1.a

```
p1(G = (V,E), v):
    G' := copy(G)
    for i in inc(v):
        for j in out(v):
            G'w(i,j) := min(G'w(i,j), Gw(i,v) + Gw(v,j))
    return G'
```

1.b

```
p2(G = (V,E), G' = (V-v,E')):
    for x in V:
        minval := inf
        for j in Gout(v):
            minval := min(minval, Gw(v,j) + spd(j,x))
        spd(v,x) := minval
    for x in V:
        minval := inf
        for j in Gin(v):
            minval := min(minval, Gw(j,v) + spd(x,j))
        spd(x,v) := minval
    return
```

1.c

```
APSP(G = (V,E)):
    v := arbitrary vertex in V
    if |V| = 1:
        spd(v,v) := w(v,v)
        return
    G' := P1(G,v)
    APSP(G')
    P2(G,G',v)
    spd(v,v) := inf
    for x in out(v):
        spd(v,v) := min(spd(v,v), spd(x,v) + w(v,x))
    return
```