All problems solved with Lindo 6.1

1 a.

```
max c
ST
g = 0
b - a <= 8
f - a <= 10
e - b <= 4
c - b <= 4
d - c <= 3
e - d <= 25
f - d <= 18
d - e <= 9
g - e <= 7
a - f <= 5
b - f <= 7
c - f <= 3
e - f <= 2
h - g <= 3
d - g <= 2
a - h <= 4
b - h <= 9
END
```

Reports Window

```
       OBJECTIVE FUNCTION VALUE

       1)      16.00000

 VARIABLE        VALUE          REDUCED COST
        C        16.000000          0.000000
        G         0.000000          0.000000
        B        12.000000          0.000000
        A         4.000000          0.000000
        F        13.000000          0.000000
        E         0.000000          0.000000
        D         0.000000          0.000000
        H         3.000000          0.000000


      ROW   SLACK OR SURPLUS     DUAL PRICES
        2)         0.000000          1.000000
        3)         0.000000          0.000000
        4)         1.000000          0.000000
        5)        22.000000          0.000000
        6)         0.000000          1.000000
```

b.

LP OPTIMUM FOUND AT STEP 0

OBJECTIVE FUNCTION VALUE

1) 7.000000

VARIABLE	VALUE	REDUCED COST
A	7.000000	0.000000
G	0.000000	0.000000
B	12.000000	0.000000
F	13.000000	0.000000
E	15.000000	0.000000
C	16.000000	0.000000
D	2.000000	0.000000
H	3.000000	0.000000

NO. ITERATIONS= 0

LP OPTIMUM FOUND AT STEP 0

OBJECTIVE FUNCTION VALUE

1) 2.000000

VARIABLE	VALUE	REDUCED COST
D	2.000000	0.000000
G	0.000000	0.000000
B	12.000000	0.000000
A	7.000000	0.000000
F	13.000000	0.000000
E	15.000000	0.000000
C	16.000000	0.000000
H	3.000000	0.000000

NO. ITERATIONS= 0

LP OPTIMUM FOUND AT STEP 0

OBJECTIVE FUNCTION VALUE

1) 12.00000

VARIABLE	VALUE	REDUCED COST
B	12.000000	0.000000
G	0.000000	0.000000
A	7.000000	0.000000
F	13.000000	0.000000
E	15.000000	0.000000
C	16.000000	0.000000
D	2.000000	0.000000
H	3.000000	0.000000

NO. ITERATIONS= 1

LP OPTIMUM FOUND AT STEP 0

OBJECTIVE FUNCTION VALUE

1) 17.00000

VARIABLE	VALUE	REDUCED COST
F	17.000000	0.000000
G	0.000000	0.000000
B	12.000000	0.000000
A	7.000000	0.000000
E	19.000000	0.000000
C	16.000000	0.000000
D	2.000000	0.000000
H	3.000000	0.000000

NO. ITERATIONS= 0

LP OPTIMUM FOUND AT STEP 1

OBJECTIVE FUNCTION VALUE

1) 19.00000

VARIABLE	VALUE	REDUCED COST
E	19.000000	0.000000
G	0.000000	0.000000
B	12.000000	0.000000
A	7.000000	0.000000
F	17.000000	0.000000
C	16.000000	0.000000
D	2.000000	0.000000
H	3.000000	0.000000

