Q1)

```
1    X=(1~=0)|(2>2)&(7<4)
```

Command Window

```
>> Ass2Q1

X =

  logical

   1
```

Name	Value
X	1

A ~= B returns a logical array with elements set to logical 1 (true) where arrays A and B

are not equal; otherwise, the element is logical 0 (false). The test compares both real

and imaginary parts of numeric arrays. ne returns logical 1 (true) where A or B

have NaN or undefined categorical elements and that’s why the answer is logical 1 = true but here it asks about the value

of X which is 1

Q2)

```
p=[1 8 2];
r=roots(p);
```

Command Window

```
>> Ass2Q2

r =

   -7.7417
   -0.2583
```

r = roots(p) return the roots of the polynomial represented by p as a column vector.

Input p is a vector containing n+1 polynomial coefficients, starting with the coefficient of xn.

A coefficient of 0 indicates an intermediate power that is not present in the equation.

For example, p = [1 8 2] represents the polynomial x^2 + 8x -2

Q3)

```
a=12/1*15/1;
b=a/a*a;
c=tand(30)+1/3;
d=1+c;
e=a-b*c+d
```

Command Window

```
>> AssQ3m

e =

   17.9876
```

Name	Value
a	180
b	180
c	0.9107
d	1.9107
e	17.9876

It is basically variables and were substitutes in an equation to get the value of e

As a = 180 , b = 180 , c = which is the tangent of (30) added by 1 divided by 3 as tand(X) returns the tangent of the elements of X, which are expressed in degrees which is 0.9107 and then d is 1 + c (0.9107) = 1.9107 and then e which we substitute the values e = (180) – (180)*0.9107+1.9107 = 17.9876

Q.4. $A = \begin{bmatrix} -7 & 13 & -16 \\ 13 & -10 & 13 \\ -16 & 13 & -7 \end{bmatrix}$

Initial vector n= $x_i = [1.0 \quad -0.8 \quad 0.9]^T$

Formula:

$$x_{i+1} = Ax_i$$

For first iteration: $i = 0$

$$x_1 = Ax_0 = \begin{bmatrix} -7 & 13 & -16 \\ 13 & -10 & 13 \\ -16 & 13 & -7 \end{bmatrix} \begin{bmatrix} 1.0 \\ -0.8 \\ 0.9 \end{bmatrix}$$

$$= \begin{bmatrix} -31.8 \\ 32.7 \\ -32.7 \end{bmatrix}$$

$$= 32.7 \begin{bmatrix} -0.9725 \\ 1 \\ -1 \end{bmatrix}$$

For 2nd iteration:

$$x_2 = Ax_1 = \begin{bmatrix} -7 & 13 & -16 \\ 13 & -10 & 13 \\ -16 & 13 & -7 \end{bmatrix} \begin{bmatrix} -0.9725 \\ 1 \\ -1 \end{bmatrix}$$

$$= \begin{bmatrix} 35.8075 \\ -35.6425 \\ 35.56 \end{bmatrix}$$

$$= 35.8075 \begin{bmatrix} 1 \\ -0.9954 \\ 0.9931 \end{bmatrix}$$

For 3rd iteration:

$$x_3 = Ax_2 = \begin{bmatrix} -7 & 13 & -16 \\ 13 & -10 & 13 \\ -16 & 13 & -7 \end{bmatrix} \begin{bmatrix} 1 \\ -0.9954 \\ 0.9931 \end{bmatrix}$$

$$= \begin{bmatrix} -35.8298 \\ 35.8643 \\ -35.8919 \end{bmatrix}$$

$$= 35.8643 \begin{bmatrix} -0.9990 \\ 1 \\ -1.0008 \end{bmatrix}$$

For 4th iteration:

$$x_4 = Ax_3 = \begin{bmatrix} -7 & 13 & -16 \\ 13 & -10 & 13 \\ -16 & 13 & -7 \end{bmatrix} \begin{bmatrix} -0.9990 \\ 1 \\ -1.0008 \end{bmatrix}$$

$$= \begin{bmatrix} 36.0058 \\ -35.9974 \\ 35.9896 \end{bmatrix}$$

$$= 36.0058 \begin{bmatrix} 1 \\ -0.9998 \\ 0.9996 \end{bmatrix}$$

For 5th iteration:

$$x_5 = Ax_4 = \begin{bmatrix} -7 & 13 & -16 \\ 13 & -10 & 13 \\ -16 & 13 & -7 \end{bmatrix} \begin{bmatrix} 1 \\ -0.9998 \\ 0.9996 \end{bmatrix}$$

$$= \begin{bmatrix} -35.991 \\ 35.9928 \\ -35.9946 \end{bmatrix}$$

$$= 35.9928 \begin{bmatrix} -0.9999 \\ 1 \\ -1.0001 \end{bmatrix}$$

For 6th iteration:

$$x_6 = Ax_5 = \begin{bmatrix} -7 & 13 & -16 \\ 13 & -10 & 13 \\ -16 & 13 & -7 \end{bmatrix} \begin{bmatrix} -0.9999 \\ 1 \\ -1.0001 \end{bmatrix}$$

$$= \begin{bmatrix} 36.0009 \\ -36 \\ 35.9991 \end{bmatrix}$$

$$= 36.0009 \begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}$$

For 7th iteration:

$$x_7 = Ax_6 = \begin{bmatrix} -7 & 13 & -16 \\ 13 & -10 & 13 \\ -16 & 13 & -7 \end{bmatrix} \begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} -36 \\ 36 \\ -36 \end{bmatrix}$$

$$= -36 \begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}$$

Q5)

