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Question 3
b)

MatLab Program:

```
function Question3b(~)
    function printConditionNumber(x, diff_x)
        fprintf('Choose x = %f, f(%f) = %f\n', x, x, log(x))
        fprintf('f(%f) = %f, conditionNumber = %f\n', x-diff_x, log(x-
diff_x), cNum(x,x-diff_x))
        fprintf('f(%f) = %f, conditionNumber = %f\n', x+diff_x,
log(x+diff_x), cNum(x,x+diff_x))
    end

    function conditionNumber = cNum(x, new_x)
        relY = log(new_x) / log(x) - 1;
        relX = new_x / x - 1;
        conditionNumber = abs(relY/relX);
    end

    printConditionNumber(0.99990, 0.000005)
    printConditionNumber(1.00010, 0.000005)
    printConditionNumber(9.99990, 0.000005)
    printConditionNumber(10.00010, 0.000005)

end
```

Output:

```
>> Question3b
Choose x = 0.999900, f(0.999900) = -0.000100
f(0.999895) = -0.000105, conditionNumber = 9999.524993
f(0.999905) = -0.000095, conditionNumber = 9999.474991
Choose x = 1.000100, f(1.000100) = 0.000100
f(1.000095) = 0.000095, conditionNumber = 10000.524990
f(1.000105) = 0.000105, conditionNumber = 10000.474993
Choose x = 9.999900, f(9.999900) = 2.302575
f(9.999895) = 2.302575, conditionNumber = 0.434296
f(9.999905) = 2.302576, conditionNumber = 0.434296
Choose x = 10.000100, f(10.000100) = 2.302595
f(10.000095) = 2.302595, conditionNumber = 0.434293
f(10.000105) = 2.302596, conditionNumber = 0.434292
```

Question 5
a)

MatLab Program:

```
function result = exp1(x)
    exp_result = 0;
    new_result = 1;
    i = 1;
    while exp_result ~= new_result;
        exp_result = new_result;
        new_result = new_result + (power(x, i)/factorial(i));
        i = i + 1;
    end
    result = exp_result;
```

```
end

function Question5a(~)
          x_array = -25:1:25;
    for j = x_array(1:end);
        fprintf('exp(%d)=%f, relative error = %f\n', j, exp1(j), rErr(j))
    end

    function relativeError = rErr(x)
        relativeError = (exp1(x) - exp(x))/exp(x);
    end
end
```

Output:

```
>> Question5a
exp(-25)=0.000001, relative error = 58226.187024
exp(-24)=0.000000, relative error = 9966.350698
exp(-23)=0.000000, relative error = 66.228996
exp(-22)=-0.000000, relative error = -115.073655
exp(-21)=0.000000, relative error = 35.386515
exp(-20)=0.000000, relative error = 1.024904
exp(-19)=0.000000, relative error = -0.544198
exp(-18)=0.000000, relative error = 0.049480
exp(-17)=0.000000, relative error = 0.001020
exp(-16)=0.000000, relative error = 0.000285
exp(-15)=0.000000, relative error = 0.000010
exp(-14)=0.000001, relative error = -0.000009
exp(-13)=0.000002, relative error = -0.000001
exp(-12)=0.000006, relative error = 0.000000
exp(-11)=0.000017, relative error = 0.000000
exp(-10)=0.000045, relative error = -0.000000
exp(-9)=0.000123, relative error = -0.000000
exp(-8)=0.000335, relative error = -0.000000
exp(-7)=0.000912, relative error = 0.000000
exp(-6)=0.002479, relative error = -0.000000
exp(-5)=0.006738, relative error = 0.000000
exp(-4)=0.018316, relative error = 0.000000
exp(-3)=0.049787, relative error = 0.000000
exp(-2)=0.135335, relative error = 0.000000
exp(-1)=0.367879, relative error = 0.000000
exp(0)=1.000000, relative error = 0.000000
exp(1)=2.718282, relative error = 0.000000
exp(2)=7.389056, relative error = -0.000000
exp(3)=20.085537, relative error = -0.000000
exp(4)=54.598150, relative error = 0.000000
exp(5)=148.413159, relative error = -0.000000
exp(6)=403.428793, relative error = 0.000000
exp(7)=1096.633158, relative error = -0.000000
exp(8)=2980.957987, relative error = -0.000000
exp(9)=8103.083928, relative error = 0.000000
exp(10)=22026.465795, relative error = -0.000000
exp(11)=59874.141715, relative error = 0.000000
exp(12)=162754.791419, relative error = -0.000000
exp(13)=442413.392009, relative error = -0.000000
exp(14)=1202604.284165, relative error = 0.000000
exp(15)=3269017.372472, relative error = 0.000000
exp(16)=8886110.520508, relative error = 0.000000
exp(17)=24154952.753575, relative error = 0.000000
exp(18)=65659969.137331, relative error = 0.000000
exp(19)=178482300.963187, relative error = -0.000000
```

```
exp(20)=485165195.409790, relative error = -0.000000
exp(21)=1318815734.483214, relative error = -0.000000
exp(22)=3584912846.131593, relative error = 0.000000
exp(23)=9744803446.248905, relative error = 0.000000
exp(24)=26489122129.843472, relative error = 0.000000
exp(25)=72004899337.385880, relative error = 0.000000
```