NO. ITERATIONS= 0

LP OPTIMUM FOUND AT STEP 0

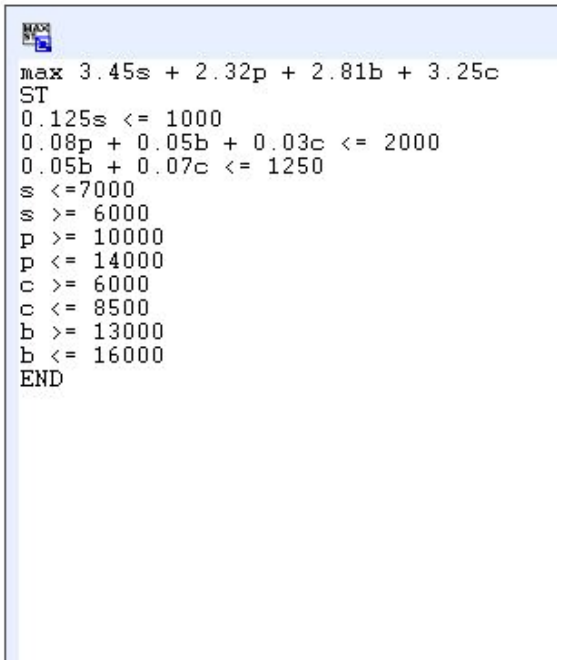
OBJECTIVE FUNCTION VALUE

1) 3.000000

VARIABLE	VALUE	REDUCED COST
H	3.000000	0.000000
G	0.000000	0.000000
B	12.000000	0.000000
A	7.000000	0.000000
F	17.000000	0.000000
E	19.000000	0.000000
C	16.000000	0.000000
D	2.000000	0.000000

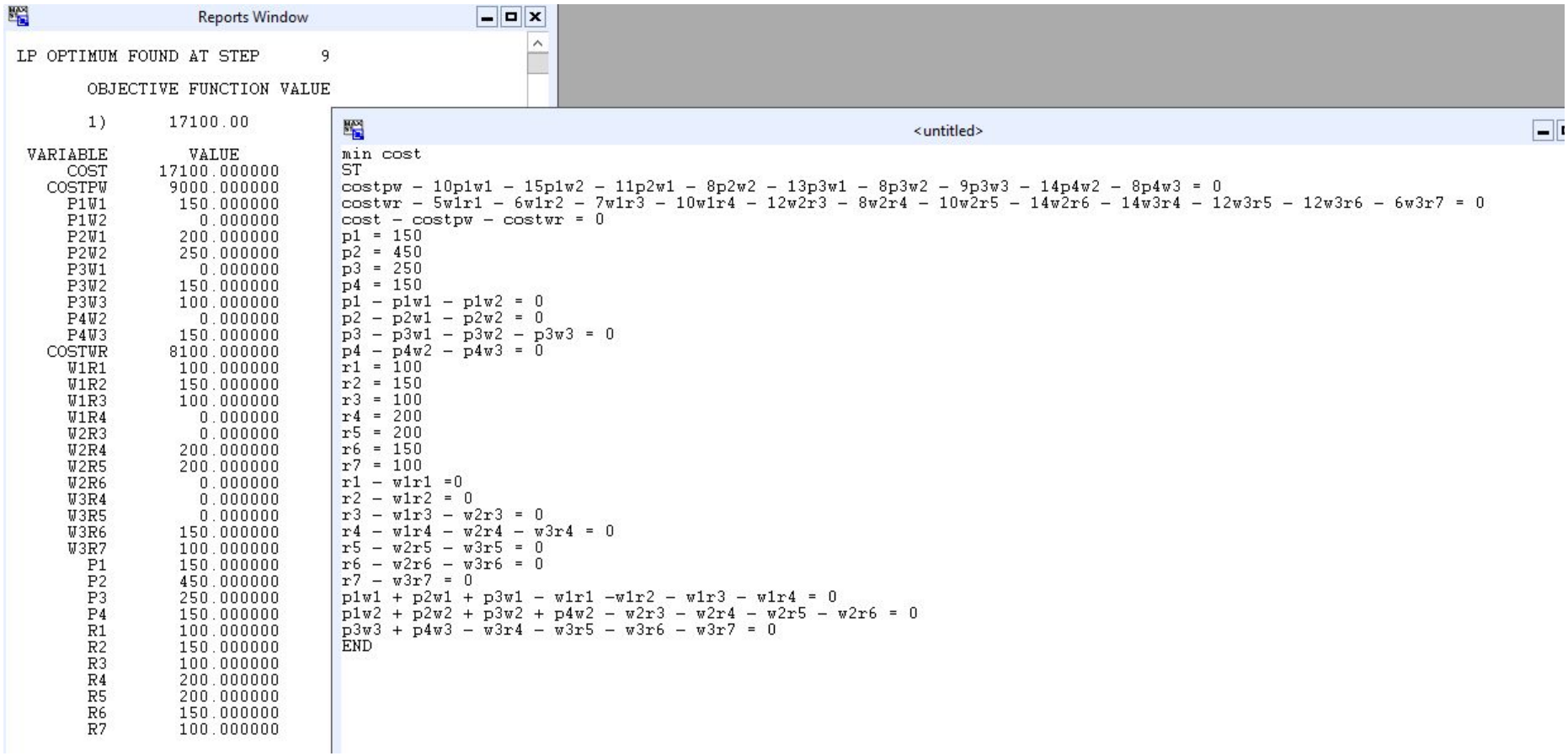
2.

```
LP OPTIMUM FOUND AT STEP      0

       OBJECTIVE FUNCTION VALUE

       1)      120196.0

 VARIABLE        VALUE          REDUCED COST
        S      7000.000000          0.000000
        P     13625.000000          0.000000
        B     13100.000000          0.000000
        C      8500.000000          0.000000


      ROW    SLACK OR SURPLUS     DUAL PRICES
        2)       125.000000          0.000000
        3)         0.000000         29.000000
        4)         0.000000         27.200001
        5)         0.000000          3.450000
        6)      1000.000000          0.000000
        7)      3625.000000          0.000000
        8)       375.000000          0.000000
        9)      2500.000000          0.000000
       10)         0.000000          0.476000
       11)       100.000000          0.000000
       12)      2900.000000          0.000000

NO. ITERATIONS=       0
```