Denote the variable $T_k\ as\ X, and\ S_k\ as\ Y$

Then the linear equation that fits the data can be given by

$Y = aX + b$

Where,

$$a = Slope = \ a = \frac{N\sum(xy) - \sum x \sum y}{N\sum(x^2) - (\sum x)^2}$$

$$b = Intercept = \frac{(\sum Y) - a\sum X}{N}$$

Here, N = Total Number of Observation (data point)

Construct a table of value as shown below:

	$Tk\ (X)$	$Sk\ (Y)$	XY	$(X)'2$
	0	1.15	0.00	0
	1	2.32	2.32	1
	2	3.32	6.64	4
	3	4.53	13.59	9
	4	5.56	22.60	16

	5	6.97	34.85	25
	6	8.02	48.12	36
	7	9.23	64.61	49
SUM	**28**	**41.19**	**192.73**	**140**

From the table;

$N = 8$

$\sum X = 28$

$\sum Y = 41.19$

$\sum XY = 192.73$

$\sum X^2 = 140$

Use the table values to obtain the values of $\boldsymbol{a}$ and$\boldsymbol{b}$.

So,

$$a = Slope = \frac{(8 \times 192.73) - 28 \times 41.19}{8 \times (140) - (28)^2}$$

$$\Rightarrow a = \frac{388.52}{336} = 1.15631$$

And

$$b = Intercept = \frac{(41.19) - (1.15631) \times 28}{8}$$

$$\Rightarrow b = \frac{8.81332}{8} = 1.10167$$

Required line of best fit will be:

$S = (1.15631)T + 1.10167$

Where,

$a = 1.15631 \approx 1.15630$

$b = 1.10167$

So, option (C) gives the nearest approximation.

Q6

X	Y
1	5.12
3	3
6	2.48
9	2.34
15	2.18

$y = ae^{\beta x}$

$\ln(y) = \ln(a) + \beta x \ \ln(e)$

$Y = A + Bx$

When $Y = \ln(y)$

$A = \ln(a)$

$B = \ln(e)$

Corresponding normal equation we.

$$\sum Y = NA + B\sum x$$

$$\sum XY = A\sum x + B\sum x^2$$

X	y	$Y = In(y)$	x^2	$x.Y$
1	5.122	1.6332	1	1.6332
3	3	1.0986	9	3.2958
6	2.48	0.9083	36	5.4498
9	2.34	0.8502	81	7.6518
15	2.18	0.7793	225	11.6895
$\sum x = 34$	$\sum y = 15.12$	$\sum Y = 5.2696$	$\sum x^2 = 352$	$\sum x.y = 29.7201$

Slope formula $\beta = \frac{n\sum(XY) - \sum X\sum Y}{n\sum(X^2) - (\sum X)^2}$

$$\beta = \frac{5(29.7201) - (34)(5.2696)}{5(352) - (34)^2}$$

= -0.05061

Intercept formula $= \frac{(\sum X^2)\sum y - \sum(XY)\sum x}{n\sum(x^2) - (\sum x)^2}$

$$= \frac{5.2696 - (-0.05061)(34)}{5}$$

= 1.3981

$= \ln(x)$

$1.3980 = \ln(a)$

$a = 4.04709$

$$\boxed{y = 4.047\, e^{-0.0506x}}$$

Q7):

Given equation $\Rightarrow g(x) = \ a + \frac{\beta}{x}$

We can write as:

$y = mx + c$

$y = a + \frac{1}{x}\beta$

$\boldsymbol{x}$	$\boldsymbol{Y = y}$	$\boldsymbol{X = \frac{1}{x}}$	$\boldsymbol{XY}$	$\boldsymbol{X^2}$
1	5.12	1	5.12	1
3	3	0.33	1	0.111
6	2.48	0.166	0.4133	0.0277
9	2.34	0.111	0.26	0.0123
12	2.18	0.0666	0.14533	0.0044
	15.12	**1.677**	**6.93866**	**1.1557**

$$\beta = \frac{5(6.93866) - (1.677)(15.12)}{5(1.1557) - (1.677)^2}$$

$$= 3.14828$$

a $= \dfrac{(15.12) - (3.14828)(1.677)}{5} \quad = 1.9681$

Q8)

