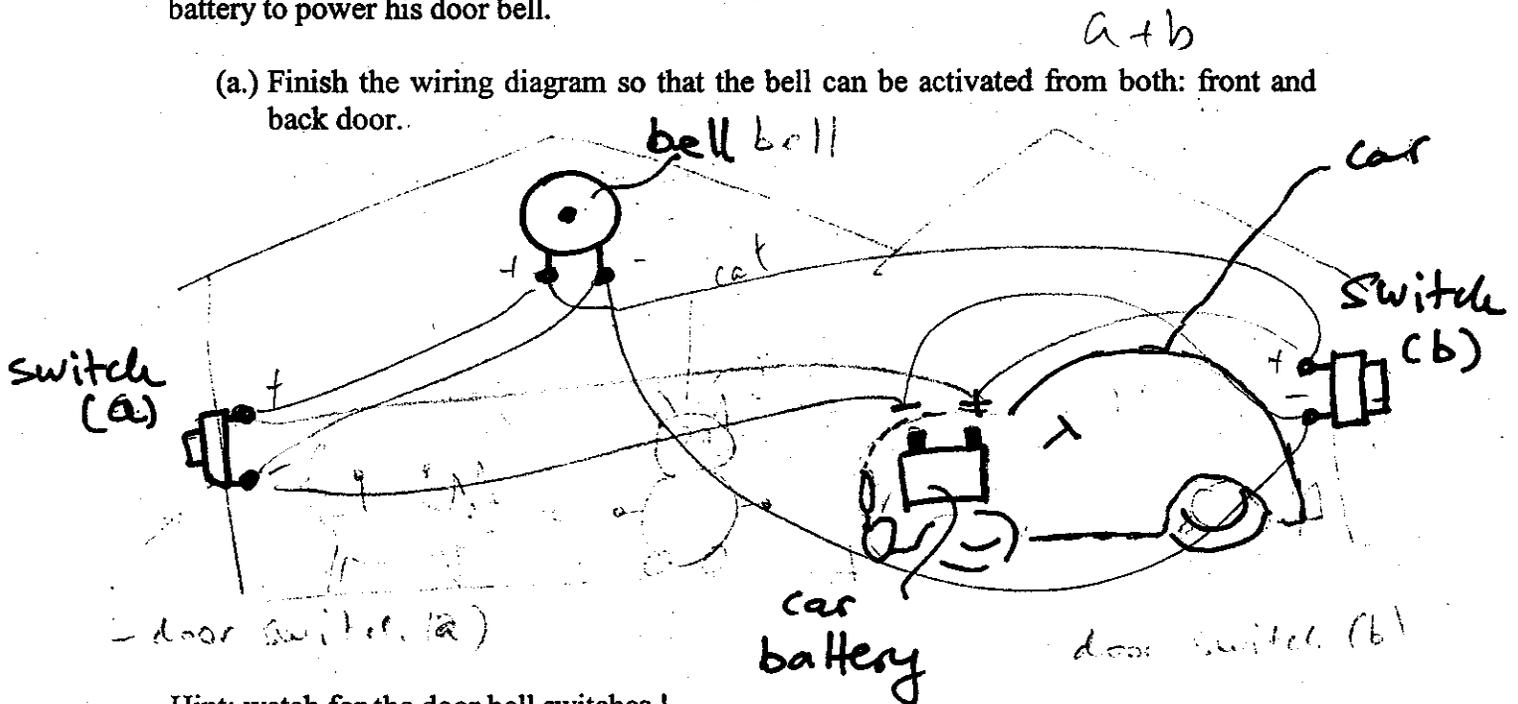**Your Name:** -

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

$a + b$

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f(a,b) = ab' + ba'$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?   Yes
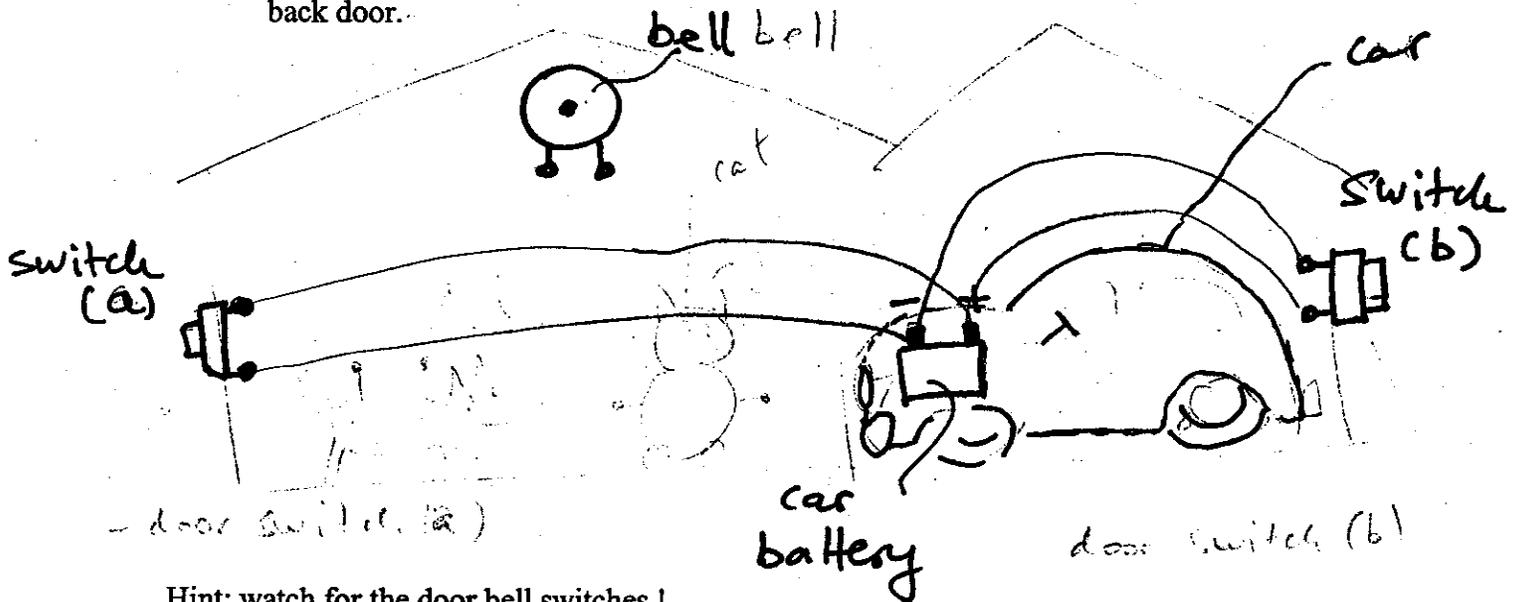
(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

No

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

bell bell

car

switch (b)

switch (a)

door switch (a)

car battery

door switch (b)

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$) $(\bar{a} + b) + (a + \bar{b}) + (a + b)$

a	b	f
0	1	1
1	0	1
0	0	0
1	1	1

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?
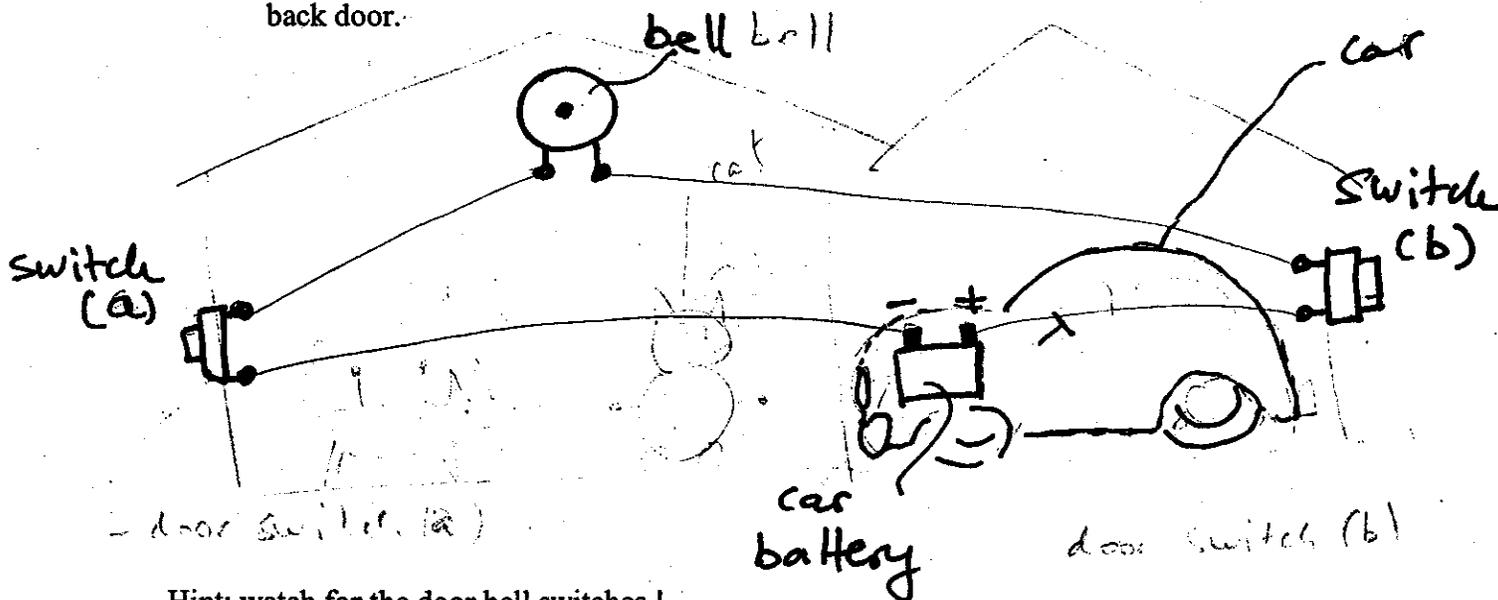
Yes

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

No

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f(a,b) = \bar{a}b + \bar{b}a$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?
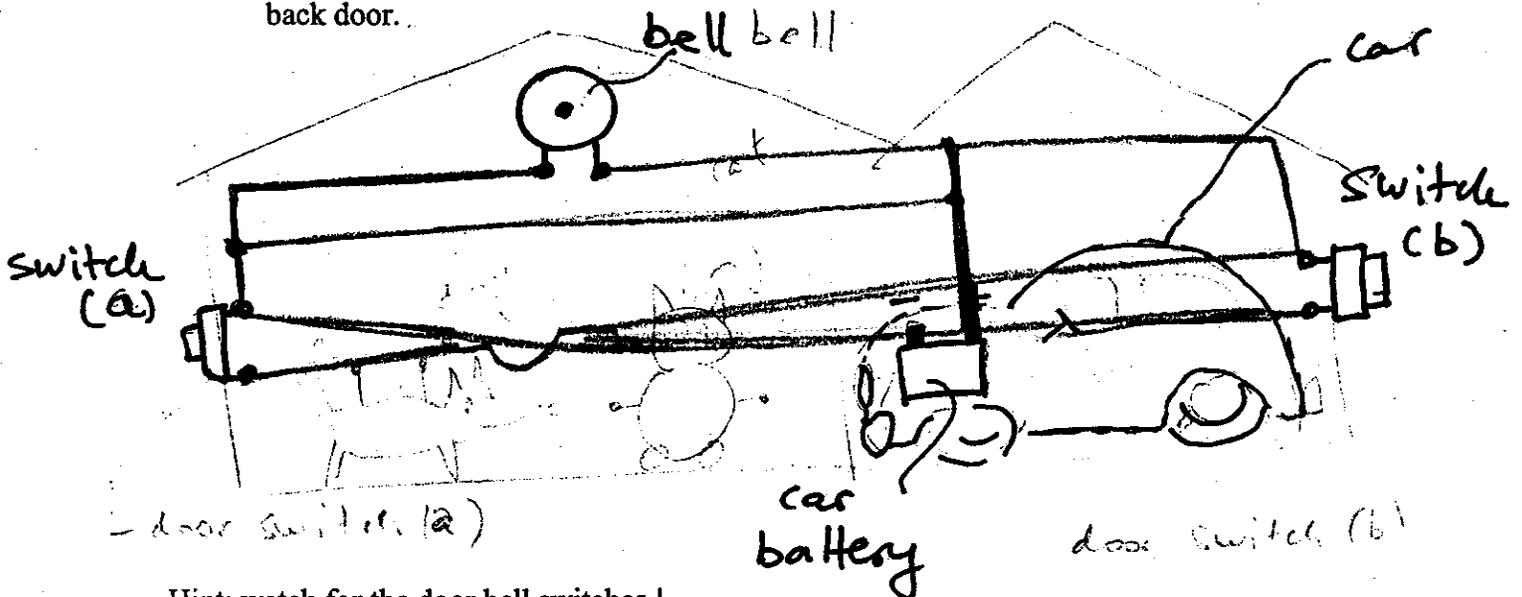
Yes

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

No

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f(a,b) = a + b$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?

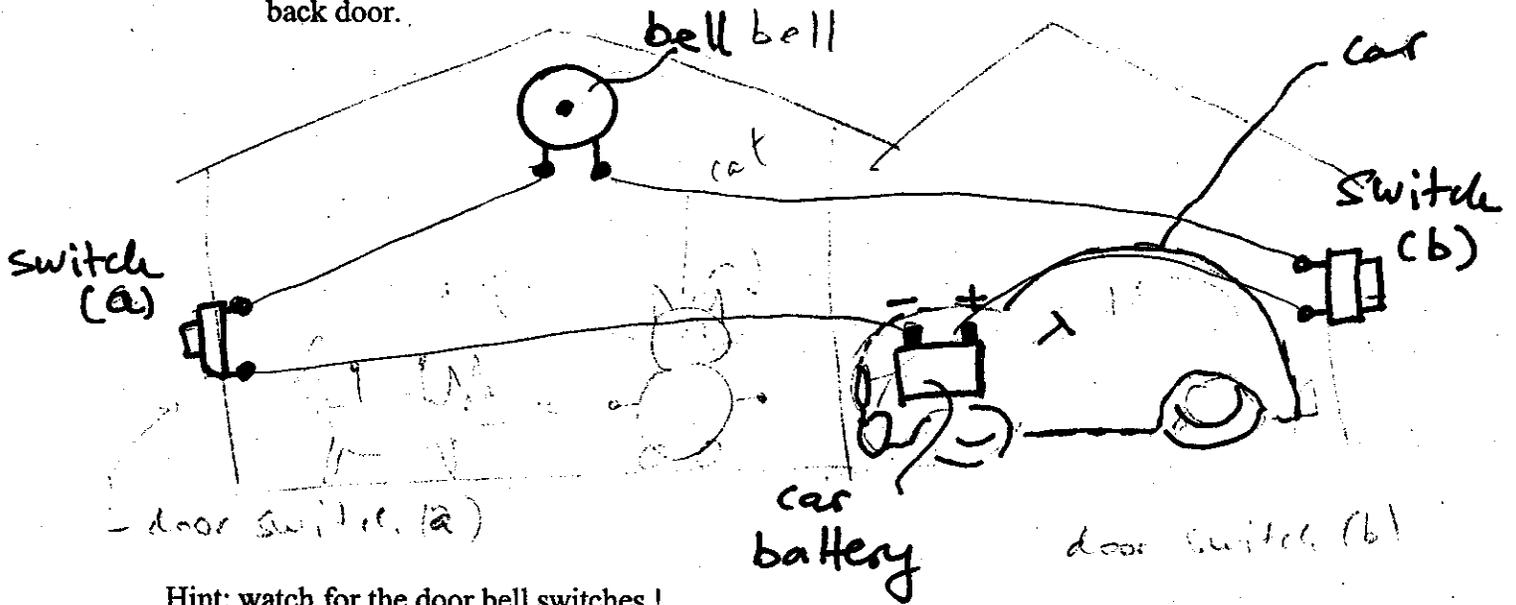No, because there is no battery to activate the switches

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

No,

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f(a,b) = a + b$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?

no

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?
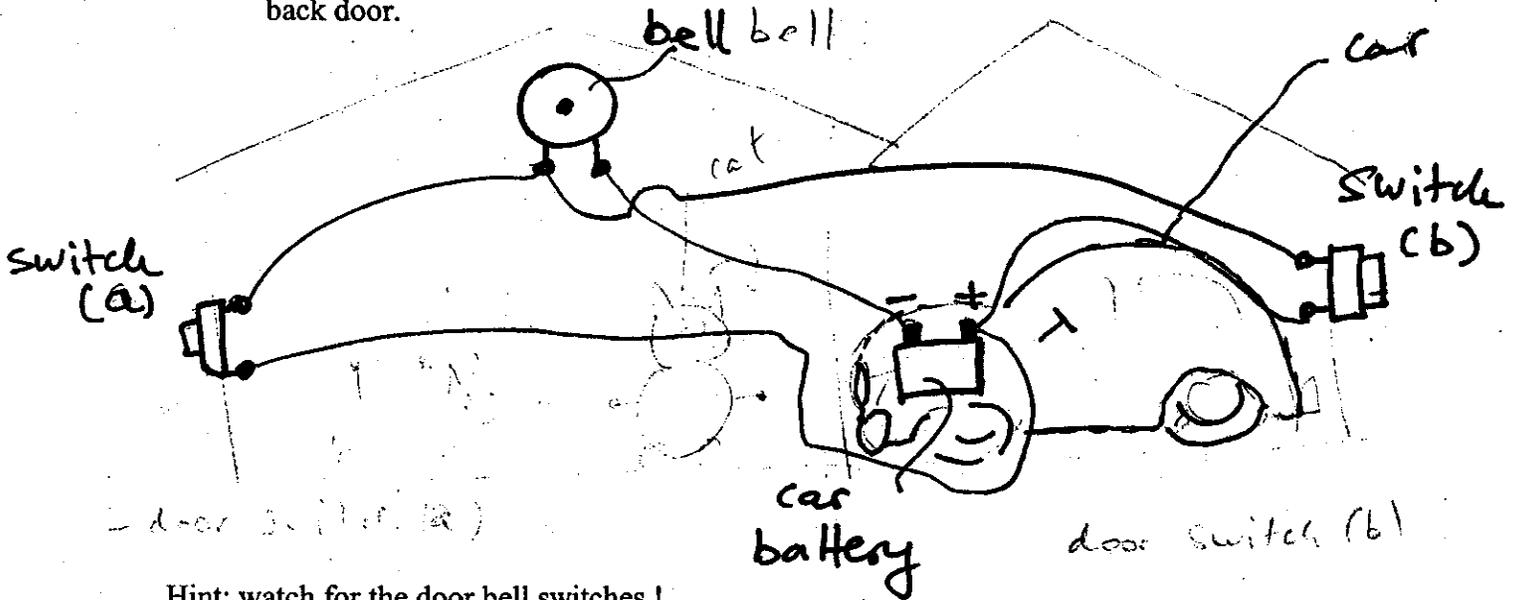
yes

