```
//  Zu Aufgabe 8
//  nur Teillösung,  überarbeitet


#include <iostream>
using namespace std;


class Z {
public:

      Z (int s = 0, int e = 0) {
            expo = e;
            signi = s;
      }

      friend Z add (Z, Z);
      friend Z sub (Z, Z);
      friend Z mul (Z, Z);
      friend Z div (Z, Z);

      void print ();
      void normalize ();

private:

      int expo;    // -99 <= expo <= +99
      int signi;   // -9999 <= signi <= 9999
      // Nichtzahl : {signi=0 ^ expo=99}

};//Z
```

```
void Z::print () {
            cout << signi << " E" << expo << endl;
}// print


void Z::normalize () {
      if  (signi == 0 && expo == 99)
            return;
      // Normalisierung der Null
      if  (signi == 0) {
            expo = 0;
            return;
      }
      while ((abs (signi) < 1000) && (expo != -99)) {
            signi *= 10;
            expo -= 1;
      }
}//normalize



Z add (Z a, Z b) {
      if (   (a.expo == 99 && a.signi == 0)
            || (b.expo == 99 && b.signi == 0))
      return Z (0, 99);

      a.normalize ();
      b.normalize ();

      if (a.signi == 0)
            return b;
      if (b.signi == 0)
            return a;
```

```
    int s;
    int e;
    if (a.expo == b.expo) {
        s = a.signi + b.signi;
        e = a.expo;
    } else if (a.expo > b.expo) {
        s = b.signi;
        e = a.expo;
        for (int x = a.expo - b.expo; x != 0; --x)
            s /= 10;
        s += a.signi;
    } else  {
        s = a.signi;
        e = b.expo;
        for (int x = b.expo - a.expo;  x != 0;  --x)
          s /= 10;
        s += b.signi;
    }
    if (s > 9999 || s < -9999) {
          s = s / 10;
        if  (e == 99) {
            s = 0;
        } else {
            e += 1;
        }
    }
    return Z (s, e);
}//add


Z sub (Z a, Z b) {
    return add (a, Z (-b.signi, b.expo));
}// sub
```

```
Z mul (Z a, Z b) {
    if (   (a.expo == 99 && a.signi == 0)
        || (b.expo == 99 && b.signi == 0))
        return Z (0, 99);          // Nichtzahl
    if (   (a.signi == 0)
        || (b.signi == 0))
        return Z (0, 0);           // Null
    int x = a.signi * b.signi;
    int y = a.expo + b.expo;
    while (abs (x) > 9999) {
        x /= 10;
        y += 1;
    }
    // Exponenten in Grenzregionen
    while ((abs (x) < 1000) && (y > -99)) {
        x *= 10;
        y -= 1;  }
    if (y == -102) {
        x /= 1000;
        y = -99;
    } else if (y == -101) {
        x /= 100;
        y = -99;
    } else if (y == -100) {
        x /= 10;
        y = -99;
    }
    if  (y < -99)
        return Z ();
    if  ((abs (x) < 10000) && (y < 100))
        return Z (x, y);
    else
        return Z (0, 99);
}//mul
```

```
Z div (Z a, Z b) {
      a.normalize ();
      b.normalize ();
      if (   (a.expo == 99 && a.signi == 0)
            || (b.expo == 99 && b.signi == 0))
         return Z (0, 99);
      if    (a.expo == 0 && a.signi == 0)
         return Z (0, 0);                    //  0/0 = 0 !
      if    (b.expo == 0 && b.signi == 0)
         return Z (0, 99);

      // Divisor 1
      if    ((b.signi == 1000) && (b.expo == -3))
            return a;

      // verbesserungswürdig
      int  x = (a.signi*100000) / b.signi;
      int  y = a.expo - b.expo - 5;
      while (abs (x) > 9999) {
            x /= 10;
            y += 1;
      }
      if  (y < -99)
            return Z ();
      if  ((abs (x) < 10000) && (y < 100))
            return Z (x, y);
      else
            return Z (0, 99);
}//div
```

```
int main () {

      Z a (1, -99);
      Z b (2, -89);
      Z x (8, -89);
      Z y (1, 11);

      cout << "a = "; a.print ();
      cout << "b = "; b.print ();
      cout << "x = "; x.print ();
      cout << "y = "; y.print ();
      cout << endl;


      cout << "b/y = "; div (b, y).print ();
      cout << "x/y = "; div (x, y).print ();
      cout << "a/a = "; div (a, a).print ();
      cout << endl;

      cout << "ERST  = "; div (add (mul (a, y), b), add (mul
(a, y), x)).print ();
      cout << "ZWEIT = "; div (add (div (b, y), a), add (div
(x, y), a)).print ();
      cout << endl;

return 0;
}//main
```

**/* Ausgabe:**

**a = 1 E-99**
**b = 2 E-89**
**x = 8 E-89**
**y = 1 E11**

**b/y = 0 E0**
**x/y = 0 E0**
**a/a = 1000 E-3**

**ERST = 6666 E-4**
**ZWEIT = 1000 E-3**

***/**