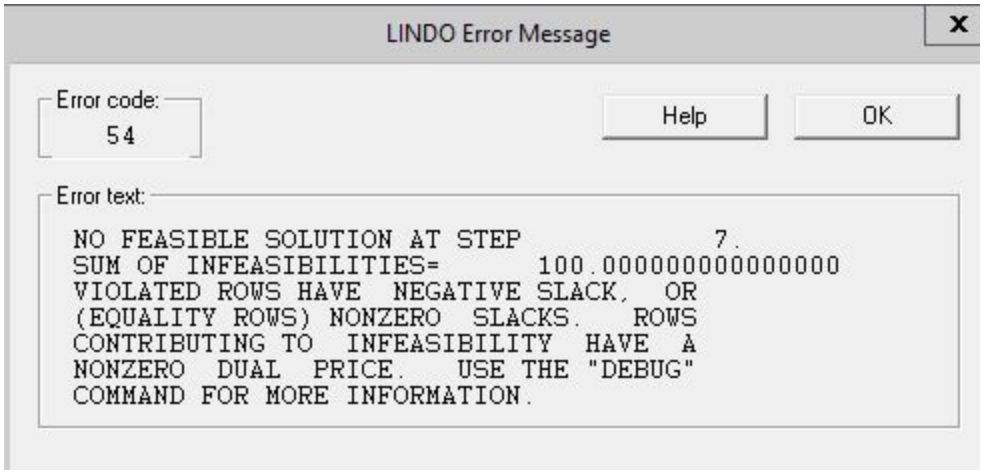


```
max 3.45s + 2.32p + 2.81b + 3.25c
ST
0.125s <= 1000
0.08p + 0.05b + 0.03c <= 2000
0.05b + 0.07c <= 1250
s <=7000
s >= 6000
p >= 10000
p <= 14000
c >= 6000
c <= 8500
b >= 13000
b <= 16000
END
```

