

Task 1

1. Thermoelectric devices (TEDs) are solid state devices capable of converting a temperature difference into electric power. As the interest for alternative sources of energy grows, the demand for TEDs will increase in the future. As a consequence, your company is developing a recycling process for TEDs.

A sample from commercial TEDs received by your company revealed that their composition:

Fraction	Mass (g)
Semiconductor (Bi_2Te_3)	x.xx
Connectors (Cu)	x.xx
Ceramic (Al_2O_3)	x.xx

- What is the chemical composition of TEDs (15 points)?
(Atomic masses (g/mol) are: Bi = 209; T_{e} = 128; Cu = 63,5; Al = 27; O = 16)

Student number	Data	
1	Fraction	Mass (g)
	Semiconductor (Bi_2Te_3)	1.1
	Connectors (Cu)	5.75
	Ceramic (Al_2O_3)	13.15
2	Fraction	Mass (g)
	Semiconductor (Bi_2Te_3)	1.15
	Connectors (Cu)	5.7
	Ceramic (Al_2O_3)	13.15
3	Fraction	Mass (g)
	Semiconductor (Bi_2Te_3)	1.2
	Connectors (Cu)	5.65
	Ceramic (Al_2O_3)	13.15
4	Fraction	Mass (g)
	Semiconductor (Bi_2Te_3)	1.25
	Connectors (Cu)	5.6
	Ceramic (Al_2O_3)	13.15
5	Fraction	Mass (g)
	Semiconductor (Bi_2Te_3)	1.3
	Connectors (Cu)	5.55
	Ceramic (Al_2O_3)	13.15
6	Fraction	Mass (g)
	Semiconductor (Bi_2Te_3)	1.35
	Connectors (Cu)	5.5
	Ceramic (Al_2O_3)	13.15
7	Fraction	Mass (g)
	Semiconductor (Bi_2Te_3)	1.4
	Connectors (Cu)	5.45
	Ceramic (Al_2O_3)	13.15
	Fraction	Mass (g)

8	100936375	Semiconductor (Bi ₂ Te ₃)	1.1
		Connectors (Cu)	5.4
		Ceramic (Al ₂ O ₃)	13.5
9	101511634	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.15
		Connectors (Cu)	5.35
		Ceramic (Al ₂ O ₃)	13.5
10	101799689	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.2
		Connectors (Cu)	5.4
		Ceramic (Al ₂ O ₃)	13.4
11	101796323	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.25
		Connectors (Cu)	5.46
		Ceramic (Al ₂ O ₃)	13.29
12	770851	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.3
		Connectors (Cu)	5.37
		Ceramic (Al ₂ O ₃)	13.33
13	101374693	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.35
		Connectors (Cu)	5.26
		Ceramic (Al ₂ O ₃)	13.39
14	101844783	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.4
		Connectors (Cu)	5.16
		Ceramic (Al ₂ O ₃)	13.44
15	647104	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.12
		Connectors (Cu)	5.72
		Ceramic (Al ₂ O ₃)	13.16
16	100918966	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.14
		Connectors (Cu)	5.65
		Ceramic (Al ₂ O ₃)	13.21
17	101844563	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.16
		Connectors (Cu)	5.44
		Ceramic (Al ₂ O ₃)	13.4
18	100566486	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.24
		Connectors (Cu)	5.67
		Ceramic (Al ₂ O ₃)	13.09
19	101579472	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.26
		Connectors (Cu)	5.64
		Ceramic (Al ₂ O ₃)	13.1
		Fraction	Mass (g)

20	101432483	Semiconductor (Bi ₂ Te ₃)	1.28
		Connectors (Cu)	5.76
		Ceramic (Al ₂ O ₃)	12.96
21	69376J	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.31
		Connectors (Cu)	5.55
		Ceramic (Al ₂ O ₃)	13.14
22	101579715	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.34
		Connectors (Cu)	5.65
		Ceramic (Al ₂ O ₃)	13.01
23	101549114	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.36
		Connectors (Cu)	5.76
		Ceramic (Al ₂ O ₃)	12.88
24	716983	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.26
		Connectors (Cu)	5.34
		Ceramic (Al ₂ O ₃)	13.4
25	779632	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.1
		Connectors (Cu)	5.75
		Ceramic (Al ₂ O ₃)	13.15
26	101382546	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.15
		Connectors (Cu)	5.7
		Ceramic (Al ₂ O ₃)	13.15
27	100944493	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.2
		Connectors (Cu)	5.65
		Ceramic (Al ₂ O ₃)	13.15
28	101795955	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.25
		Connectors (Cu)	5.6
		Ceramic (Al ₂ O ₃)	13.15
29	902739	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.3
		Connectors (Cu)	5.55
		Ceramic (Al ₂ O ₃)	13.15
30	101403991	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.15
		Connectors (Cu)	5.7
		Ceramic (Al ₂ O ₃)	13.15
31	101737780	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.2
		Connectors (Cu)	5.65
		Ceramic (Al ₂ O ₃)	13.15
		Fraction	Mass (g)