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f(a,b) = a + b$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?
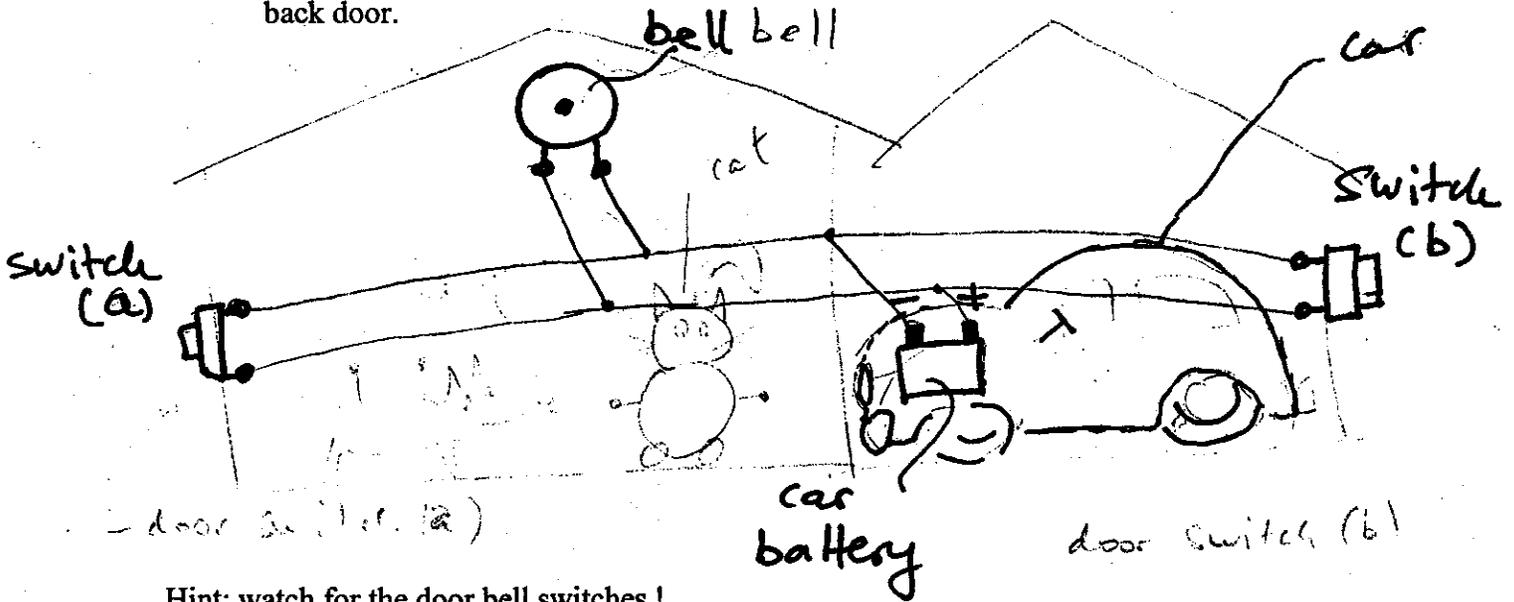
No!

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

No!

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f(a,b) = ab + a\overline{b} + \overline{a}b$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?
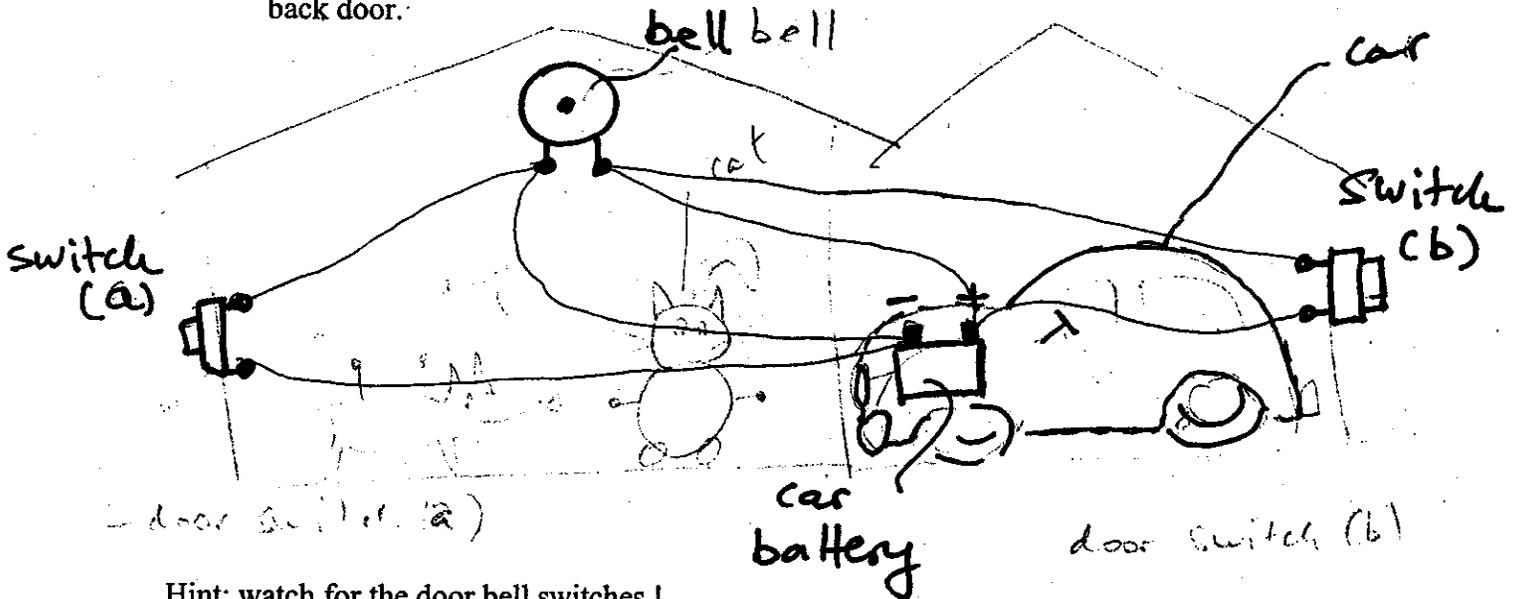
No, because the battery is not there.

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

No, because the bell ring when pressed the contact., alarm is off does not mean there is contact.

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b)$ = ? (assume that door bell rings when $f=1$)

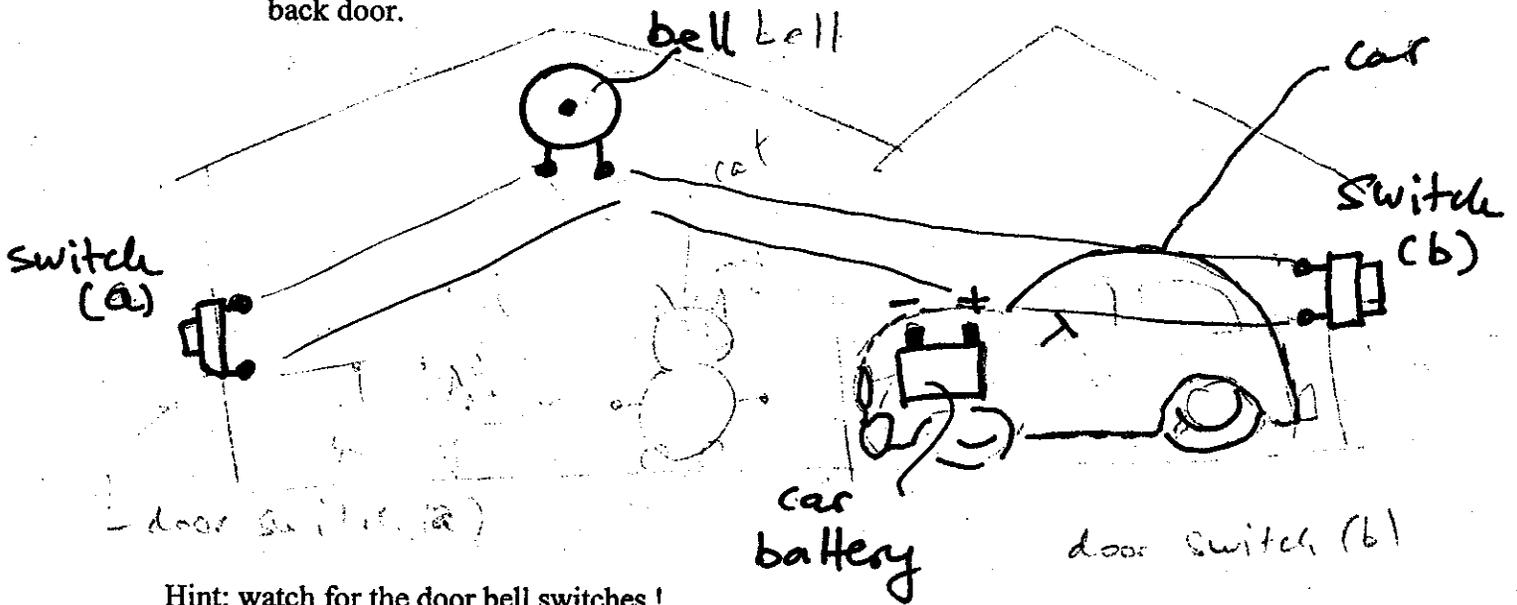| a	b	f
0	0	0
0	1	1
1	0	1
1	1	1

$$f(a,b) = a + B$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ? No unless the wires are still connected

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ? Not unless the switches are ON

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$a \cdot \overline{b} + \overline{a} \cdot b$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?

$$b = 1$$
$$a = 0$$
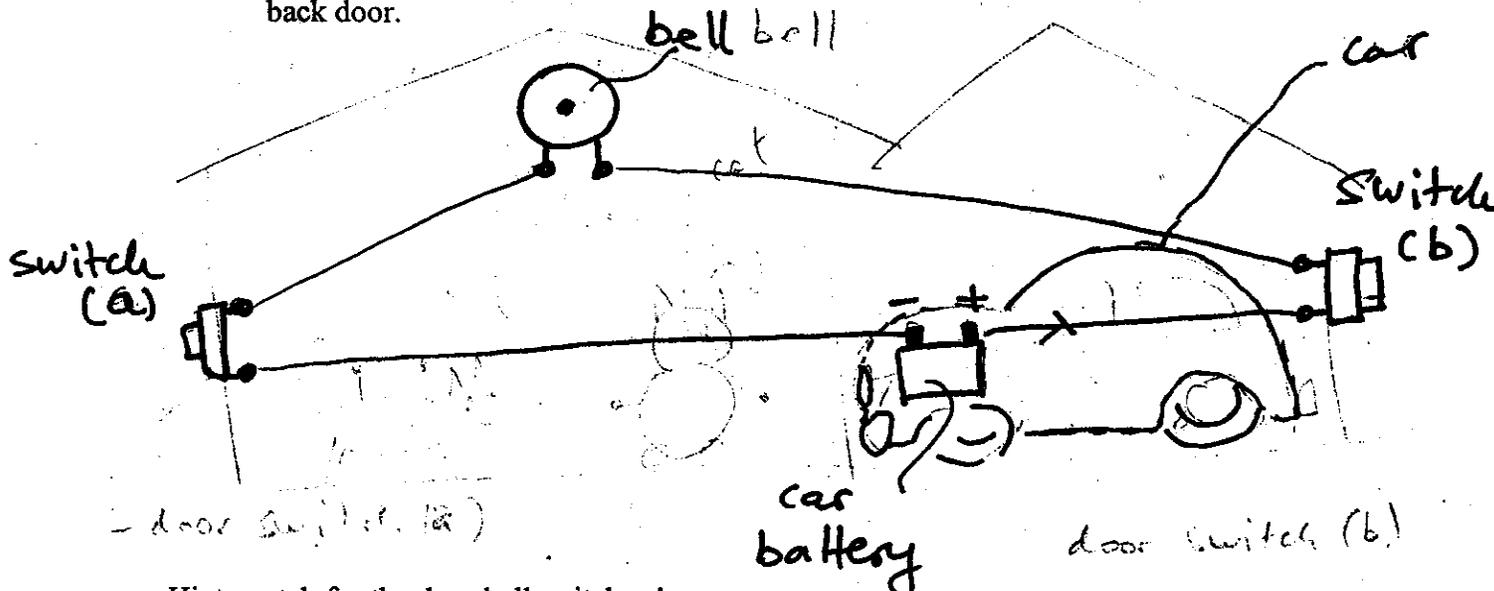$$0 \cdot 0 + 1 \cdot 1 = 1 \quad \text{yes}$$

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

No.

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.
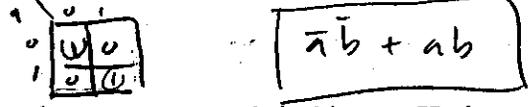

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$f=1$ true

a	b	f
0	0	1
0	1	0
1	0	0
1	1	1

$$\bar{a}\bar{b} + ab$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?

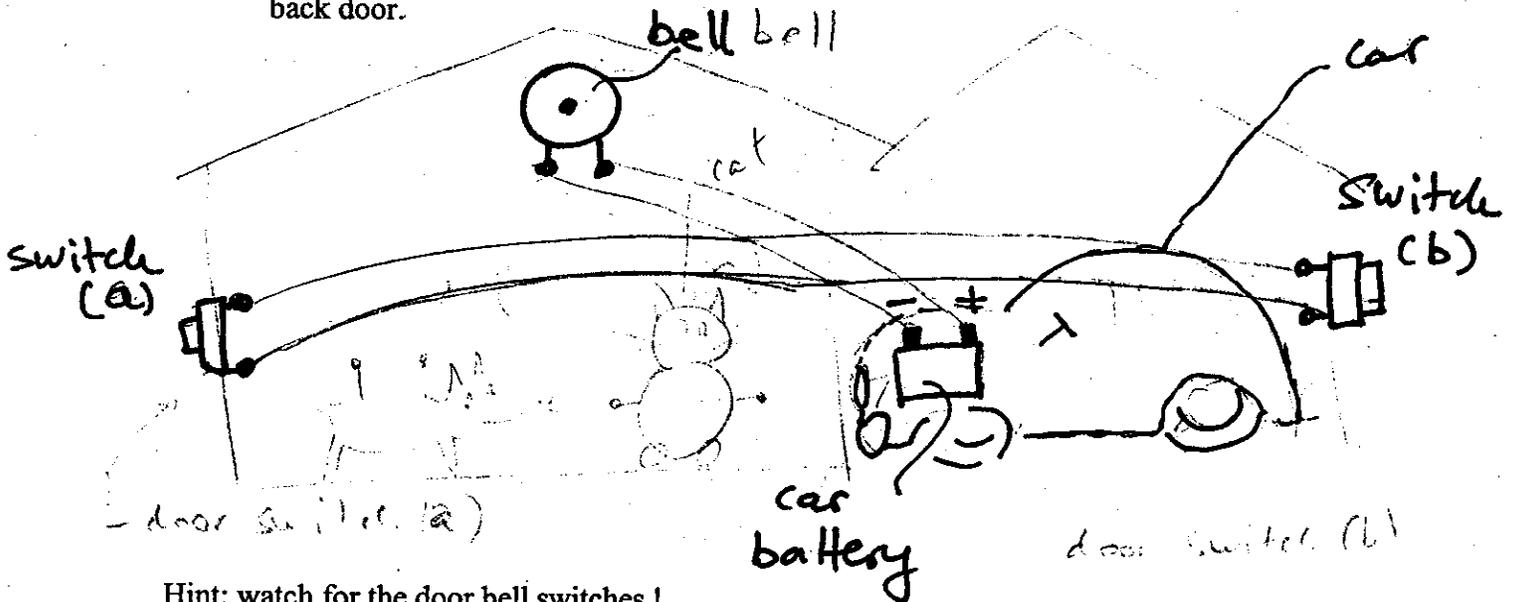YES, BECAUSE WHEN DOOR BELL IS PRESSED IS ON.

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

NO, BECAUSE THE DOORBELL WAS NOT PRESSED.