3 a. Cost = 17100



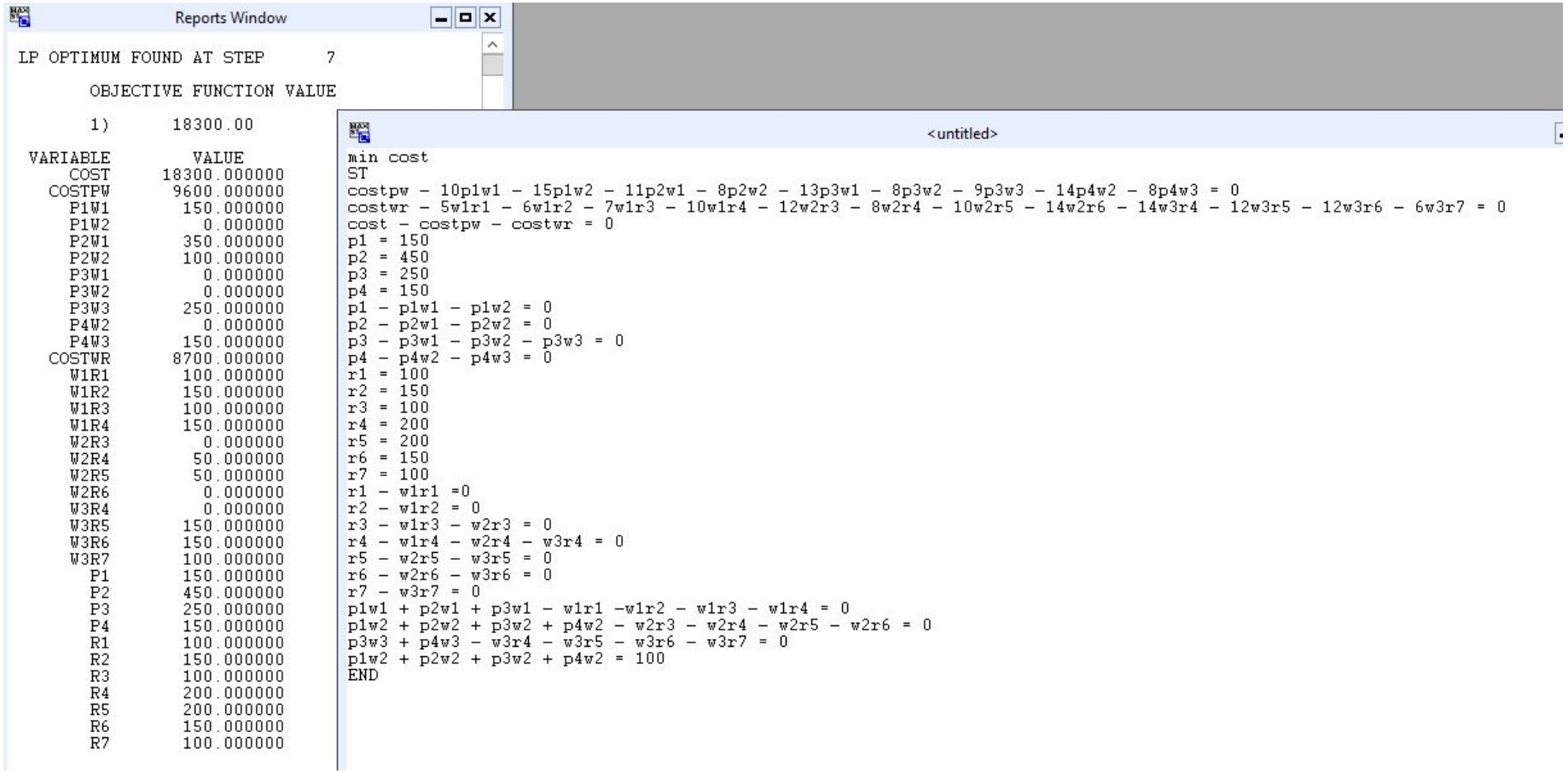
b.The solution is infeasible because warehouse 3 is the only warehouse that ships to retailers 5, 6 and 7 which require 450 fridges total. Factories 3 and 4 are the only ones that can reach warehouse 3 and they only produce 400 between them.



