

Question 2

Source Code

```
/*-----
File: heattransfer.c
Author: Armin Teymouri
Description: This program calculates the rate of heat transfer of a
            certain material with given dimensions and known coefficient
            of thermal conductivity.
-----*/

#include <stdio.h>
#define K 273.15
// function prototypes
double calculateH(BLOCK);

//Structure Prototype
typedef struct
{
    int s; //s will be the index used to select the proper material from the array of
k values.
    double x;
    double y;
    double z;
    double T1;
    double T2;
} BLOCK;
/*-----
Function: main
Description: Requests from the user the dimensions of the block and the
            type of material. Calls another function to calculate the rate
            of heat transfer.
-----*/

int main()
{
    BLOCK block1; //declares block1 a structure of type BLOCK.
    // Variable declarations
    double h, k;

    double materialH[5] = {0.15, 0.8, 35.3, 401, 46};

    // Instructions

    printf("Please enter the length(x), width(y), and depth(z) of the block in
cm.\n");
    scanf("%lf%lf%lf", &block1.x, &block1.y, &block1.z);
    printf("Please enter the temperature of the front fact and the temperature of the
back face in Celsius.\n");
    scanf("%lf%lf", &block1.T2, &block1.T1);
    printf("Please select the type of material of the block (1) Oak (2) Glass (3)
Lead (4) Copper (5) Steel.\n");
    scanf("%d", &block1.s);

    h = calculateH(block1);
```

```

        printf("For substances with dimensions x = %.2f cm, y = %.2f cm, z = %.2f cm\n",
block1.x, block1.y, block1.z);
        printf("and face temperatures T2 = %.2f Celsius and T1 = %.2f\n", block1.T2,
block1.T1);
        printf("and head conductivity k = %.2f W/m K\n", materialH[block1.s - 1]);
        printf("the heat transfer rate is %.4f watts\n", h);

        return 0;
    }
/*-----
Function: calculateH
Parameters:
    block1 - Structure type defined by BLOCK. BLOCK is shown before the main function.
Return: The value returned, h, is the rate of heat transfer.
Description: This function first finds which coefficient of thermal conductivity to
use.
            It then converts all input parameters into the proper units of
measurements
            then uses a simple function to find the value of h. It then returns h.
-----*/
double calculateH(BLOCK block1)
{
    // Variable declarations
    double h, k, x, y, z, t1, t2; //k will be used in the calculation. it represents
the coefficient of thermal conductivity.

    double materialH[5] = {0.15, 0.8, 35.3, 401, 46};
    // Instructions
    k = materialH[block1.s - 1];

    x = block1.x/100;
    y = block1.y/100;
    z = block1.z/100;
    t1 = block1.T1+K;
    t2 = block1.T2+K;

    h = (k*(x*y)*(t2 - t1))/z;

    return h;
}

