Homework 3

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Problem 1

In[ ]:=

```
ClearAll["Global`*"];
y = 1;
n = 5;
For[i = 1, i ≤ n, ++i, y = y * i] ;
nfactorial = y
nfactorial == n! (*the solution is verfied by this example*)

x = 1;
n = 5;
For[i = 1, i ≤ (2 n - 1), i = i + 2, x = x * i]
x
(2 n - 1)!! == x (*the solution is verfied by this example*)

(*The bionmial cooefcient is Binomial[a, b]*)
z = 1;
h = 1;
a = 5;
b = 3;
For[i = a - b + 1, i ≤ a, ++i, z = z * i];
For[i = 1, i ≤ b, ++i, h = h * i] ;
binomialcoefficient = z / h
Binomial[5, 3] == binomialcoefficient
```

Out[ ]= 120

Out[ ]= True

Out[ ]= 945

Out[ ]= True

Out[ ]= 10

Out[ ]= True

Problem 2

In[•]:=
```
ClearAll["Global`*"];
z = 0.5;
y = 0.15;
a = 1/π * NIntegrate[Exp[y * Cos[θ]] * Cos[z * Sin[θ]], {θ, 0, π}]
b = BesselJ[0, Sqrt[z^2 - y^2]]

c = NIntegrate[1/Sqrt[6 - u^2], {u, 2, Sqrt[6]}]
d = ArcCot[N[Sqrt[2]]]
```

Out[•]= 0.943929

Out[•]= 0.943929

Out[•]= 0.61548

Out[•]= 0.61548

Problem 3

In[•]:=
```
ClearAll["Global`*"];
Plot[{(1 + x^-1)^x, x}, {x, 0.1, 3}];
FindRoot[x - (1 + x^-1)^x, {x, 2}]
```

Out[•]= {x → 2.29317}

Problem 4

In[ ]:=
```
ClearAll["Global`*"];
FindMaximum[(θ - Sin[θ])^(5/3)/θ^(2/3), θ]
(*31.8337  the max at theta of 30.4754*)
```

Out[ ]= {31.8337, {θ → 30.4754}}

Problem 5

In[ ]:=
```
ClearAll["Global`*"]
data = {{0.01, 0}, {0.1141, 0.09821}, {0.2181, 0.1843},
   {0.3222, 0.2671}, {0.4262, 0.3384}, {.5303, .426}, {.6343, .5316},
   {.7384, .5845}, {.8424, .6527}, {.9465, .6865}, {1.051, .8015},
   {1.155, .8265}, {1.259, .7696}, {1.363, .7057}, {1.467, .4338}, {1.571, .0}} ;
model = ArcTan[(a Cot[x] Sin[x]^2 - b Cot[x])/(c + d Cos[2 x])];
fit = FindFit[data, model, {a, b, c, d}, x]
modelf = Function[{x}, Evaluate[model /. fit]] ;
Plot[modelf[t], {t, 0, 2}, Epilog → Map[Point, data]];
```

Out[ ]= {a → 883.218, b → 0.086806, c → 615.908, d → 439.499}

Problem 6

In[•]:=

```
ClearAll["Global`*"];
ϵ = 0.16;
γ = 0.4;
ω = 0.97;
L = 1 + ϵ Sin[ω * t + 9 π / 8]^7;
a = 7 ϵ * ω Sin[ω * t + 9 π / 8]^6 Cos[ω * t + 9 π / 8];

{y1sol, y2sol} = NDSolveValue[{y'[t] == x[t], x'[t] == -(2/L * a + γ L) * x[t] - 1/L * Sin[y[t]],
   y[0] == -1, x[0] == 1}, {y[t], x[t]}, {t, 0, 30}]
ParametricPlot[{y1sol, y2sol}, {t, 0, 30}]
```

Out[•]=

```
{InterpolatingFunction[ Domain: {{0., 30.}}
                        Output: scalar ][t],
 InterpolatingFunction[ Domain: {{0., 30.}}
                        Output: scalar ][t]}
```

Out[•]=