c)

MatLab Program:

```
function result = exp2(x)
    if x >= 0;
        result = exp1(x);
    else;
        result = 1/exp(-x);
end

function Question5c(~)
    x_array = -25:1:25;
    for j = x_array(1:end);
        fprintf('exp(%d)=%f, relative error = %f\n', j, exp2(j), rErr(j))
    end

    function relativeError = rErr(x)
        relativeError = (exp2(x) - exp(x))/exp(x);
    end
end
```

Output:

```
>> Question5c
exp(-25)=0.000000, relative error = -0.000000
exp(-24)=0.000000, relative error = 0.000000
exp(-23)=0.000000, relative error = 0.000000
exp(-22)=0.000000, relative error = 0.000000
exp(-21)=0.000000, relative error = 0.000000
exp(-20)=0.000000, relative error = 0.000000
exp(-19)=0.000000, relative error = -0.000000
exp(-18)=0.000000, relative error = 0.000000
exp(-17)=0.000000, relative error = 0.000000
exp(-16)=0.000000, relative error = 0.000000
exp(-15)=0.000000, relative error = 0.000000
exp(-14)=0.000001, relative error = 0.000000
exp(-13)=0.000002, relative error = 0.000000
exp(-12)=0.000006, relative error = 0.000000
exp(-11)=0.000017, relative error = 0.000000
exp(-10)=0.000045, relative error = 0.000000
exp(-9)=0.000123, relative error = -0.000000
exp(-8)=0.000335, relative error = 0.000000
exp(-7)=0.000912, relative error = 0.000000
exp(-6)=0.002479, relative error = 0.000000
exp(-5)=0.006738, relative error = 0.000000
exp(-4)=0.018316, relative error = 0.000000
exp(-3)=0.049787, relative error = 0.000000
exp(-2)=0.135335, relative error = 0.000000
exp(-1)=0.367879, relative error = -0.000000
exp(0)=1.000000, relative error = 0.000000
exp(1)=2.718282, relative error = 0.000000
exp(2)=7.389056, relative error = -0.000000
exp(3)=20.085537, relative error = -0.000000
```

```
exp(4)=54.598150, relative error = 0.000000
exp(5)=148.413159, relative error = -0.000000
exp(6)=403.428793, relative error = 0.000000
exp(7)=1096.633158, relative error = -0.000000
exp(8)=2980.957987, relative error = -0.000000
exp(9)=8103.083928, relative error = 0.000000
exp(10)=22026.465795, relative error = -0.000000
exp(11)=59874.141715, relative error = 0.000000
exp(12)=162754.791419, relative error = -0.000000
exp(13)=442413.392009, relative error = -0.000000
exp(14)=1202604.284165, relative error = 0.000000
exp(15)=3269017.372472, relative error = 0.000000
exp(16)=8886110.520508, relative error = 0.000000
exp(17)=24154952.753575, relative error = 0.000000
exp(18)=65659969.137331, relative error = 0.000000
exp(19)=178482300.963187, relative error = -0.000000
exp(20)=485165195.409790, relative error = -0.000000
exp(21)=1318815734.483214, relative error = -0.000000
exp(22)=3584912846.131593, relative error = 0.000000
exp(23)=9744803446.248905, relative error = 0.000000
exp(24)=26489122129.843472, relative error = 0.000000
exp(25)=72004899337.385880, relative error = 0.000000
```