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

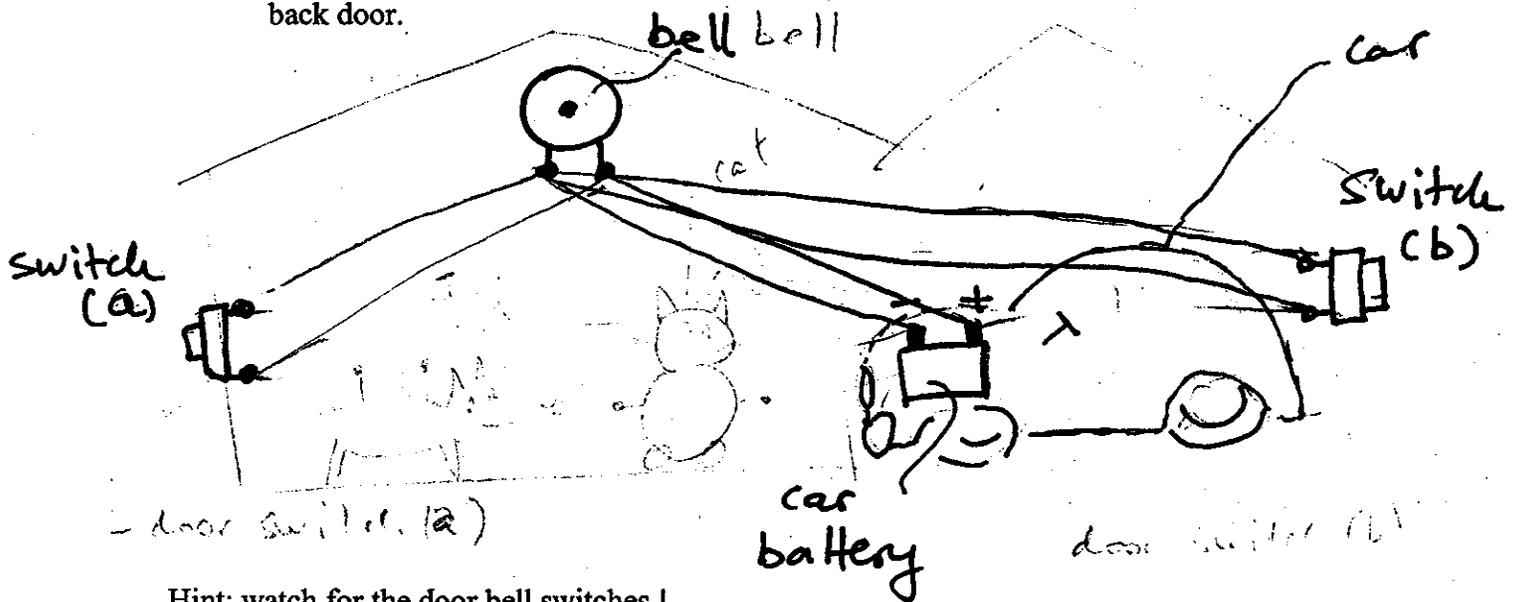$$f(a,b) = ab + \bar{a}b + a\bar{b}$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ? *No.*

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ? *No*

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

bell bell

car

switch (b)

switch (a)

door switch (a)

car battery

door switch (b)

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f(a,b) = a\bar{b} + \bar{a}b$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?

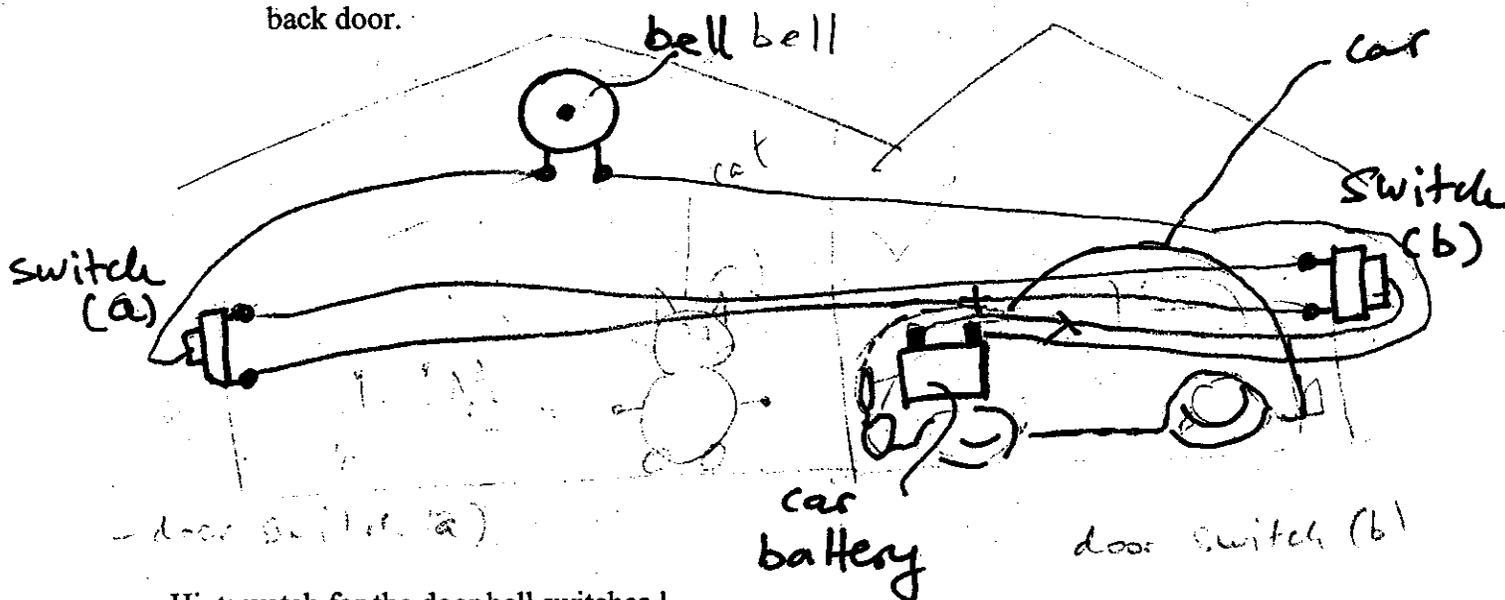No, the car battery is hooked up to the bell

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

Yes

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

bell

car

switch (b)

switch (a)

car battery

door switch (b)

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$ f = ab + a\bar{b} + \bar{a}b $$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?
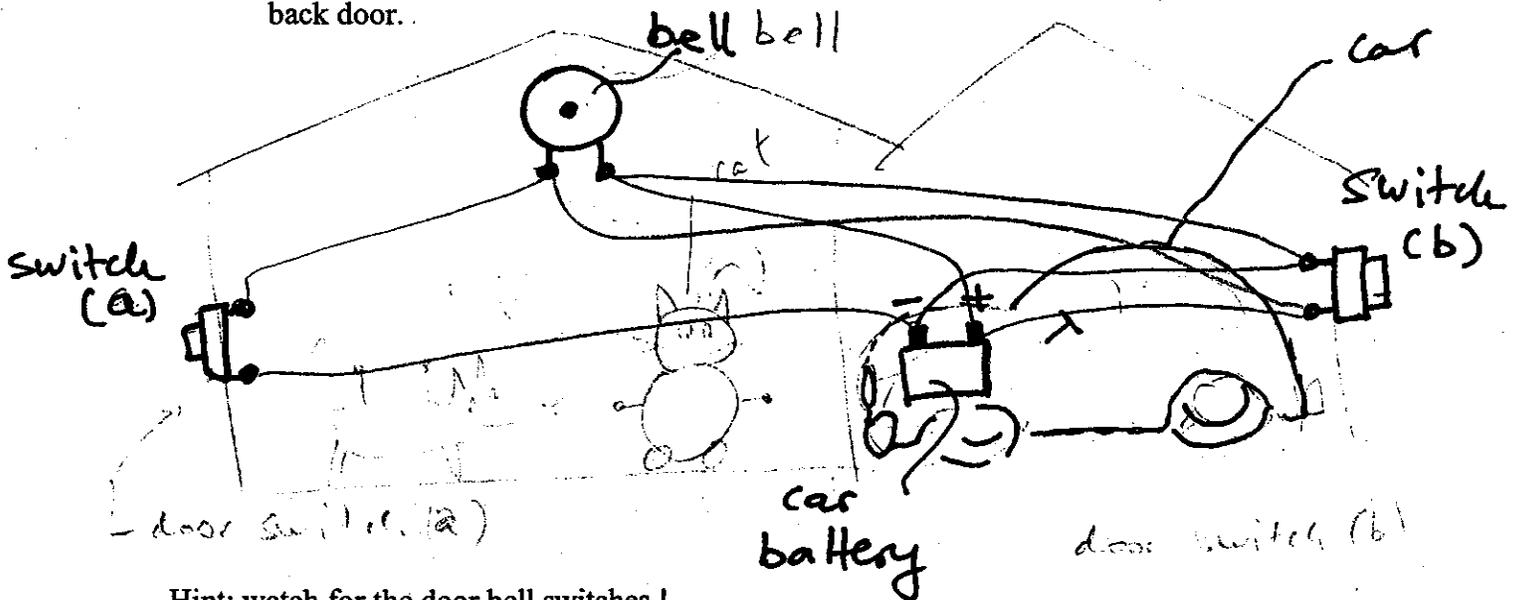
No, There is no power,

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

Only if someone pushed the bell, Since

In parallel the bell should ring if either switch is pushed,

Your Name: _____ 2 /

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f(a,b) = a + b$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?
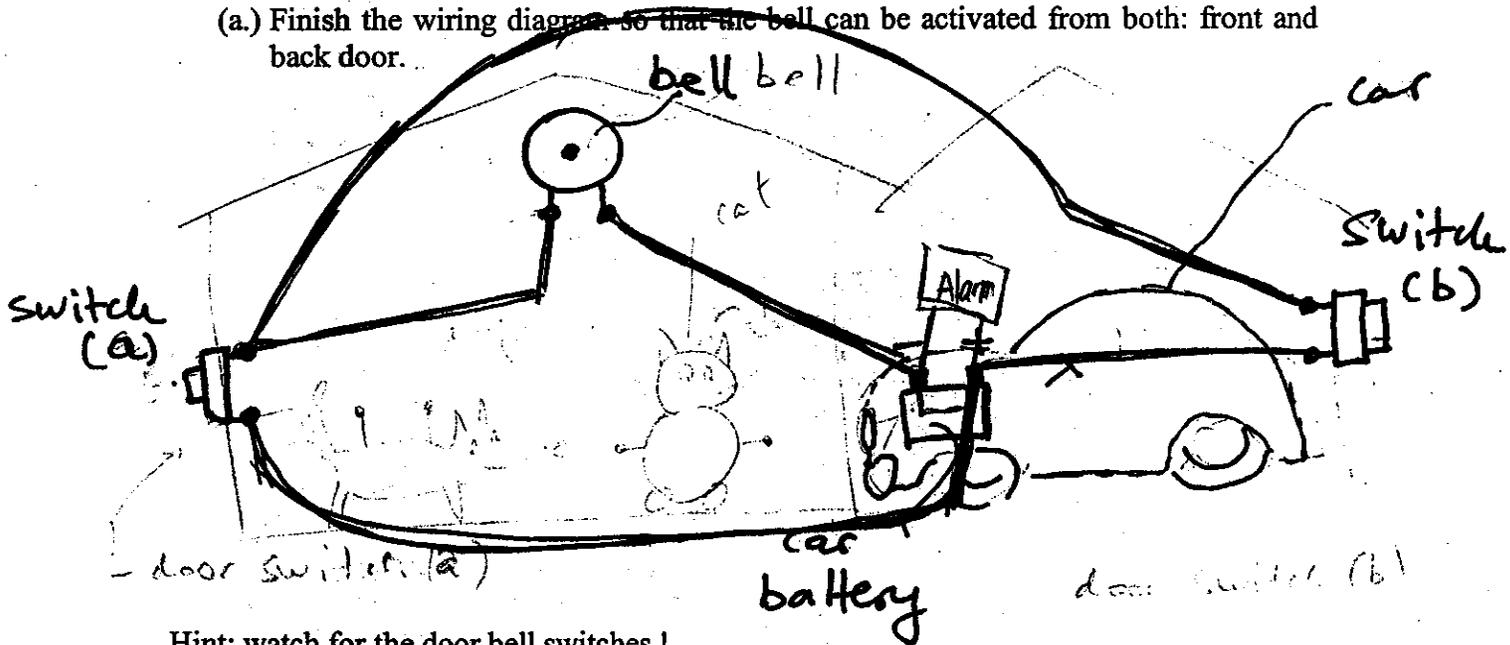
Yes

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

No

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f = (a + b)$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?
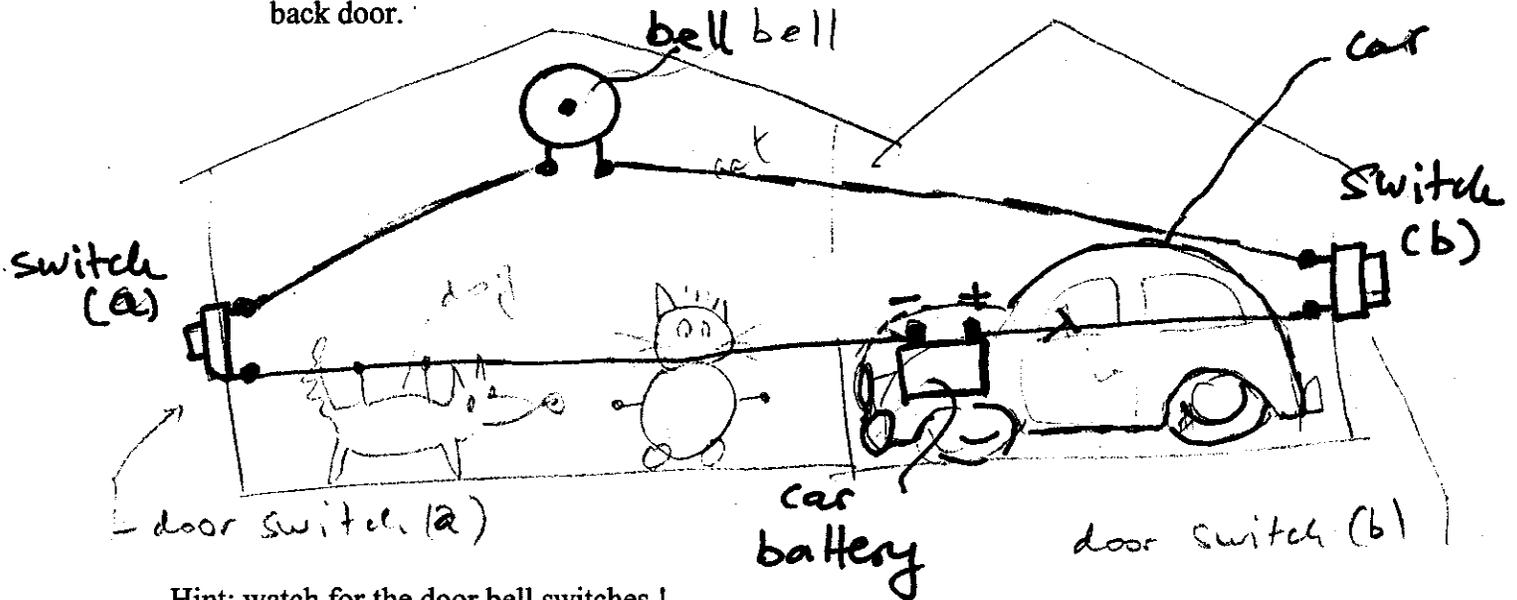
no

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

no

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)
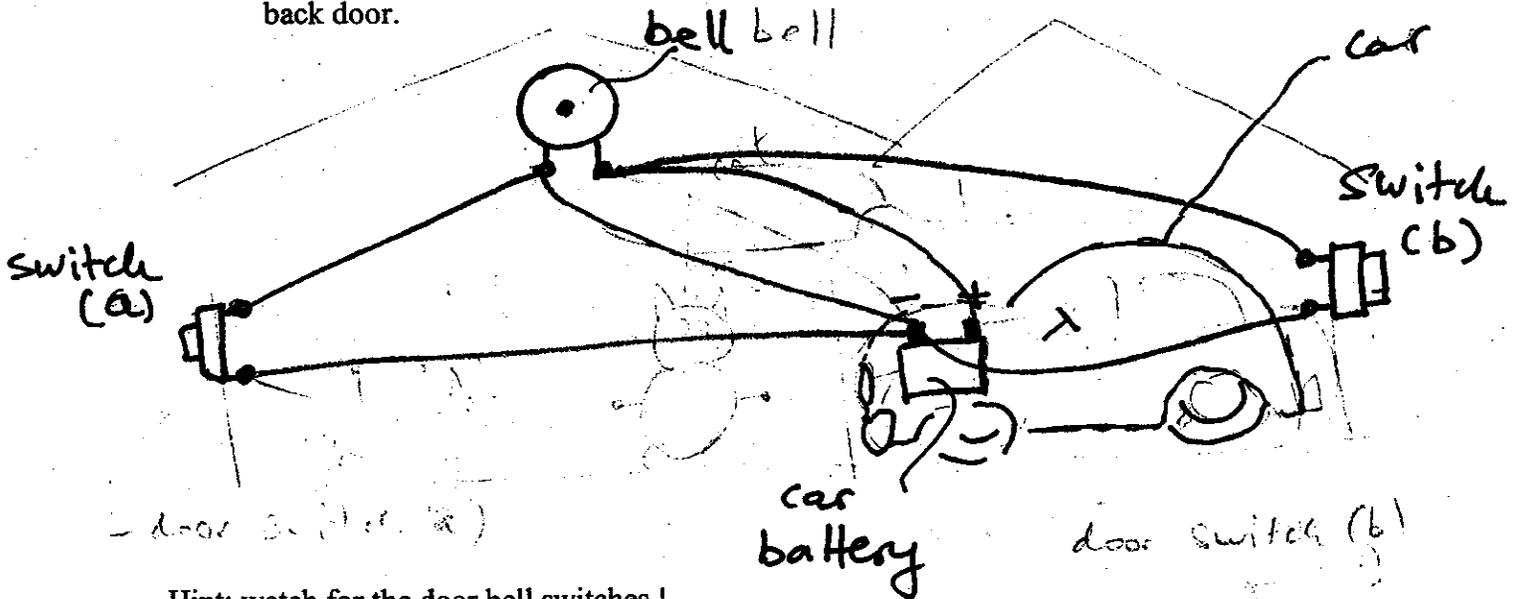
$$F = a\bar{b} + \bar{a}b$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ? It depends on how recently he left, since the switch acts as a capacitance which holds a charge for a short amount of time

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ? no the car alarm uses the battery, but the switch must complete the circuit

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that <u>the bell can be activated from both</u>: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f(a,b) = a + b$$