```

Test Cases

```
"C:\Users\Armin\Desktop\School\Computation\As...  — □ ×
Please enter the length(x), width(y), and depth(z) of the block in cm.
15.2
4.3
30
Please enter the temperature of the front fact and the temperature of the back f
ace in Celsius.
20.5
10.4
Please select the type of material of the block (1) Oak (2) Glass (3) Lead (4)
Copper (5) Steel.
1
For substances with dimensions x = 15.20 cm, y = 4.30 cm, z = 30.00 cm
and face temperatures T2 = 20.50 Celsius and T1 = 10.40
and head conductivity k = 0.15 W/m K
the heat transfer rate is 0.0330 watts

Process returned 0 (0x0)  execution time : 22.042 s
Press any key to continue.
```

```
"C:\Users\Armin\Desktop\School\Computation\As...  — □ ×
Please enter the length(x), width(y), and depth(z) of the block in cm.
25
25
18
Please enter the temperature of the front fact and the temperature of the back f
ace in Celsius.
13.81
25.6
Please select the type of material of the block (1) Oak (2) Glass (3) Lead (4)
Copper (5) Steel.
2
For substances with dimensions x = 25.00 cm, y = 25.00 cm, z = 18.00 cm
and face temperatures T2 = 13.81 Celsius and T1 = 25.60
and head conductivity k = 0.80 W/m K
the heat transfer rate is -3.2750 watts

Process returned 0 (0x0)  execution time : 12.585 s
Press any key to continue.
```

```
"C:\Users\Armin\Desktop\School\Computation\As...  — □ ×
Please enter the length(x), width(y), and depth(z) of the block in cm.
2.5
2.5
.5
Please enter the temperature of the front fact and the temperature of the back f
ace in Celsius.
20
15
Please select the type of material of the block  (1) Oak (2) Glass (3) Lead (4)
Copper (5) Steel.
3
For substances with dimensions x = 2.50 cm, y = 2.50 cm, z = 0.50 cm
and face temperatures T2 = 20.00 Celsius and T1 = 15.00
and head conductivity k = 35.30 W/m K
the heat transfer rate is 22.0625 watts

Process returned 0 (0x0)  execution time : 14.964 s
Press any key to continue.
```

```
"C:\Users\Armin\Desktop\School\Computation\As...  — □ ×
Please enter the length(x), width(y), and depth(z) of the block in cm.
5.18
7.45
50
Please enter the temperature of the front fact and the temperature of the back f
ace in Celsius.
20
15
Please select the type of material of the block  (1) Oak (2) Glass (3) Lead (4)
Copper (5) Steel.
4
For substances with dimensions x = 5.18 cm, y = 7.45 cm, z = 50.00 cm
and face temperatures T2 = 20.00 Celsius and T1 = 15.00
and head conductivity k = 401.00 W/m K
the heat transfer rate is 15.4750 watts

Process returned 0 (0x0)  execution time : 19.609 s
Press any key to continue.
```

```
"C:\Users\Armin\Desktop\School\Computation\As...  -  □  ×

Please enter the length(x), width(y), and depth(z) of the block in cm.
2.5
2.5
20
Please enter the temperature of the front fact and the temperature of the back f
ace in Celsius.
20
15
Please select the type of material of the block (1) Oak (2) Glass (3) Lead (4)
Copper (5) Steel.
5
For substances with dimensions x = 2.50 cm, y = 2.50 cm, z = 20.00 cm
and face temperatures T2 = 20.00 Celsius and T1 = 15.00
and head conductivity k = 46.00 W/m K
the heat transfer rate is 0.7188 watts

Process returned 0 (0x0)  execution time : 12.951 s
Press any key to continue.
```

```
"C:\Users\Armin\Desktop\School\Computation\As...  -  □  ×

Please enter the length(x), width(y), and depth(z) of the block in cm.
2.5
2.5
10
Please enter the temperature of the front fact and the temperature of the back f
ace in Celsius.
-5.30
-20.5
Please select the type of material of the block (1) Oak (2) Glass (3) Lead (4)
Copper (5) Steel.
3
For substances with dimensions x = 2.50 cm, y = 2.50 cm, z = 10.00 cm
and face temperatures T2 = -5.30 Celsius and T1 = -20.50
and head conductivity k = 35.30 W/m K
the heat transfer rate is 3.3535 watts

Process returned 0 (0x0)  execution time : 16.074 s
Press any key to continue.
```

```
"C:\Users\Armin\Desktop\School\Computation\As...  — □ ×
Please enter the length(x), width(y), and depth(z) of the block in cm.
15.2
4.3
1.5
Please enter the temperature of the front fact and the temperature of the back f
ace in Celsius.
50.75
25.6
Please select the type of material of the block (1) Oak (2) Glass (3) Lead (4)
Copper (5) Steel.
4
For substances with dimensions x = 15.20 cm, y = 4.30 cm, z = 1.50 cm
and face temperatures T2 = 50.75 Celsius and T1 = 25.60
and head conductivity k = 401.00 W/m K
the heat transfer rate is 4394.4360 watts

Process returned 0 (0x0)   execution time : 18.706 s
Press any key to continue.
```