=det([A(:, 1) b A(:, 3)]); A3=det([A(:, 1:2) b]); ADet=det(A);
>> x=[A1/ADet; A2/ADet; A3/ADet]
x =
      1/3
     -2/3
      1/3
```

5.

```
>> AdjOfA=det(A)*inv(A)
AdjOfA =

     2     0    -1
     8    -9     2
    -7     6    -1
```

6.

a)
```
>> A=[2 1 -3; 4 5 1; -2 -1 4]; b=[0;8;2];
>> x=A\b
x =
     4
    -2
     2
>> c=null(A,'r')
c =
   Empty matrix: 3-by-0
```

So x is the solution.

or

```
>> d=rref([A b])
d =
     1     0     0     4
     0     1     0    -2
     0     0     1     2
>> x=d(:,end)
x =
     4
    -2
     2
```

b)
```
>> A=[2 1 -3; 4 5 1; 2 4 4]; b=[0;8;8];
>> c=null(A,'r')
c =
      8/3
     -7/3
      1
>> x0=A\b
Warning: Matrix is singular to working precision.
x0 =
```

```
          -4/3
           8/3
           0
>> syms k
>> x=x0+c*k
x =
     -4/3+8/3*k1
       8/3-7/3*k1
              k1
```

or

```
>> d=rref([A b])
d=
          1          0          -8/3          -4/3
          0          1           7/3           8/3
          0          0           0             0
>> syms k
>> x=d(:,end)+[-d(1:end-1,end-1);1]*k
x =
   [ -4/3+8/3*k]
   [    8/3-7/3*k]
   [              k]
```

7.

```
>> format short
>> A=[2 1 -3; 4 5 1; 2 -2 -10]; d=rref(A)
d =
     1.0000        0        -2.6667
       0         1.0000       2.3333
       0           0            0
>> i=rank(A)
i=
     2
>> x=[-d(1:i,i+1);1]
x =
     2.6667
    -2.3333
     1.0000
>> A*x
ans =
   1.0e-014 *
    -0.0444
    -0.1776
          0
```

8. Omitted
9. Omitted

10.

```
>> A=[1 2 1; 2 4 2; 2 1 1]; B=[3 1 2; 1 2 2; 3 1 4]; C=A+i*B
```

1).

```
C =
   1.0000 + 3.0000i   2.0000 + 1.0000i   1.0000 + 2.0000i
   2.0000 + 1.0000i   4.0000 + 2.0000i   2.0000 + 2.0000i
   2.0000 + 3.0000i   1.0000 + 1.0000i   1.0000 + 4.0000i
>> C'
ans =
   1.0000 - 3.0000i   2.0000 - 1.0000i   2.0000 - 3.0000i
   2.0000 - 1.0000i   4.0000 - 2.0000i   1.0000 - 1.0000i
   1.0000 - 2.0000i   2.0000 - 2.0000i   1.0000 - 4.0000i
>> C.'
ans =
   1.0000 + 3.0000i   2.0000 + 1.0000i   2.0000 + 3.0000i
   2.0000 + 1.0000i   4.0000 + 2.0000i   1.0000 + 1.0000i
   1.0000 + 2.0000i   2.0000 + 2.0000i   1.0000 + 4.0000i
```

The first matrix is the complex conjugate transpose of C while the second one is the transpose of C. Because the elements of C are complex, the results are different.

2).

```
>> A
A =
     1     2     1
     2     4     2
     2     1     1
>> A'
ans =
     1     2     2
     2     4     1
     1     2     1
>> A.'
ans =
     1     2     2
     2     4     1
     1     2     1
```

The first matrix is equal to the second one.

3).

```
>> inv(A)
Warning: Matrix is singular to working precision.
ans =
   Inf   Inf   Inf
   Inf   Inf   Inf
   Inf   Inf   Inf
>> pinv(A)
ans =
   -0.0727   -0.1455    0.6364
    0.1273    0.2545   -0.3636
```

```
    0.0182    0.0364    0.0909
```

The first matrix is not equal to the second one.

4). >> inv(B)

```
ans =
    0.6000   -0.2000   -0.2000
    0.2000    0.6000   -0.4000
   -0.5000         0    0.5000
>> pinv(B)
ans =
    0.6000   -0.2000   -0.2000
    0.2000    0.6000   -0.4000
   -0.5000   -0.0000    0.5000
```

Because B is not singular, inv(B) is equal to pinv(B).

11. Omitted