(c.) Ben has gone to work in his car. He is now sitting <u>at a shareholders</u> meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?
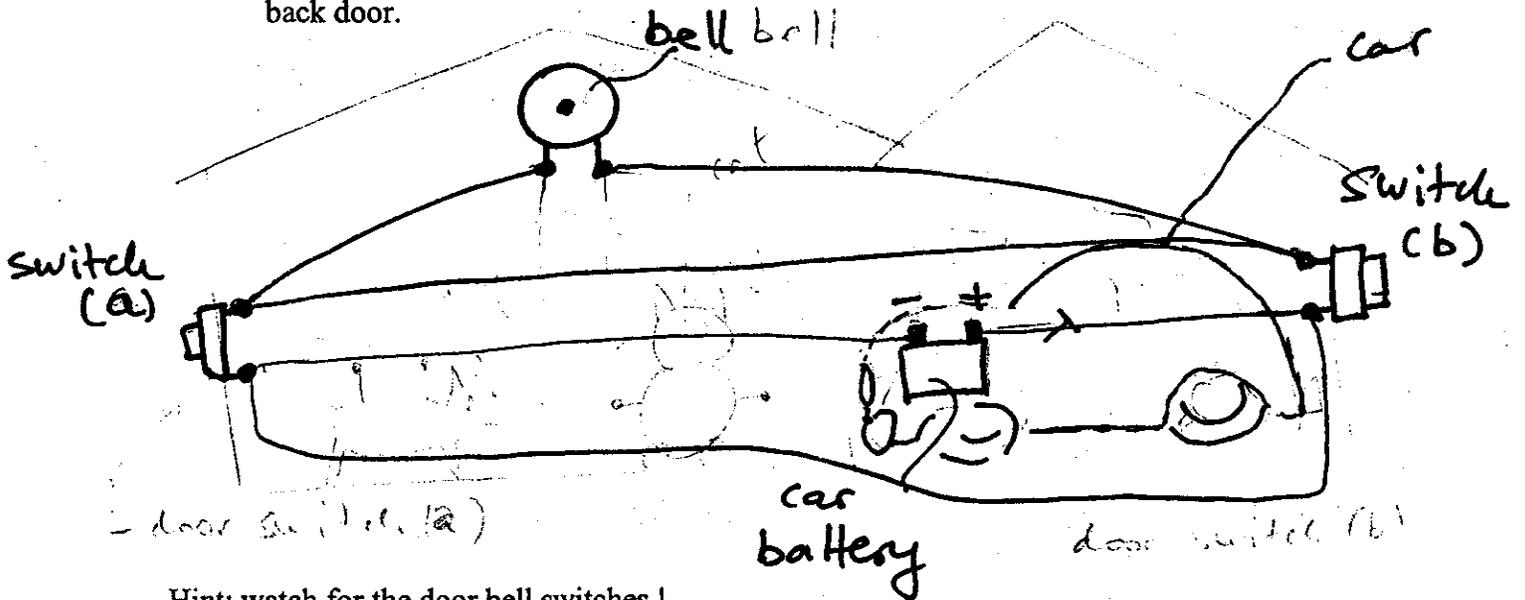
No, it doesn't.

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

No. it doesn't

Your Name:	

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

a	b	f
0	0	0
0	1	1
1	0	1
1	1	1

$$f = \bar{a}b + \bar{b}a + ab$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?

NO

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?
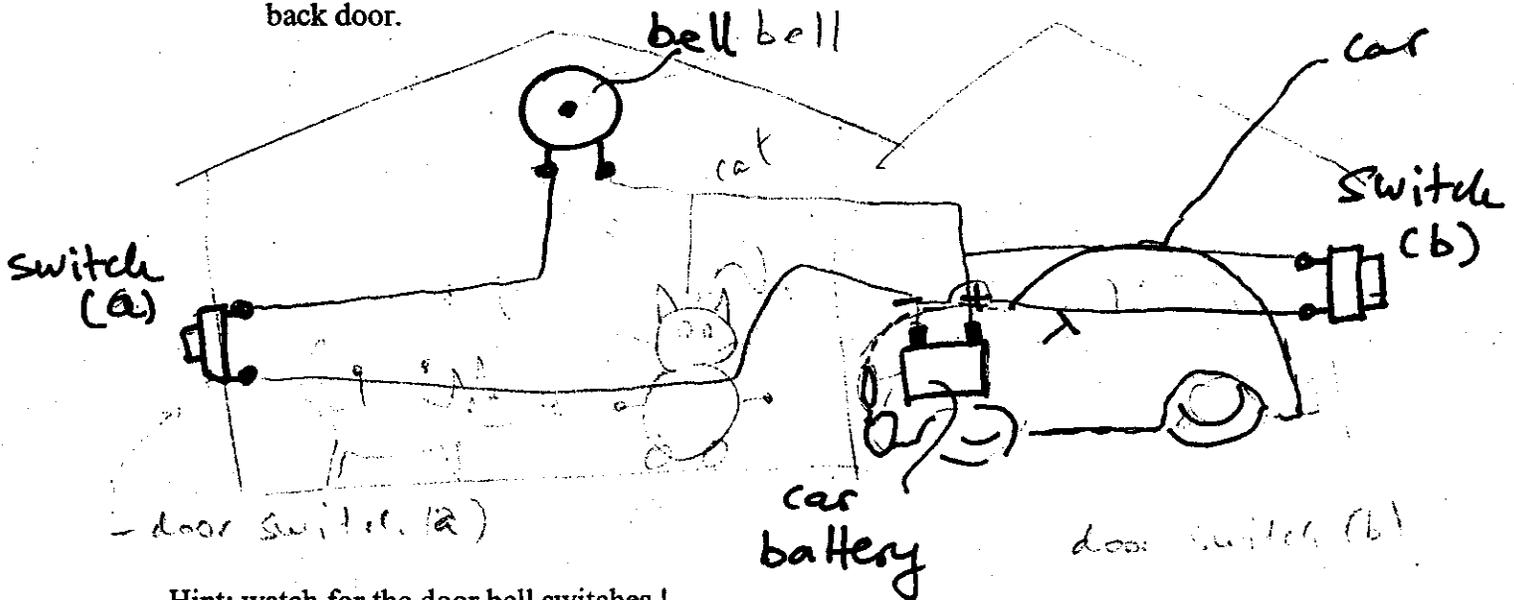
NO , The switches have to be connected

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

bell bell

car

cat

Switch (b)

Switch (a)

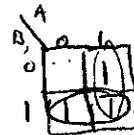door switch (a)

car battery

door switch (b)

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b)$ = ?   (assume that door bell rings when $f=1$)

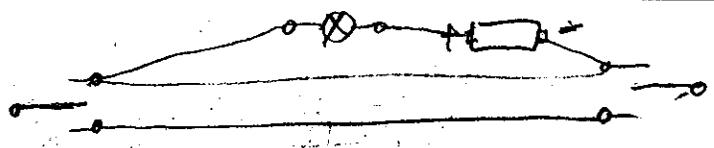$$A\bar{B} + \bar{A}B + AB$$
$$= A + B$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?

Not if the doorbell is connected to the car battery source.

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

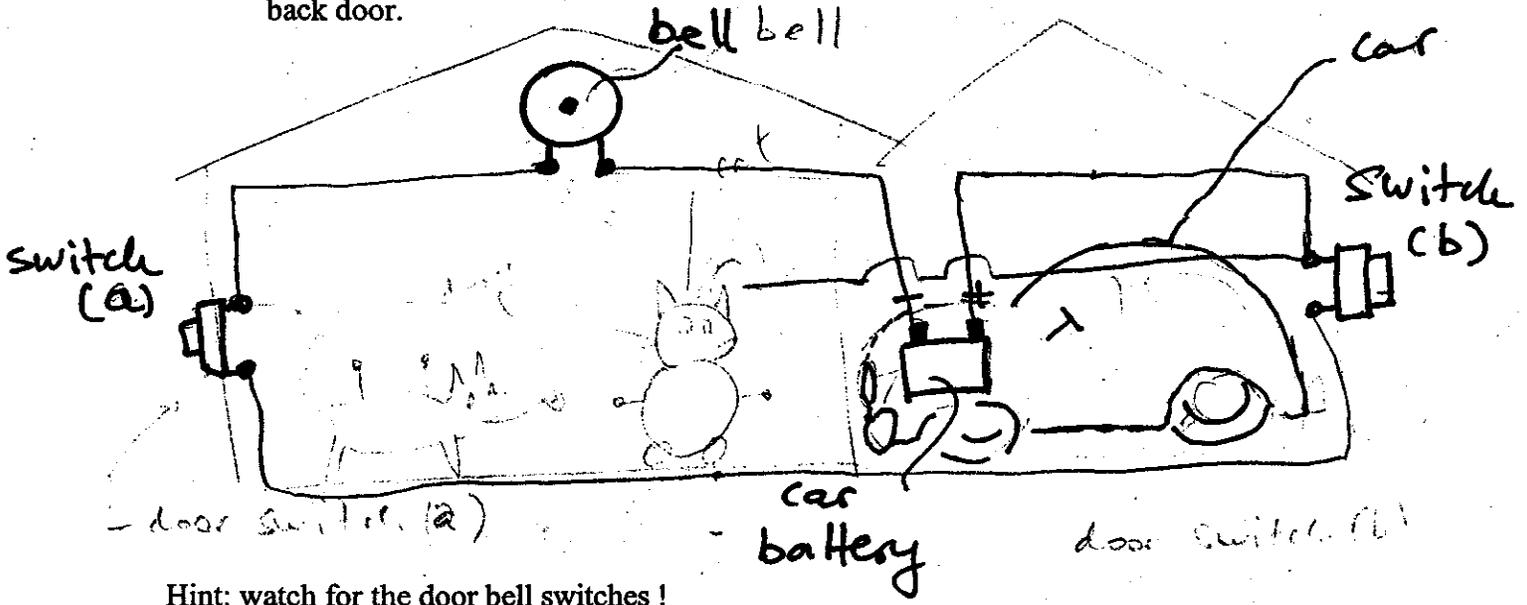Not unless the button is pushed to close the circuit.

a)

| **Your Name:** | |

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f(a,b) = a + b$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?   No voltage, no ring.

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

No

Your Name:

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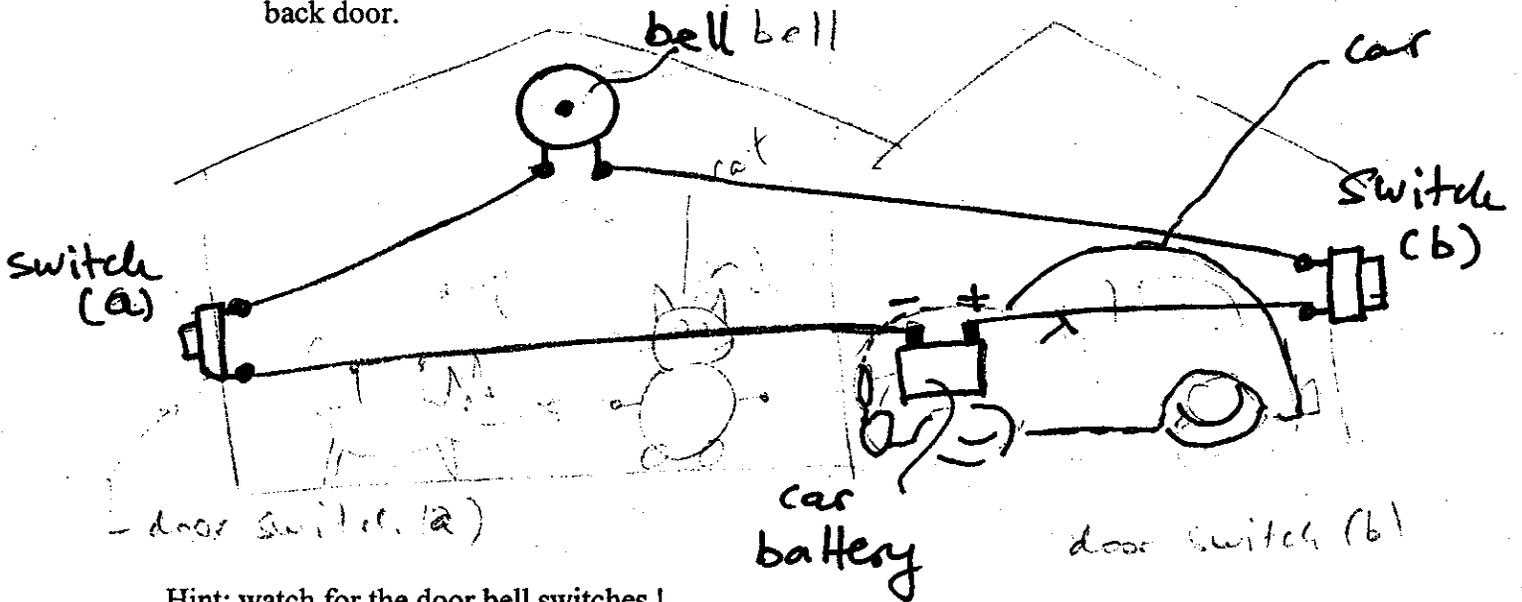
There's no Voltage → The bell would not ring.

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

The doorbell would ring, → have Voltage

Your Name:

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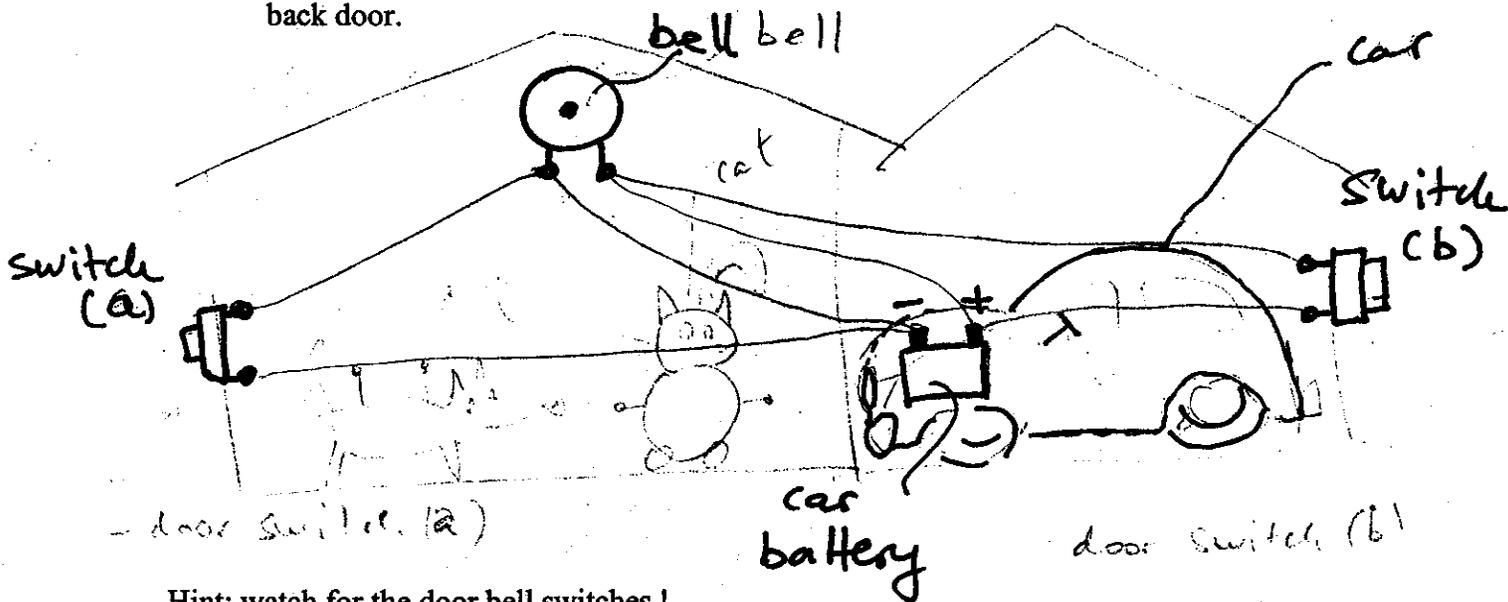
no, the battery go with the car

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

no.

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

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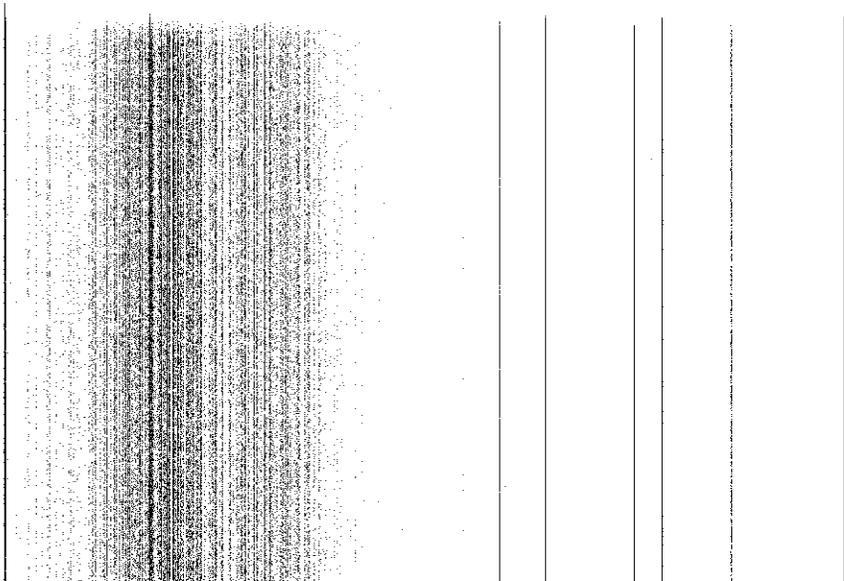i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f(a,b) = a + b = \bar{a}b + a\bar{b} + ab$$

a	b	f
0	0	0
0	1	1
1	0	1
1	1	1

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?

