Homework 1

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Problem 1:

```
In[ ]:= γ = N[Degree 60];
        α = N[Degree 35];
        n = 4/3;
        d = α - γ + ArcSin[n * Sin[γ - ArcSin[Sin[α] / n]]];
        N[d]
        clear[α, γ, n];

Out[ ]= 0.42025

In[ ]:= k = 1.2/x * (Sqrt[16 x^2 + 1] + 1/(4 x) * Log[Sqrt[16 x^2 + 1] + 4 x])^(-2/3) /. x → 0.45;
        N[k ]
        ClearAll["Global`*"]
Out[ ]= 1.33936

In[ ]:=
```

Problem 2

```
In[ ]:= a = N[Sin[π/15], 50]
        b = N[1/4 Sqrt[7 - Sqrt[5] - Sqrt[30 - 6 Sqrt[5]]], 50]
        a/b
        ClearAll["Global`*"]
Out[ ]= 0.20791169081775933710174228440512516621658476062772

Out[ ]= 0.20791169081775933710174228440512516621658476062772

Out[ ]= 1.00000000000000000000000000000000000000000000000000
```

Problem 3

In[•]:=
```
exact = π^2/(8 α) * (1 - 2/(π Sqrt[α])) Tanh[π Sqrt[α]/2];
summ = Sum[1/(m^2 (m^2 + α)), {m, 1, M, 2}];
Abs[N[exact /. α → 0.5] - N[summ /. {α → 0.5, M → 31}]]
ClearAll["Global`*"]
```

Out[•]= 5.07488×10^{-6}

Problem 4

In[•]:=
```
ClearAll["Global`*"]
a = Sin[(2 m + k) x1/3] * Sin[k * y1] * Sin[(2 m + k) x2/3] * Sin[k * y2];
b = (k^2 + k * m + m^2)^2;
d = Sum[Sum[a/b, {m, 2, 12, 2}], {k, 1, 11, 2}];
N[d /. {x1 → 0.4, y1 → 0.65, x2 → 0.3, y2 → 0.45} ]
```

Out[•]= 0.00428477

Problem 5

In[•]:=
```
k = {{1, 0, -1, 0}, {0, 0, 0, 0}, {-1, 0, 1, 0}, {0, 0, 0, 0}};
t = {{Cos[θ], Sin[θ], 0, 0}, {-Sin[θ], Cos[θ], 0, 0},
   {0, 0, Cos[θ], Sin[θ]}, {0, 0, -Sin[θ], Cos[θ]}};
result = Transpose[t].k.t;
MatrixForm[result]
```

Out[•]//MatrixForm=

$$\begin{pmatrix} \cos[\theta]^2 & \cos[\theta]\sin[\theta] & -\cos[\theta]^2 & -\cos[\theta]\sin[\theta] \\ \cos[\theta]\sin[\theta] & \sin[\theta]^2 & -\cos[\theta]\sin[\theta] & -\sin[\theta]^2 \\ -\cos[\theta]^2 & -\cos[\theta]\sin[\theta] & \cos[\theta]^2 & \cos[\theta]\sin[\theta] \\ -\cos[\theta]\sin[\theta] & -\sin[\theta]^2 & \cos[\theta]\sin[\theta] & \sin[\theta]^2 \end{pmatrix}$$

Problem 6

```
In[•]:= ClearAll["Global`*"]
        matrix = {{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}};
        a = Det[matrix] /. {x1 → -2, y1 → 2, x2 → 0, y2 → 0, x3 → 1, y3 → 1}
        Solve[a == 0, y] /. {x1 → -2, y1 → 2, x2 → 0, y2 → 0, x3 → 1, y3 → 1}
```

Out[•]= $4\,x + 4\,x^2 - 12\,y + 4\,y^2$

Out[•]= $\left\{\left\{y \to \frac{1}{2}\left(3 - \sqrt{9 - 4\,x - 4\,x^2}\right)\right\}, \left\{y \to \frac{1}{2}\left(3 + \sqrt{9 - 4\,x - 4\,x^2}\right)\right\}\right\}$

Problem 7

```
In[•]:= ClearAll["Global`*"]
        A = {{10/3, 5/3, 10/7}, {10/3, 30/7, 50/9}, {20/9, 5, 50/7}};
        B = {5/3, 9/7, 2/3};
        c = LinearSolve[A, B]
        A.c == B (*if the answer is true. then what we obtained is verified*)
```

Out[•]= $\left\{\frac{33}{26}, -\frac{16}{5}, \frac{126}{65}\right\}$

Out[•]= True

Problem 8

```
In[•]:= ClearAll["Global`*"]
        d = Det[{{30 - λ, -Sqrt[6], -Sqrt[6]}, {-Sqrt[6], 41 - λ, -15}, {-Sqrt[6], -15, 41 - λ}}];
        Solve[d == 0, λ]
```

Out[•]= $\{\{\lambda \to 24\}, \{\lambda \to 32\}, \{\lambda \to 56\}\}$

Problem 9

In[ ]:=
```
ClearAll["Global`*"];
```

$$d = \begin{pmatrix} 0 & 0 & 0 & 0.83 & 0.83 & 0.5 & 0.5 & 0.11 & 0.11 & 0 \\ 0.94 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0.98 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.98 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.98 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.98 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.98 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.98 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.97 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.97 & 0 \end{pmatrix};$$

```
w = Eigensystem[d];
eigen = w[[1]]
real = Select[eigen, FreeQ[#, Complex] &]
Max[real]
```

Out[ ]=
```
{1.19025, 0.242897 + 0.862085 i, 0.242897 - 0.862085 i,
 -0.804648 + 0.286163 i, -0.804648 - 0.286163 i, 0.159505 + 0.589166 i,
 0.159505 - 0.589166 i, -0.19288 + 0.552497 i, -0.19288 - 0.552497 i, 0.}
```

Out[ ]=
```
{1.19025, 0.}
```

Out[ ]=
```
1.19025
```

Problem 10

In[ ]:=
```
ClearAll["Global`*"]
B = {{3, 6, 6}, {6, 3, 6}, {6, 6, 3}};
B.B - 12 B - 45 * IdentityMatrix[3] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$