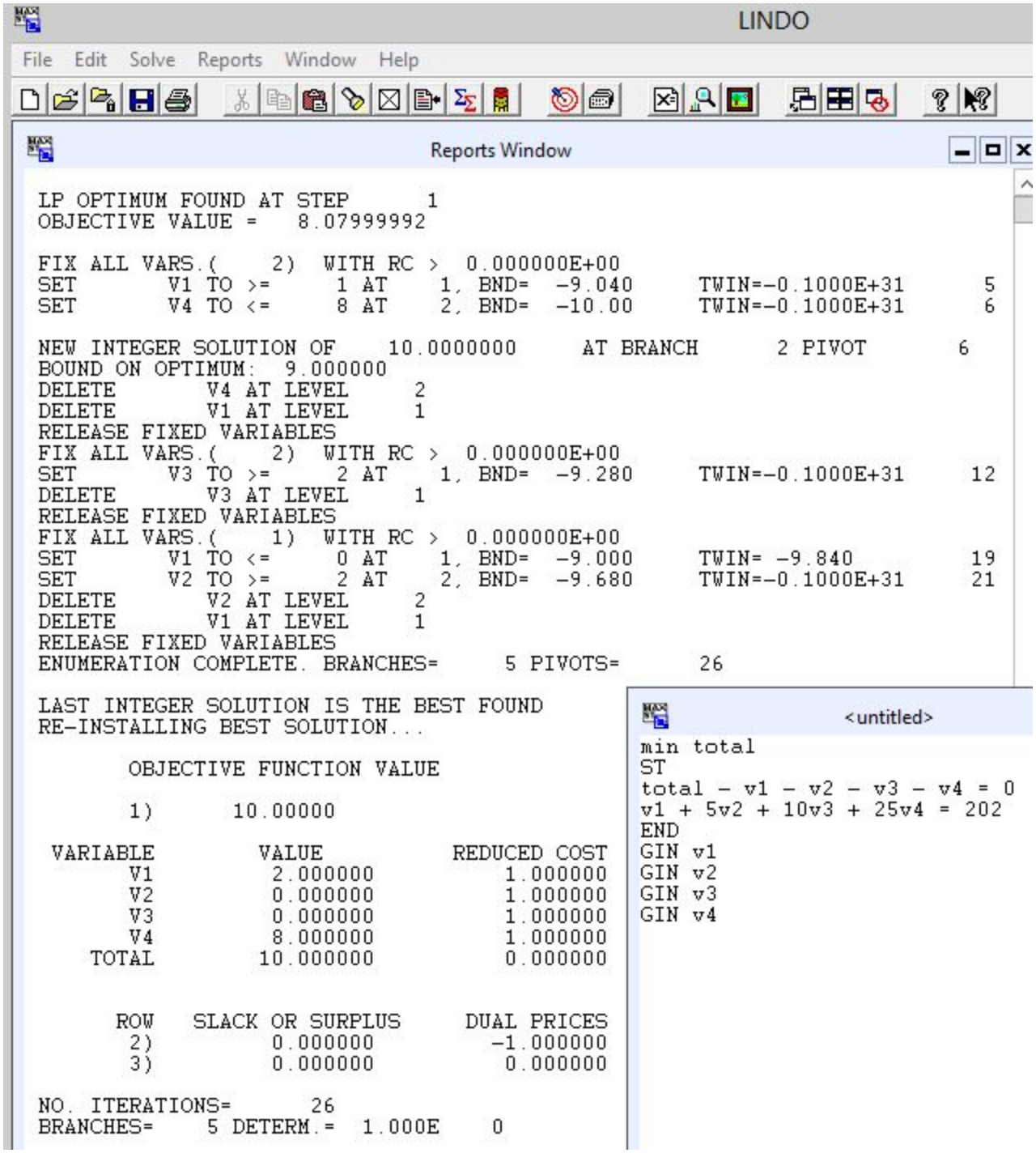
<untitled>

```
min cost
ST
costpw - 10p1w1 - 15p1w2 - 11p2w1 - 8p2w2 - 13p3w1 - 8p3w2 - 9p3w3 - 14p4w2 - 8p4w3 = 0
costwr - 5w1r1 - 6w1r2 - 7w1r3 - 10w1r4 - 12w2r3 - 8w2r4 - 10w2r5 - 14w2r6 - 14w3r4 - 12w3r5 - 12w3r6 - 6w3r7 = 0
cost - costpw - costwr = 0
p1 = 150
p2 = 450
p3 = 250
p4 = 150
p1 - p1w1 - p1w2 = 0
p2 - p2w1 - p2w2 = 0
p3 - p3w1 - p3w2 - p3w3 = 0
p4 - p4w2 - p4w3 = 0
r1 = 100
r2 = 150
r3 = 100
r4 = 200
r5 = 200
r6 = 150
r7 = 100
r1 - w1r1 =0
r2 - w1r2 = 0
r3 - w1r3 - w2r3 = 0
r4 - w1r4 - w2r4 - w3r4 = 0
r5 - w2r5 - w3r5 = 0
r6 - w2r6 - w3r6 = 0
r7 - w3r7 = 0
p1w1 + p2w1 + p3w1 - w1r1 -w1r2 - w1r3 - w1r4 = 0
p1w2 + p2w2 + p3w2 + p4w2 - w2r3 - w2r4 - w2r5 - w2r6 = 0
p3w3 + p4w3 - w3r4 - w3r5 - w3r6 - w3r7 = 0
p1w2=0
p2w2 =0
p3w2=0
p4w2=0
END
```