No it won't ring because there is no battery

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?
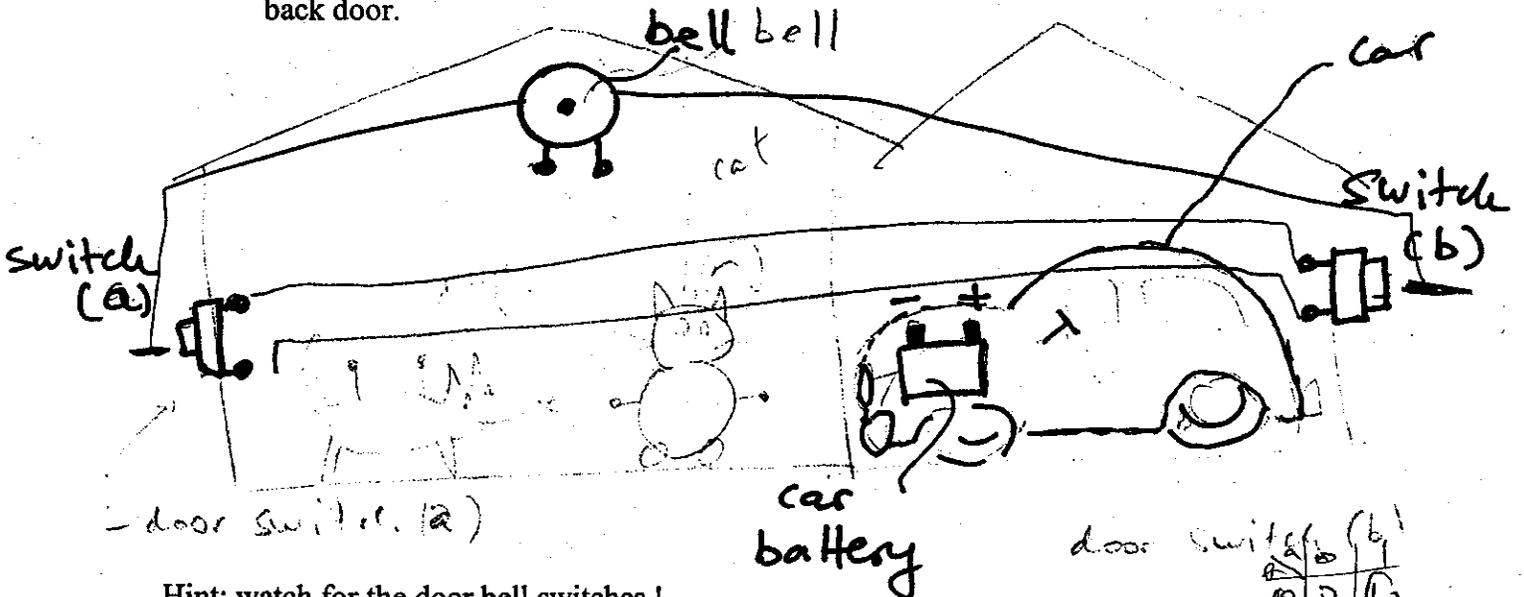
yes it would ring because the battery in working

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

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i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f(a,b) = \quad a + b$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ? No because there is no power for the door bell.
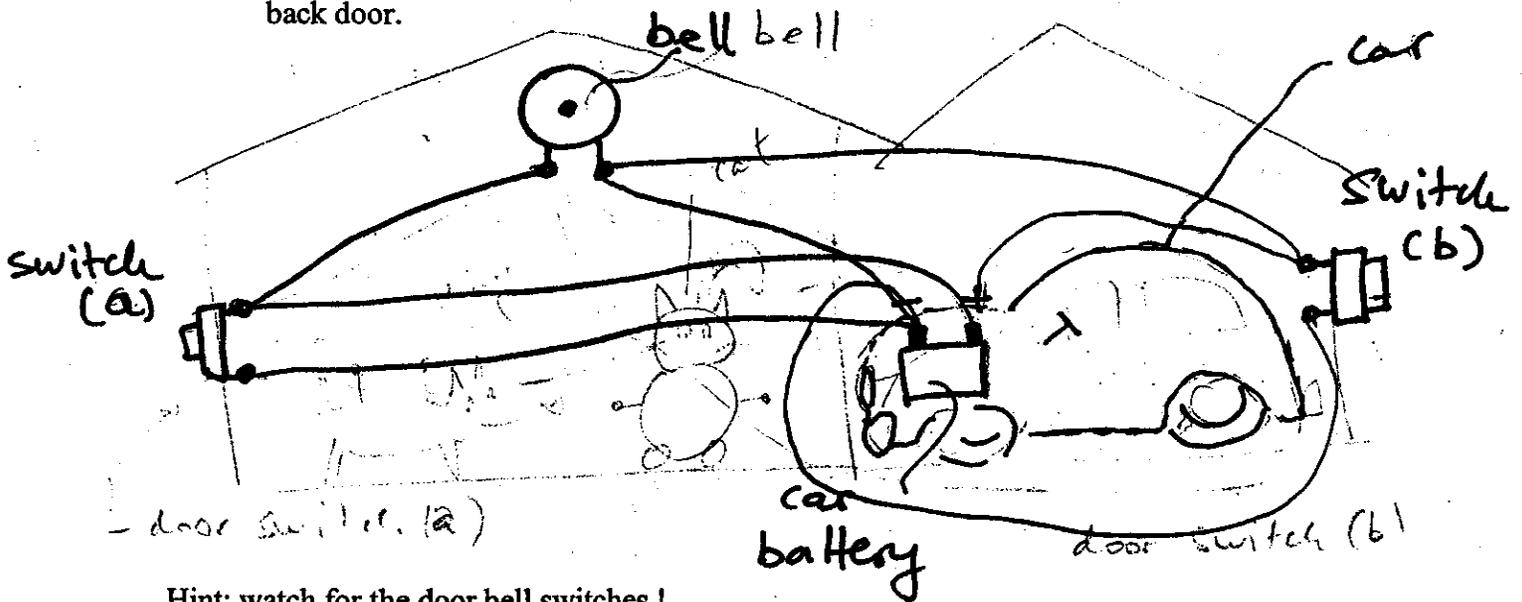
(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ? Yes because there is a flow of power connected to the door bell.

Your Name:	

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

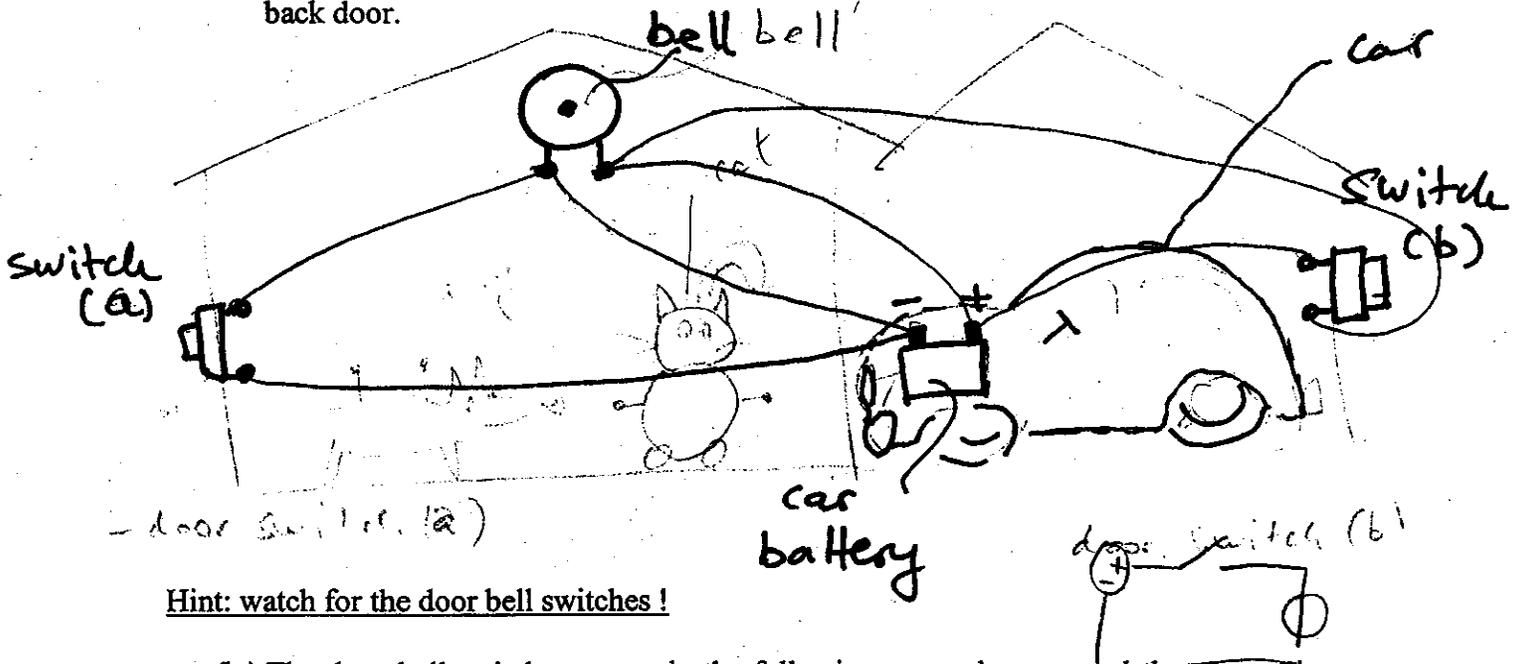i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$= (a + b)$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?

NO, BEN HAS HIS CAR @ WORK

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?

YES, IF ENOUGH VOLTAGE TO POWER
BELL w/ ALARM ON.

Your Name:

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(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.
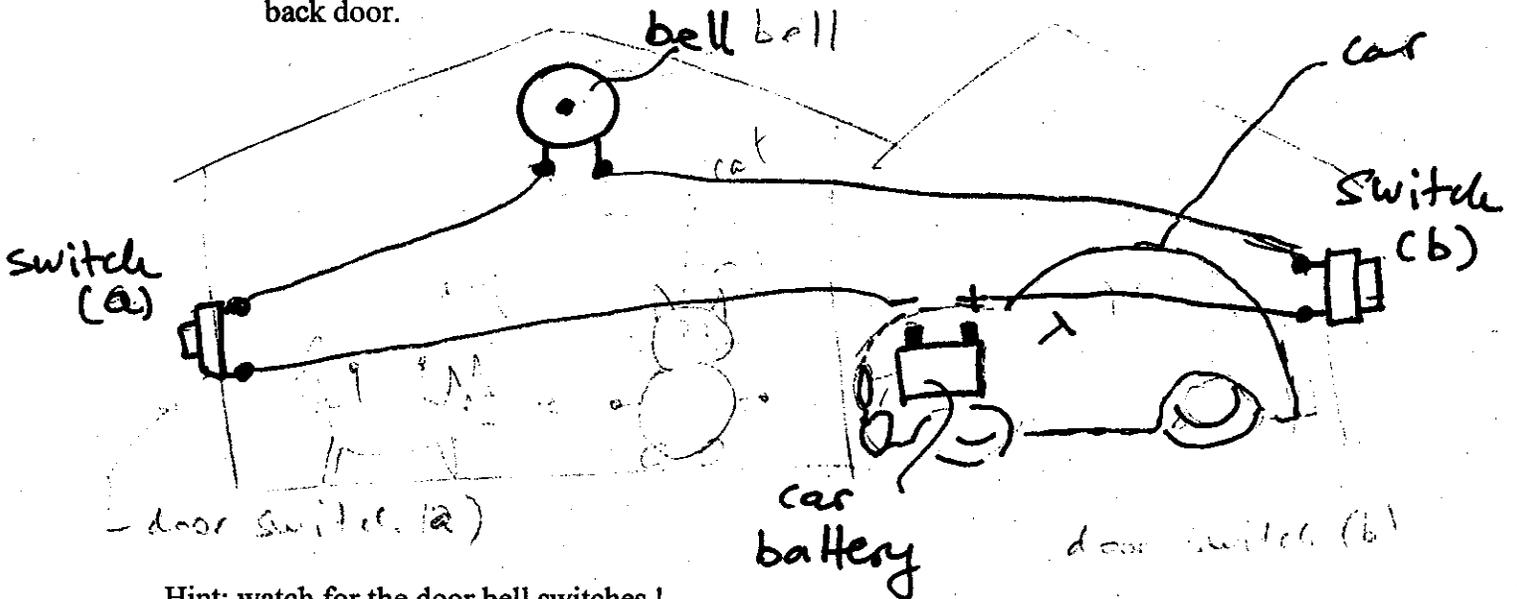
Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f = a + b$$

a	b	f
0	0	0
1	0	1
0	1	1

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ? *Not without a battery*

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ? *no*

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

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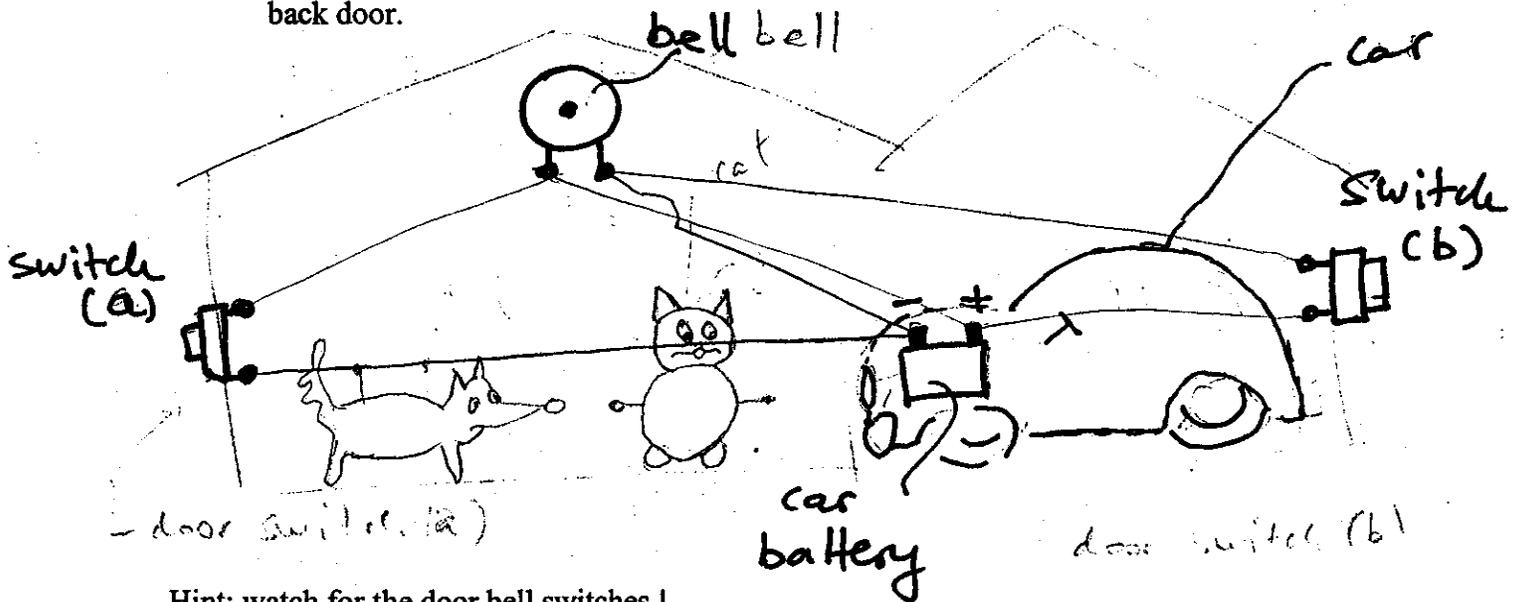i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$) $a + b$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?   NO

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?   NO

Your Name:

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

(a.) Finish the wiring diagram so that the bell can be activated from both: front and back door.

bell bell

car

switch (b)

switch (a)

car battery

door switch (a)

door switch (b)

Hint: watch for the door bell switches !

(b.) The door bell switch operates in the following way: when pressed the contact is ON. When released - there is no contact (it is OFF). What is the logical expression for the door bell as a function of the two door bell swithes a and b ?

i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)
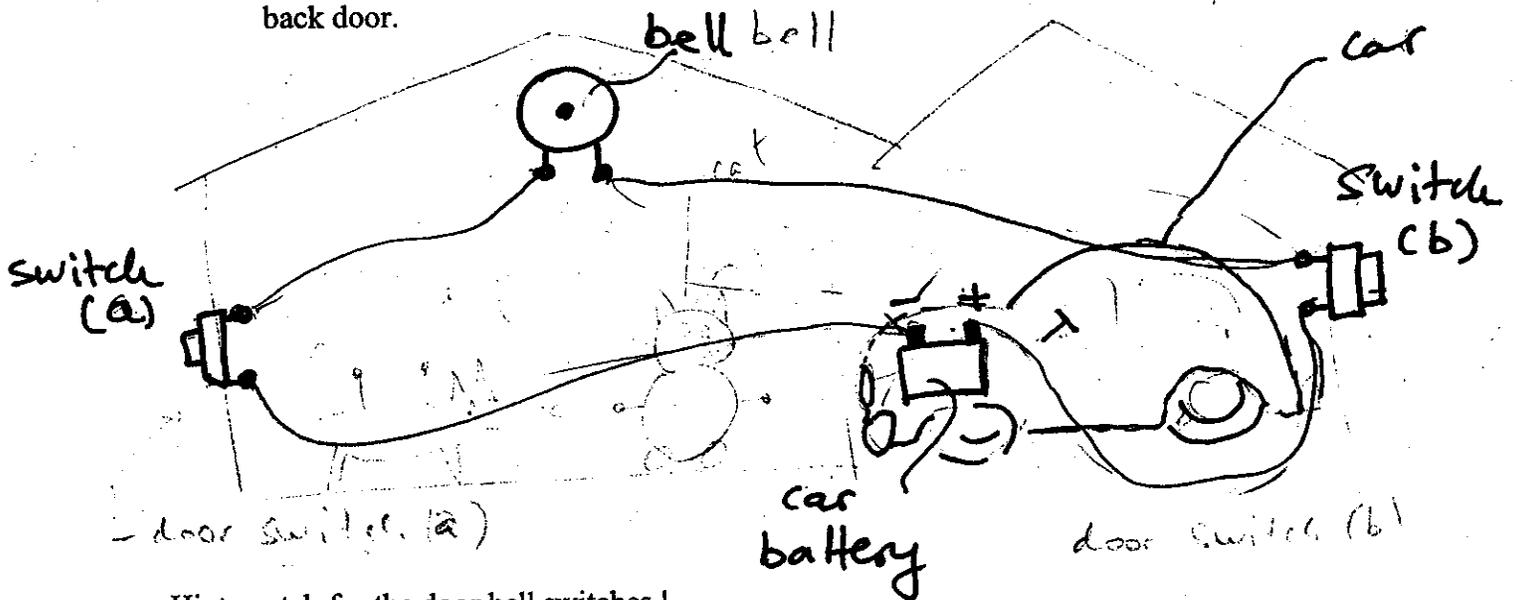
$$f(a,b) = \bar{a}\,\bar{b}$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ? yes

(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ?   NO

> **Your Name:**

Problem #1: Ben is an engineer working in the Silicon Valley start-up company. He is very energy consciencious. In order to save on his electricity bill he wants to use his car battery to power his door bell.