		Semiconductor (Bi ₂ Te ₃)	1.25
		Connectors (Cu)	5.6
32	101847528	Ceramic (Al ₂ O ₃)	13.15
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.3
		Connectors (Cu)	5.55
33	901578	Ceramic (Al ₂ O ₃)	13.15
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.35
		Connectors (Cu)	5.5
34	101473280	Ceramic (Al ₂ O ₃)	13.15
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.4
		Connectors (Cu)	5.45
35	787213	Ceramic (Al ₂ O ₃)	13.15
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.1
		Connectors (Cu)	5.4
36	101726539	Ceramic (Al ₂ O ₃)	13.5
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.15
		Connectors (Cu)	5.35
37	101848598	Ceramic (Al ₂ O ₃)	13.5
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.2
		Connectors (Cu)	5.4
38	101797393	Ceramic (Al ₂ O ₃)	13.4
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.25
		Connectors (Cu)	5.46
39	100832152	Ceramic (Al ₂ O ₃)	13.29
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.3
		Connectors (Cu)	5.37
40	101444044	Ceramic (Al ₂ O ₃)	13.33
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.35
		Connectors (Cu)	5.26
41	100525210	Ceramic (Al ₂ O ₃)	13.39
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.4
		Connectors (Cu)	5.16
42	890757	Ceramic (Al ₂ O ₃)	13.44
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.12
		Connectors (Cu)	5.72
43	477824	Ceramic (Al ₂ O ₃)	13.16
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.14

44	101443715	Connectors (Cu)	5.65
		Ceramic (Al ₂ O ₃)	13.21
45	100483899	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.16
		Connectors (Cu)	5.44
		Ceramic (Al ₂ O ₃)	13.4
46	101509497	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.24
		Connectors (Cu)	5.67
		Ceramic (Al ₂ O ₃)	13.09
47	101550255	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.26
		Connectors (Cu)	5.64
		Ceramic (Al ₂ O ₃)	13.1
48	101426499	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.28
		Connectors (Cu)	5.76
		Ceramic (Al ₂ O ₃)	12.96
49	101410667	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.31
		Connectors (Cu)	5.55
		Ceramic (Al ₂ O ₃)	13.14
50	101432344	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.34
		Connectors (Cu)	5.65
		Ceramic (Al ₂ O ₃)	13.01
51	101564322	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.36
		Connectors (Cu)	5.76
		Ceramic (Al ₂ O ₃)	12.88
52	101913627	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.26
		Connectors (Cu)	5.34
		Ceramic (Al ₂ O ₃)	13.4
53	884226	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.1
		Connectors (Cu)	5.75
		Ceramic (Al ₂ O ₃)	13.15
54	788377	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.15
		Connectors (Cu)	5.7
		Ceramic (Al ₂ O ₃)	13.15
55	101849445	Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.2
		Connectors (Cu)	5.65
		Ceramic (Al ₂ O ₃)	13.15
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.25
		Connectors (Cu)	5.6

56	101435684	Ceramic (Al ₂ O ₃)	13.15
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.3
		Connectors (Cu)	5.55
57	100756364	Ceramic (Al ₂ O ₃)	13.15
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.1
		Connectors (Cu)	5.4
58	82601K	Ceramic (Al ₂ O ₃)	13.5
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.15
		Connectors (Cu)	5.35
59	101632814	Ceramic (Al ₂ O ₃)	13.5
		Fraction	Mass (g)
		Semiconductor (Bi ₂ Te ₃)	1.2
		Connectors (Cu)	5.4
60	100575040	Ceramic (Al ₂ O ₃)	13.4

temperature gradient
expected that the
is considering the

have the following