Given

$f(x) = \log_4(\cos(x))$

x	0.5	1	1.5
$f(x)$	-0.09420	-0.44408	-1.91069

Construct a divided difference table as shown below:

x	$f(x)$	First Order	Second Order
0.5	-0.09420		
		-0.69976	
1	-0.44408		-223346
		-2.93322	
1.5	-1.91069		

Now, the Newton's divided difference formula is:

$f(x) = f(x_0) + (x - x_0)f(x_0 - x_1) + (x - x_1)f(x_0, x_1, x_2)$

Here,

$x_0 = 0.5 \Rightarrow f(x_0) = \log_4(\cos(0.5)) = -0.09420$

$x_1 = 1 \Rightarrow f(x_1) = \log_4(\cos(1)) = -0.44408$

$x_2 = 1.5 \Rightarrow f(x_2) = \log_4(\cos(1.5)) = -1.191069$

$$f(x_0, x_1) = \frac{f(x_1) - f(x_0)}{(x_1 - x_0)} = \frac{-0.44408 - (-0.09420)}{(1 - 0.5)} = -0.69976$$

$$f(x_1, x_2) = \frac{f(x_2) - f(x_1)}{(x_2 - x_1)} = \frac{-1.91069 - (-0.44408)}{(1.5 - 1)} = -2.93322$$

$$f(x_0, x_1, x_2) = \frac{f(x_1, x_2) - f(x_0, x_1)}{(x_2 - x_0)} = \frac{-2.93322 - (-0.69976)}{1.5 - 0.5} = -2.23346$$

Thus, for $x = 13$

$f(1.3) = -0.09420 + (1.3 - 0.5)(-0.69976) + (1.3 - 0.5)(1.3 - 1)(-2.23346)$

$= -0.09420 - 0.55981 - 0.53603$

$= -1.19004$

Thus, $f(1.3) = -1.19004$

Q9)

Using langrage's interpolation:

$f(x) = x^3 \log_2(x)$

$x_0 = 2 \quad , f(x_0) = 8 \log_\delta(2) = 8$

$x_1 = 3 \quad , f(x_1) = 27 \log_2(3) = 42.72$

$x_2 = 7 \quad , f(x_2) = 343 \log_2(7) = 962.90$

	$\boldsymbol{x}$	$\boldsymbol{y}$
x_0	2	8
x_1	3	42.79399
x_2	7	962.9227

Using larynges, inter pollution formula

$$f(x) = \frac{(x - x_1)(x - x_2) - f(x_0)}{(x_0 - x_1)(x_0 - x_2)} + \frac{(x - x_0)(x - x_2) - f(x_1)}{(x_1 - x_0)(x_1 - x_2)}$$

$$+ \frac{(x - x_0)(x - x_1) - f(x_2)}{(x_2 - x_0)(x_2 - x_1)}$$

$$= \frac{(x - 3)(x - 7)}{(2 - 3)(2 - 7)} 8 + \frac{(x - 2)(x - 7)}{(3 - 2)(3 - 7)} 42.793$$

$$- \frac{(x - 2)(x - 3)}{(2 - 3)(2 - 7)} 962.9227$$

For $x = 5$

$$= \frac{(5 - 3)(5 - 7)}{(2 - 3)(2 - 7)} 8 + \frac{(5 - 2)(5 - 7)}{(3 - 2)(3 - 7)} 42.793$$

$$- \frac{(5 - 2)(5 - 3)}{(2 - 3)(2 - 7)} 962.9227$$

$= -6.4 + 64.1895 + 288.87681$

$f(5) = 346.661$

Q10)

Solution: we choose first 3 points to find velocity approximation that close to 18s.

$$\begin{array}{c|c|c|c|} x/t & 9 & 15 & 20 \\ v & 21 & 32 & 48 \end{array}$$

Using langrage's interpolation

$$v = \frac{(x-x_1)(x-x_1)}{(x_0-x_1)(x_0-x_2)}\ v_o + \frac{(x-x_0)(x-x_2)}{(x_1-x_0)(x_1-x_2)} v_1$$

$$+ \frac{(x-x_0)(x-x_1)}{(x_2-x_0)(x_2-x_1)} \times v_2$$

$$= \frac{(x-15)(x-20)}{(9-15)(9-20)} \times 21 + \frac{(x-9)(x-20)}{(15-9)(15-20)} \times 32$$

$$+ \frac{(x-9)(x-15)}{(20-9)(20-15)} \times 48$$

$$= (x^2 - 35x + 300) \times 0.3182 + (x^2 - 29x + 180) \times (-1.0667)$$

$$+ (x^2 - 24x + 135) \times 0.8727$$

$$v \quad = 0.1242x^2 - 1.1485x + 21.2727$$

$$\frac{dv}{dt} = a = 0.1242 \ \times 2x - 1.1485$$

$$= 0.2484x - 1.1485$$

At $x/t = 185$

$$a = 0.2484 \times 18 - 1.1485$$

$$\mathbf{= 3.3227} \ \frac{\mathrm{m}}{\mathrm{s}^2}$$