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i.e. $f(a,b) = ?$ (assume that door bell rings when $f=1$)

$$f = a + b$$

(c.) Ben has gone to work in his car. He is now sitting at a shareholders meeting of his company in San Jose. The mailman came to his back door to deliver his dividend check and he is pressing the door switch. Would the bell ring ?   ~~Yes~~ NO, the car is gone
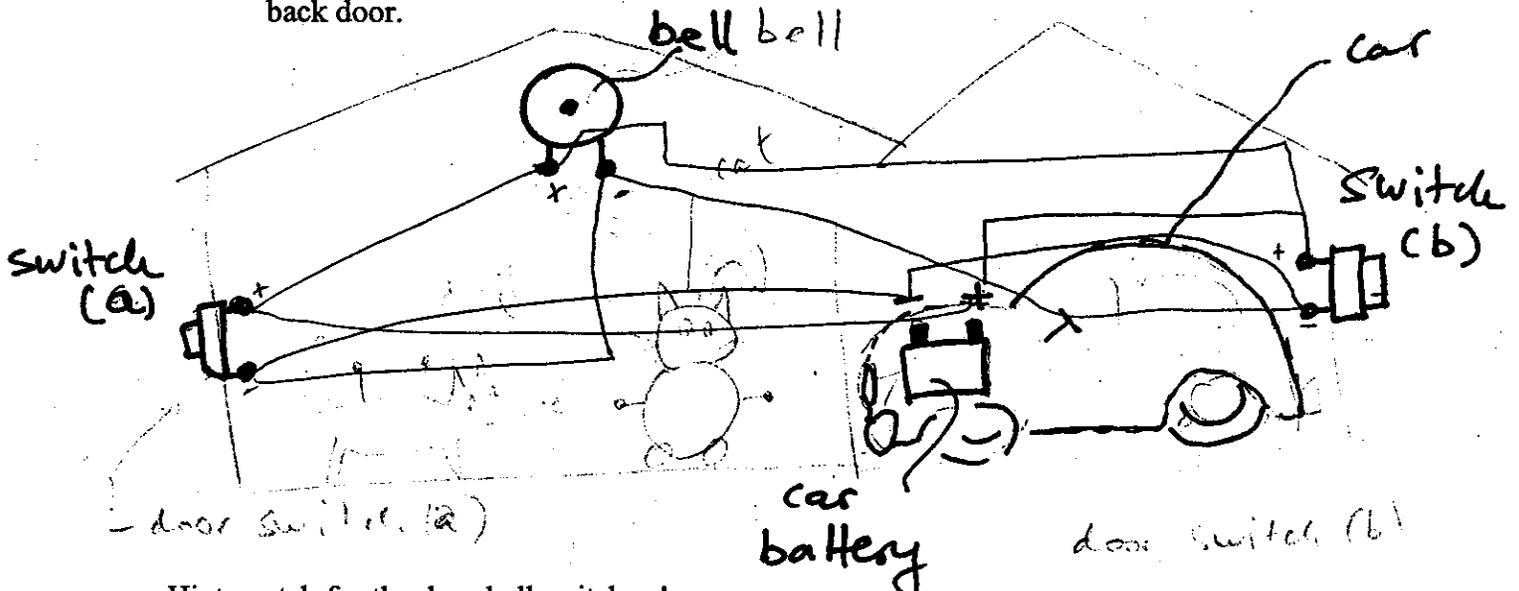
(d.) Ben is sleeping. The cat accidentally jumped on the top of his car and scared the dog. The dog started barking and this triggered Ben's car alarm. Would the door bell ring ? Yes, because battery would be triggered also.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).

If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L = f(U, D)$. *Write this expression and explain !* ~~D + D~~ if either D is a $\underline{1}$ or U is a $\underline{1}$
$$L = D + U$$
then the light will be turned on.

(b.) could this expression be minimized further ?
no.

this is power

AC

$110V$

this is light →

door upstairs

on

Switch U

on

STAIRS

door downstairs

Switch D

Beware ! this is a switch ! with two positions
Hint it can be only in one position.

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(a.) I.e. $L = f(U,D)$. Write this expression and explain !

(b.) could this expression be minimized further ?

this is power

AC

this is light

110V

door upstairs

Switch U

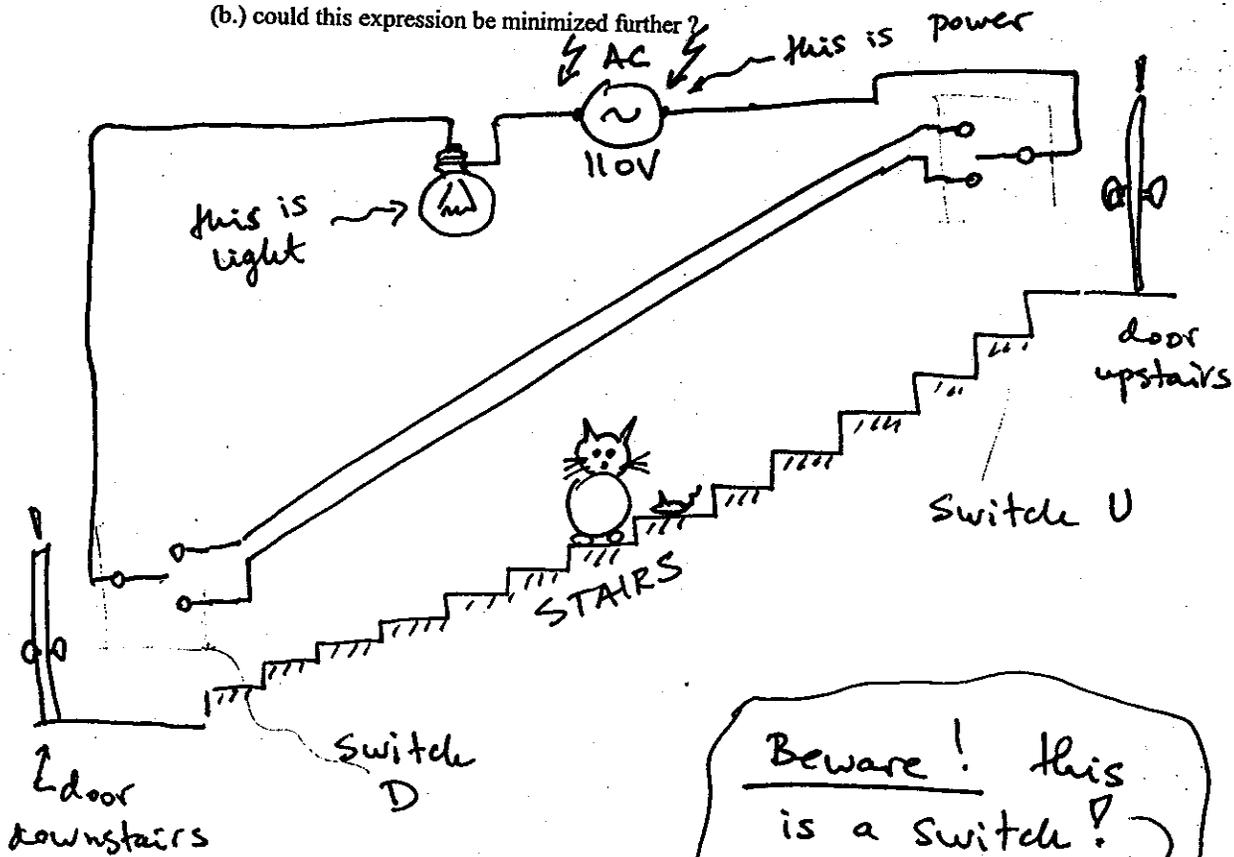STAIRS

Switch D

door downstairs

$$L = f(u, D) = 1$$

Beware! this is a switch!

with two positions

Hint it can be only in one position.

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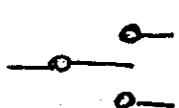
(a.) I.e. $L=f(U,D)$. Write this expression and explain !

(b.) could this expression be minimized further ?

this is power

this is light

$\rightarrow$

AC

110V

door upstairs

Switch U

STAIRS

Switch D

door downstairs

a) $\bar{D}\bar{U} + DU$
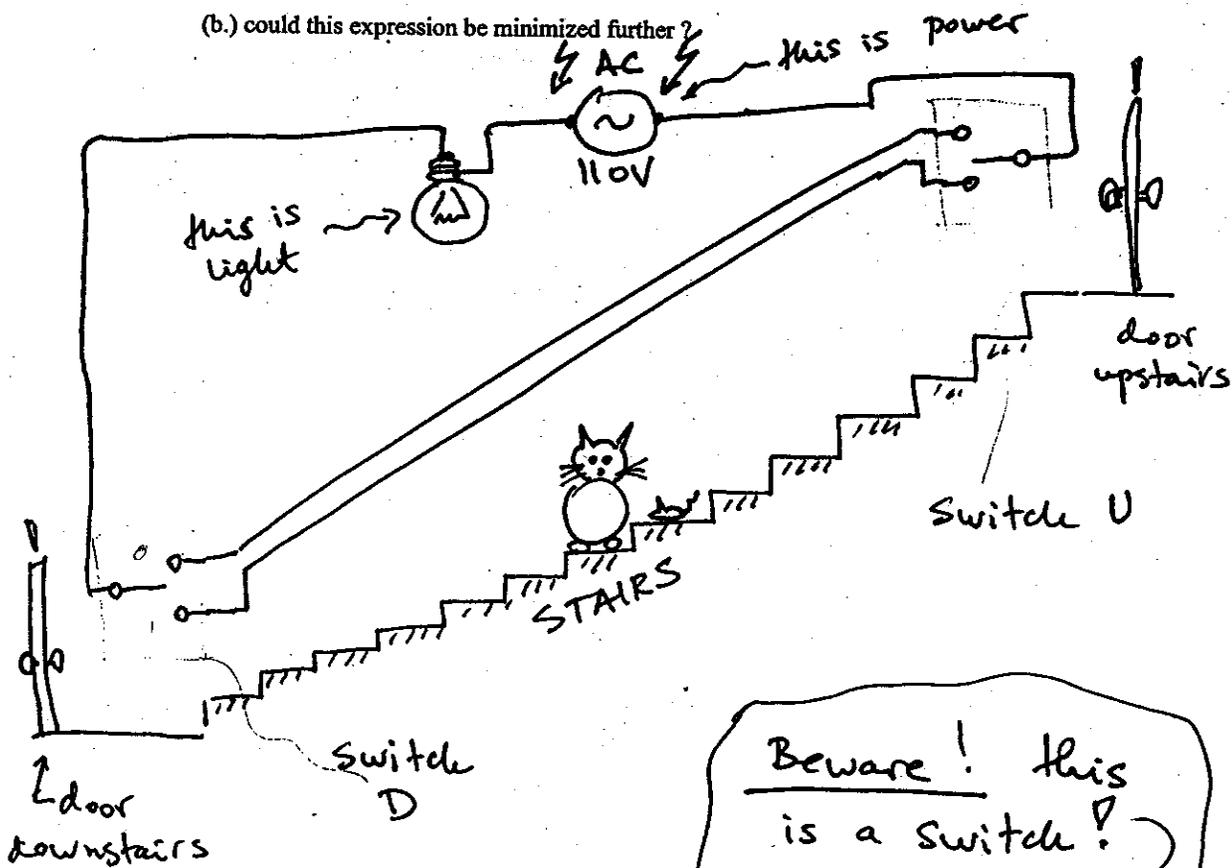
b) yes

Beware ! this is a switch !

with two positions
Hint it can be only in one position.

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If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L = f(U,D)$. *Write this expression and explain !*

(b.) could this expression be minimized further ?

this is power

ξ AC ξ

11 0V

this is light

door upstairs

Switch U

STAIRS

Switch D

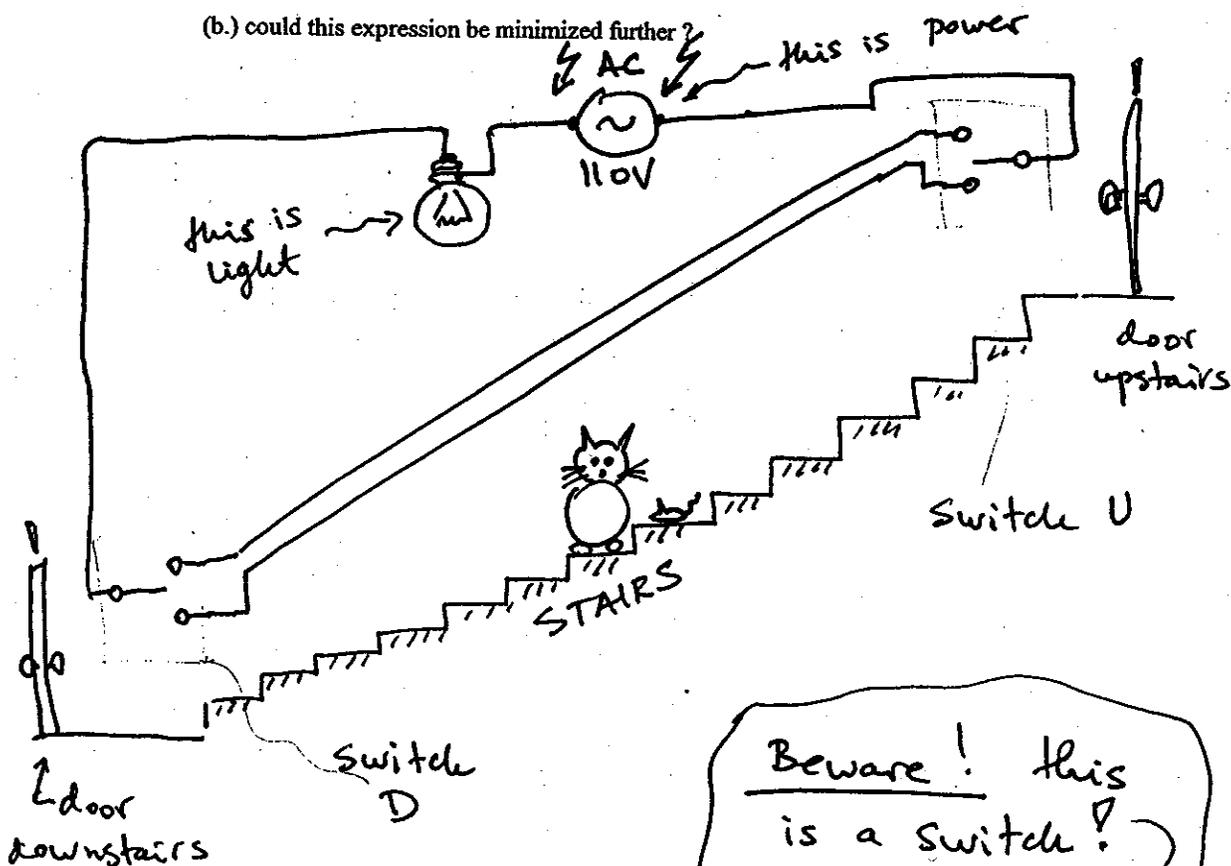door downstairs

Beware ! this is a Switch !

with two positions
Hint it can be only in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).
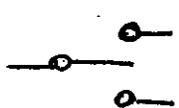If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

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(b.) could this expression be minimized further ?

AC

this is power

11 0V

this is light

door upstairs

Switch U

STAIRS

Switch D

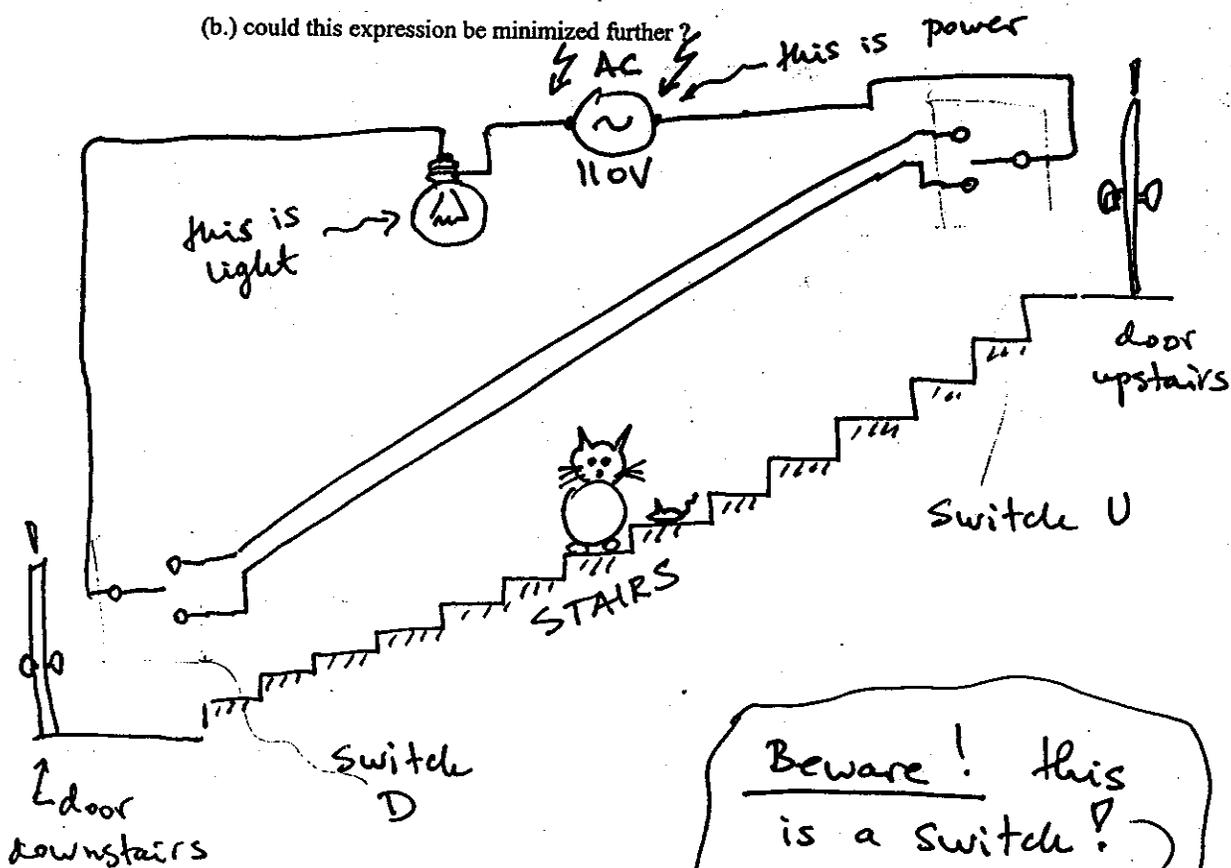door downstairs

Beware ! this is a switch !

with two positions
Hint it can be only in one position.

