

1.

10.4 The actions are quite similar to the monkey and bananas problem—you should probably assign only one of these two problems. The actions are:

Action(ACTION: *Go*(x, y), PRECOND: $At(Shakey, x) \wedge In(x, r) \wedge In(y, r)$,
EFFECT: $At(Shakey, y) \wedge \neg(At(Shakey, x))$)
Action(ACTION: *Push*(b, x, y), PRECOND: $At(Shakey, x) \wedge Pushable(b)$,
EFFECT: $At(b, y) \wedge At(Shakey, y) \wedge \neg At(b, x) \wedge \neg At(Shakey, x)$)
Action(ACTION: *ClimbUp*(b), PRECOND: $At(Shakey, x) \wedge At(b, x) \wedge Climbable(b)$,
EFFECT: $On(Shakey, b) \wedge \neg On(Shakey, Floor)$)
Action(ACTION: *ClimbDown*(b), PRECOND: $On(Shakey, b)$,
EFFECT: $On(Shakey, Floor) \wedge \neg On(Shakey, b)$)
Action(ACTION: *TurnOn*(l), PRECOND: $On(Shakey, b) \wedge At(Shakey, x) \wedge At(l, x)$,
EFFECT: *TurnedOn*(l))
Action(ACTION: *TurnOff*(l), PRECOND: $On(Shakey, b) \wedge At(Shakey, x) \wedge At(l, x)$,
EFFECT: $\neg TurnedOn(l)$)

The initial state is:

$In(Switch_1, Room_1) \wedge In(Door_1, Room_1) \wedge In(Door_1, Corridor)$
 $In(Switch_1, Room_2) \wedge In(Door_2, Room_2) \wedge In(Door_2, Corridor)$
 $In(Switch_1, Room_3) \wedge In(Door_3, Room_3) \wedge In(Door_3, Corridor)$
 $In(Switch_1, Room_4) \wedge In(Door_4, Room_4) \wedge In(Door_4, Corridor)$
 $In(Shakey, Room_3) \wedge At(Shakey, X_S)$
 $In(Box_1, Room_1) \wedge In(Box_2, Room_1) \wedge In(Box_3, Room_1) \wedge In(Box_4, Room_1)$
 $Climbable(Box_1) \wedge Climbable(Box_2) \wedge Climbable(Box_3) \wedge Climbable(Box_4)$
 $Pushable(Box_1) \wedge Pushable(Box_2) \wedge Pushable(Box_3) \wedge Pushable(Box_4)$
 $At(Box_1, X_1) \wedge At(Box_2, X_2) \wedge At(Box_3, X_3) \wedge At(Box_4, X_4)$
 $TurnedOn(Switch_1) \wedge TurnedOn(Switch_4)$

A plan to achieve the goal is:

Go($X_S, Door_3$)
Go($Door_3, Door_1$)
Go($Door_1, X_2$)
Push($Box_2, X_2, Door_1$)
Push($Box_2, Door_1, Door_2$)
Push($Box_2, Door_2, Switch_2$)

2.

Goals and preconditions can only be positive literals. So a negative effect can only make it harder to achieve a goal (or a precondition to an action that achieves the goal). Therefore, eliminating all negative effects only makes a problem easier. This would *not* be true if negative preconditions and goals were allowed.