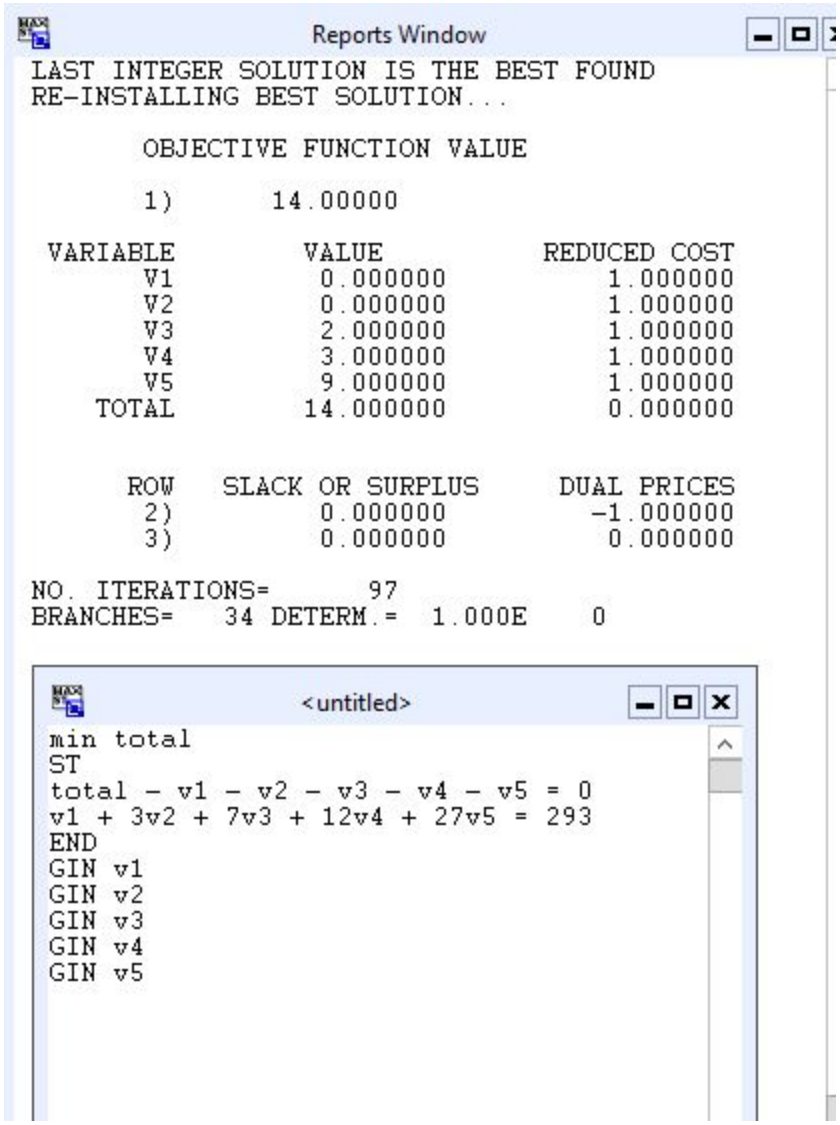
C. Cost = 18300



4. A


LINDO
File Edit Solve Reports Window Help
Reports Window
LP OPTIMUM FOUND AT STEP 1
OBJECTIVE VALUE = 8.07999992
FIX ALL VARS.(2) WITH RC > 0.000000E+00
SET V1 TO >= 1 AT 1, BND= -9.040 TWIN=-0.1000E+31 5
SET V4 TO <= 8 AT 2, BND= -10.00 TWIN=-0.1000E+31 6
NEW INTEGER SOLUTION OF 10.0000000 AT BRANCH 2 PIVOT 6
BOUND ON OPTIMUM: 9.000000
DELETE V4 AT LEVEL 2
DELETE V1 AT LEVEL 1
RELEASE FIXED VARIABLES
FIX ALL VARS.(2) WITH RC > 0.000000E+00
SET V3 TO >= 2 AT 1, BND= -9.280 TWIN=-0.1000E+31 12
DELETE V3 AT LEVEL 1
RELEASE FIXED VARIABLES
FIX ALL VARS.(1) WITH RC > 0.000000E+00
SET V1 TO <= 0 AT 1, BND= -9.000 TWIN= -9.840 19
SET V2 TO >= 2 AT 2, BND= -9.680 TWIN=-0.1000E+31 21
DELETE V2 AT LEVEL 2
DELETE V1 AT LEVEL 1
RELEASE FIXED VARIABLES
ENUMERATION COMPLETE. BRANCHES= 5 PIVOTS= 26
LAST INTEGER SOLUTION IS THE BEST FOUND
RE-INSTALLING BEST SOLUTION...
OBJECTIVE FUNCTION VALUE
1) 10.00000
VARIABLE VALUE REDUCED COST
V1 2.000000 1.000000
V2 0.000000 1.000000
V3 0.000000 1.000000
V4 8.000000 1.000000
TOTAL 10.000000 0.000000
ROW SLACK OR SURPLUS DUAL PRICES
2) 0.000000 -1.000000
3) 0.000000 0.000000
NO. ITERATIONS= 26
BRANCHES= 5 DETERM.= 1.000E 0
<untitled>
min total
ST
total - v1 - v2 - v3 - v4 = 0
v1 + 5v2 + 10v3 + 25v4 = 202
END
GIN v1
GIN v2
GIN v3
GIN v4

b.


Reports Window
LAST INTEGER SOLUTION IS THE BEST FOUND
RE-INSTALLING BEST SOLUTION...
OBJECTIVE FUNCTION VALUE
1) 14.00000
VARIABLE VALUE REDUCED COST
V1 0.000000 1.000000
V2 0.000000 1.000000
V3 2.000000 1.000000
V4 3.000000 1.000000
V5 9.000000 1.000000
TOTAL 14.000000 0.000000
ROW SLACK OR SURPLUS DUAL PRICES
2) 0.000000 -1.000000
3) 0.000000 0.000000
NO. ITERATIONS= 97
BRANCHES= 34 DETERM.= 1.000E 0
<untitled>
min total
ST
total - v1 - v2 - v3 - v4 - v5 = 0
v1 + 3v2 + 7v3 + 12v4 + 27v5 = 293
END
GIN v1
GIN v2
GIN v3
GIN v4
GIN v5