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If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L=f(U,D)$. Write this expression and explain !

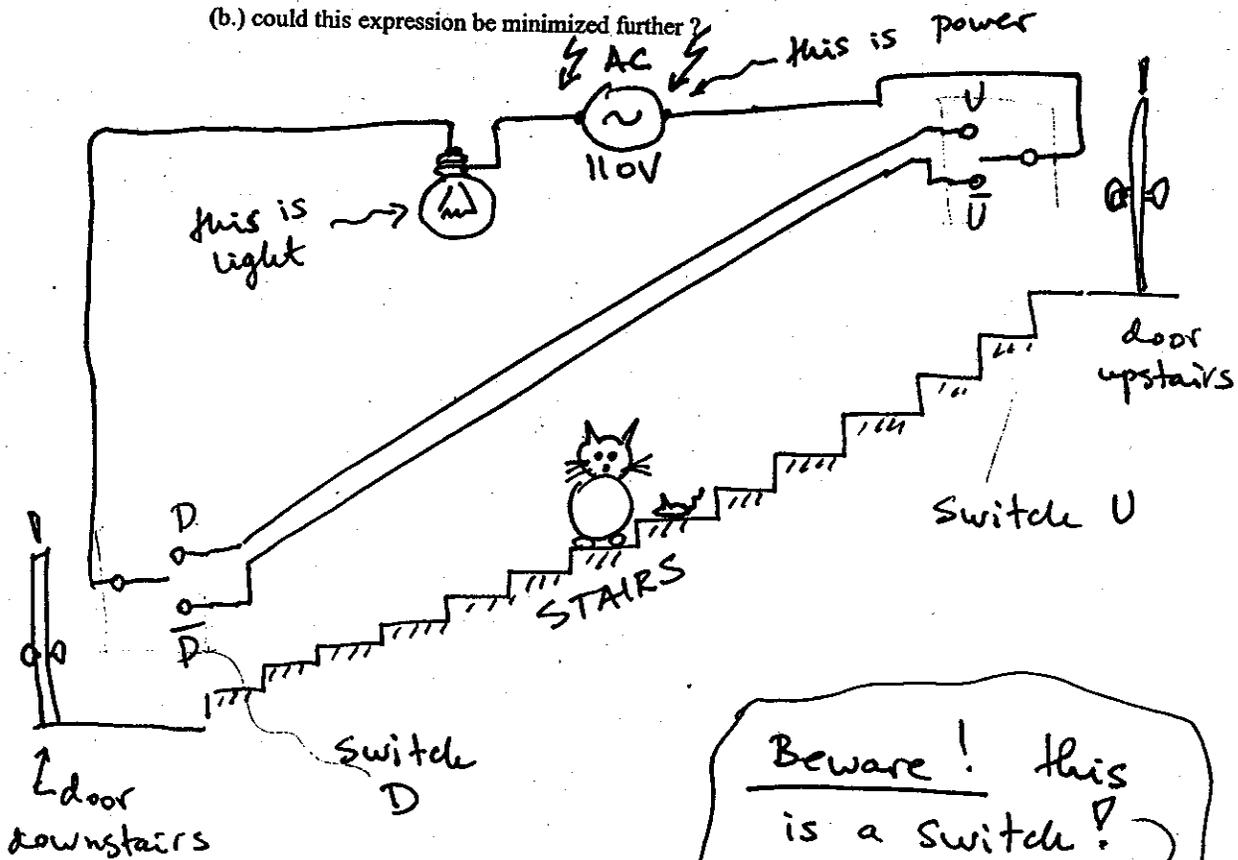(b.) could this expression be minimized further ?

this is power

this is light

AC

$110V$

U

$\bar{U}$

door upstairs

Switch U

STAIRS

D

$\bar{D}$

Switch D

door downstairs

Beware ! this is a switch !

with two positions

Hint it can be only in one position.

a) $L = f(U,D)$,

$\quad = (U \cdot D) + (\bar{U}\bar{D})$)

2 DIFFERENT COMBINATIONS OF SWITCHES TO HAVE LIGHT ON

b) $L = f(U,D)$

$\quad = UD + \bar{U}\bar{D}$

CAN'T BE MINIMIZED FURTHER!

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).
If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. *L=f(U,D). Write this expression and explain !*

$$\overline{U}\,D + U\,\overline{D}$$

SAME AS PROB. #1

(b.) could this expression be minimized further ?

NO

this is power

AC

110V

this is light

Switch U

door upstairs

Switch D

door downstairs

STAIRS

Beware ! this is a Switch !

with two positions
Hint it can be only
in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).
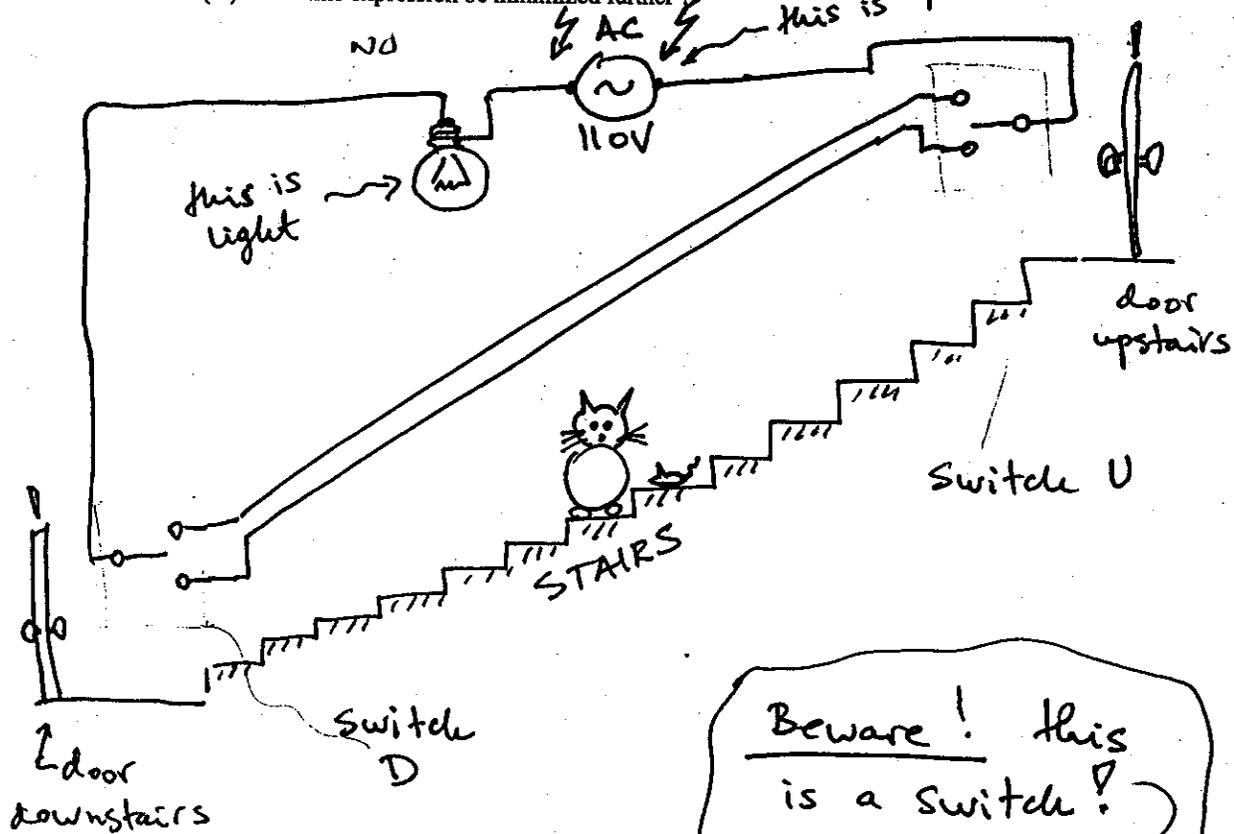
If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L=f(U,D)$. Write this expression and explain !

(b.) could this expression be minimized further ?

this is power

AC

110V

this is light

door upstairs

Switch U

STAIRS

Switch D

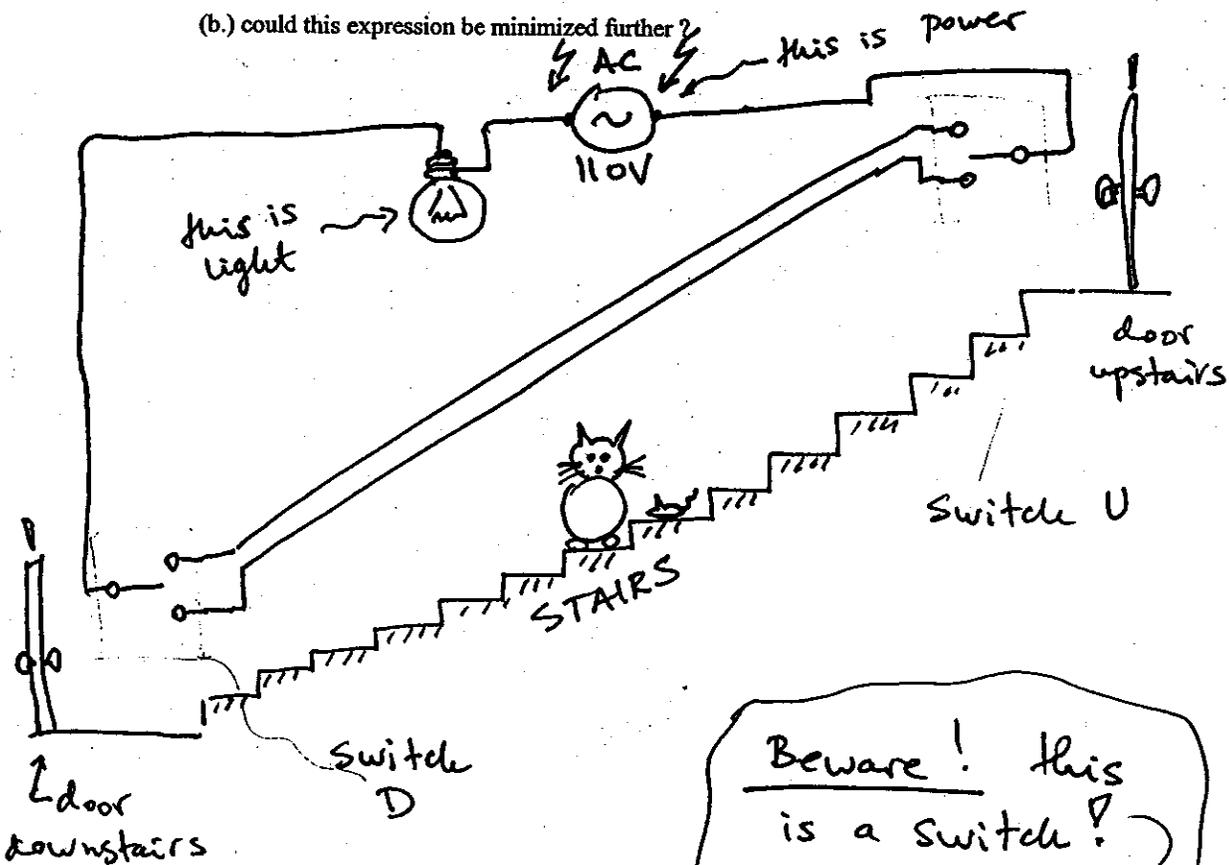door downstairs

Beware ! this is a switch !

with two positions
Hint it can be only in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).
If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L = f(U,D)$. Write this expression and explain !

(b.) could this expression be minimized further ?

this is power

AC

~

110V

this is
light

door
upstairs

Switch U

STAIRS

Switch
D

door
downstairs

a). $F = U\bar{D} + \bar{U}D$
the light is on only when you turn on one switch.

b). No, it could not be min. further
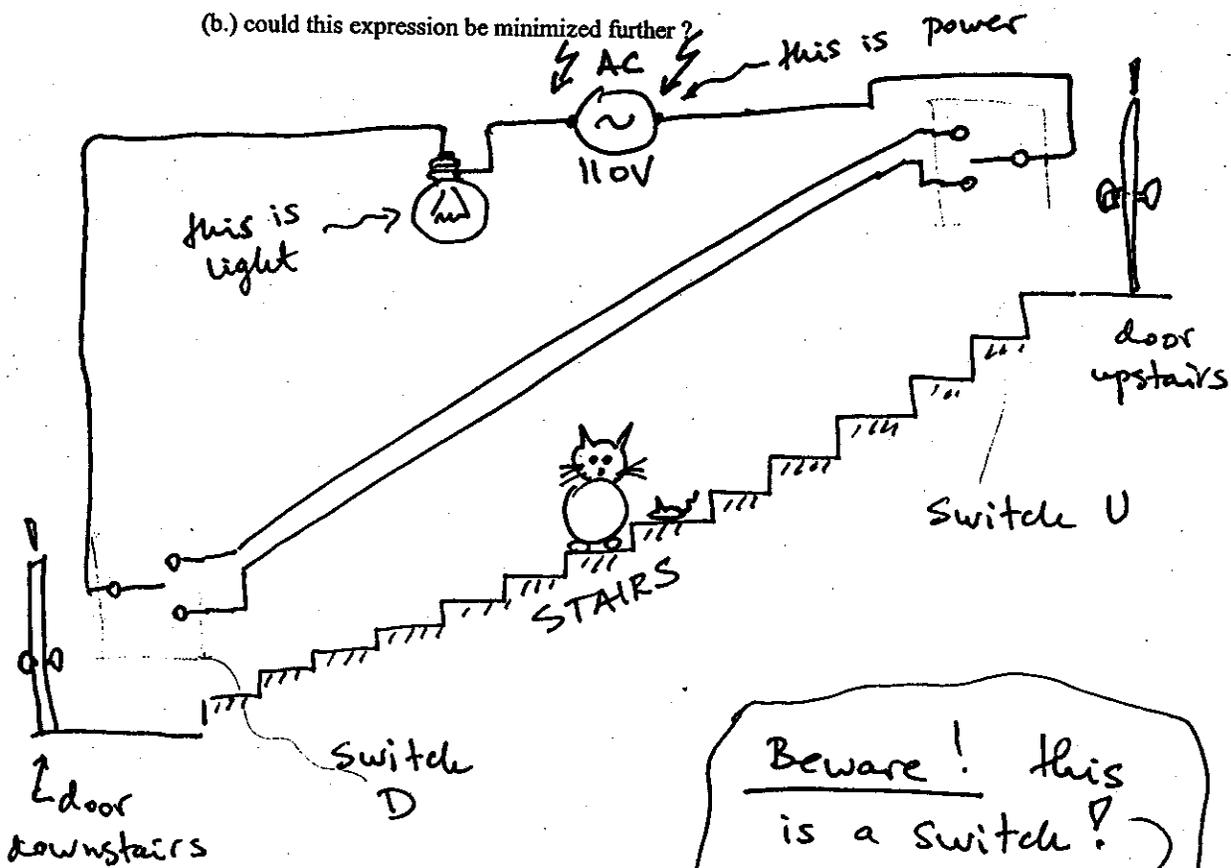
Beware ! this
is a Switch !

with two positions
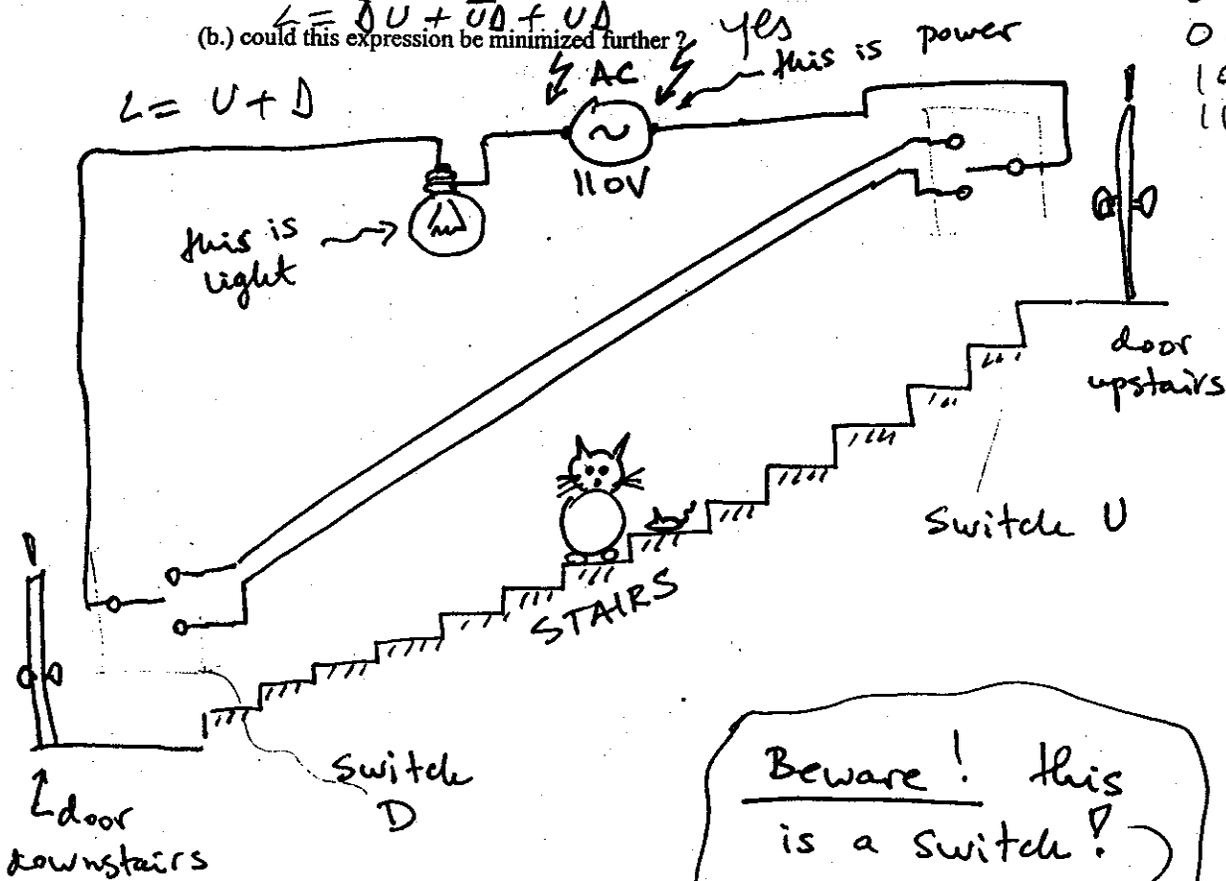Hint it can be only
in one position.

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If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L = f(U,D)$. *Write this expression and explain !*

(b.) could this expression be minimized further ?   yes

$$L = \overline{D}U + \overline{U}D + UD$$

$$L = U + D$$

this is light →

this is power

AC

110V

this is light

door upstairs

Switch U

STAIRS

Switch D

door downstairs

D	U	L
0	0	0
0	1	1
1	0	1
1	1	1

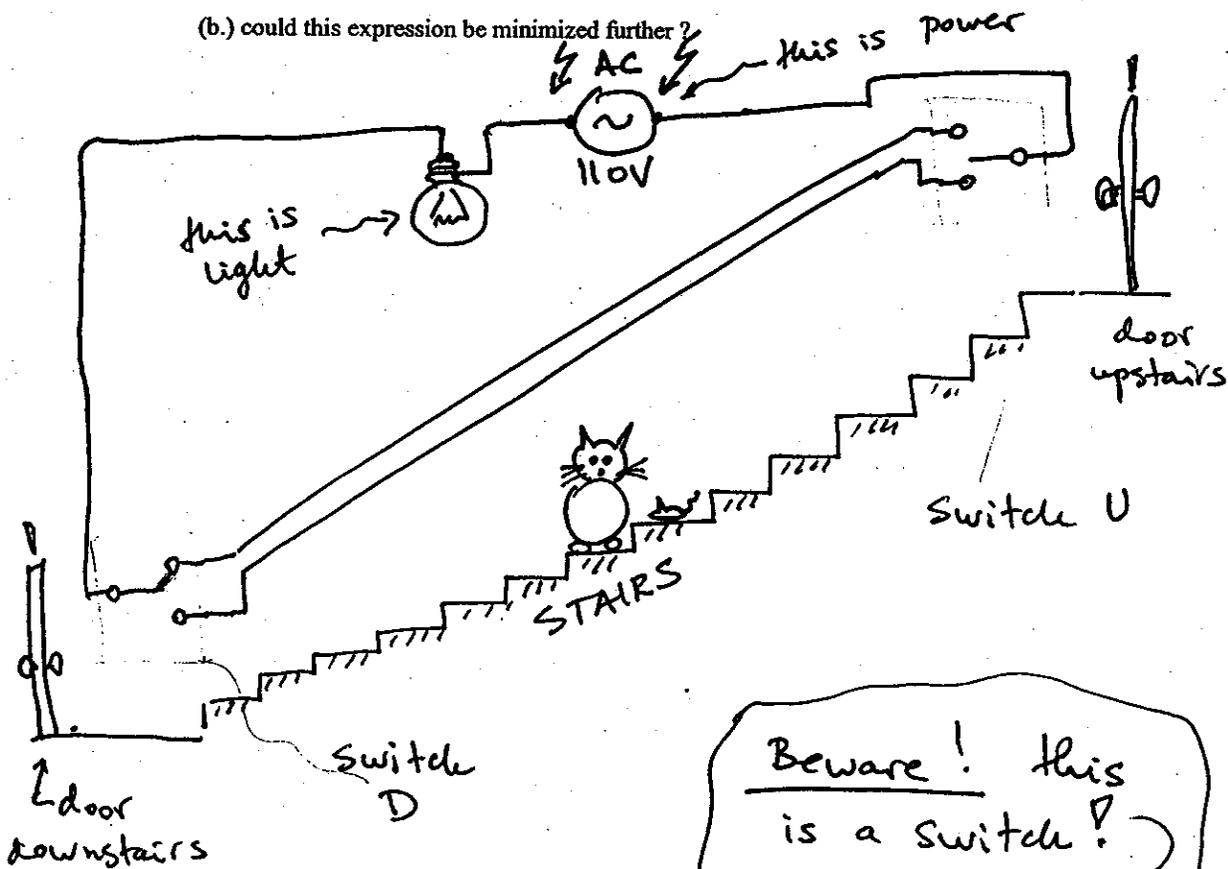| D\U	0	1
0	0	1
1	1	1

Beware ! this is a switch !

with two positions

Hint it can be only in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).

If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L = f(U,D)$. Write this expression and explain !

(b.) could this expression be minimized further ?

this is power

⚡ AC ⚡

110V

this is light

this is → (light)

door upstairs

Switch U

STAIRS

Switch D

door downstairs

Beware ! this is a switch !

with two positions

Hint it can be only in one position.

$$\overline{F} = \overline{D} + \overline{U}$$

$$F = \overline{\overline{D} + \overline{U}}$$

$$= \overline{\overline{D}}$$

$$\overline{F} = \overline{D}U + D\overline{U}$$

$$F = \overline{\overline{D}U + D\overline{U}} = \overline{\overline{D}U} \cdot \overline{D\overline{U}}$$

$$F = (D + \overline{U})(\overline{D} + U)$$

$$F = \overline{D}\,\overline{U} + UD$$

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).

If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L = f(U,D)$. *Write this expression and explain !* $= f(u, D) = u + D$

(b.) could this expression be minimized further ?

this is power

$\sim$ AC

110V

this is light

door upstairs

Switch U

STAIRS

door downstairs

Switch D

NO

b) There's NO expression to be minimized farther

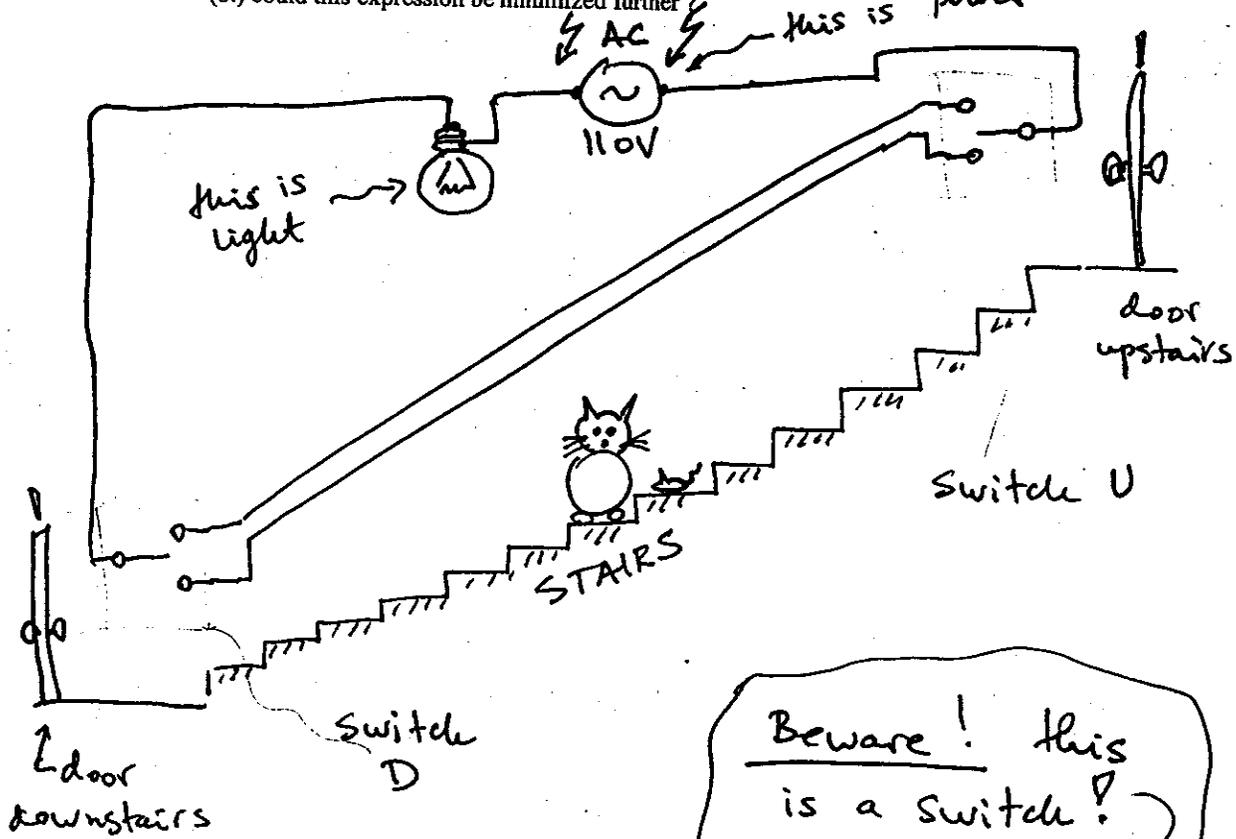Beware ! this is a switch !

with two positions

Hint it can be only in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).
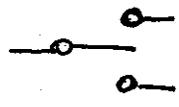If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON?

(a.) I.e. L=f(U,D). Write this expression and explain !

a) $L = f(U, D) = U + D$ =) The light is on if either U is on OR D is on.

(b.) could this expression be minimized further ?

this is power

$\sim$ AC $\sim$

110V

this is light

this is light

door upstairs

Switch U

STAIRS

door downstairs

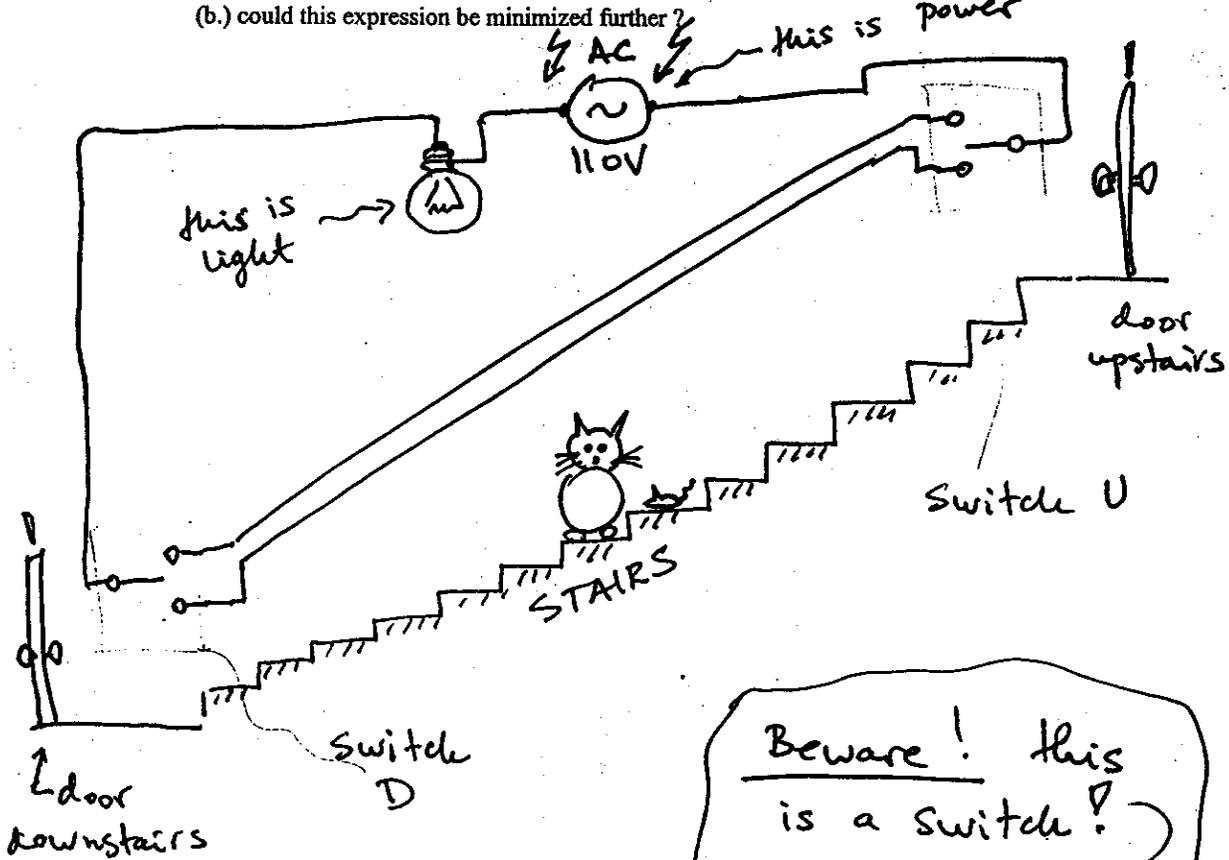Switch D

b) No further simplification.
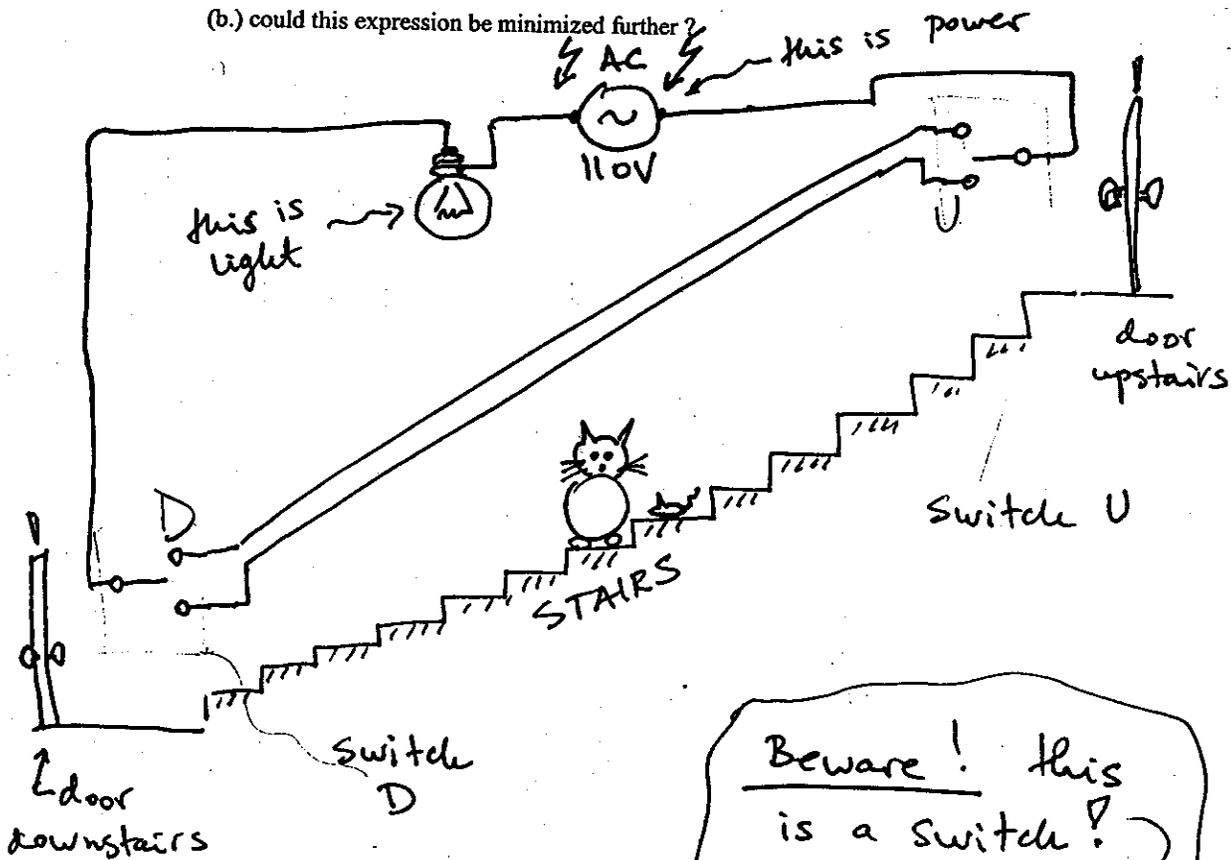
Beware! this is a switch!

with two positions
Hint it can be only in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. - (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).

If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L=f(U,D)$. Write this expression and explain !

(b.) could this expression be minimized further ?

this is power

ξ AC ξ

110V

this is light

door upstairs

Switch U

STAIRS

Switch D

door downstairs

a) $\bar{U}D + U\bar{D}$

One must be in the UP position while one is in the down position at all times to complete the circuit.

Beware ! this is a switch !

with two positions
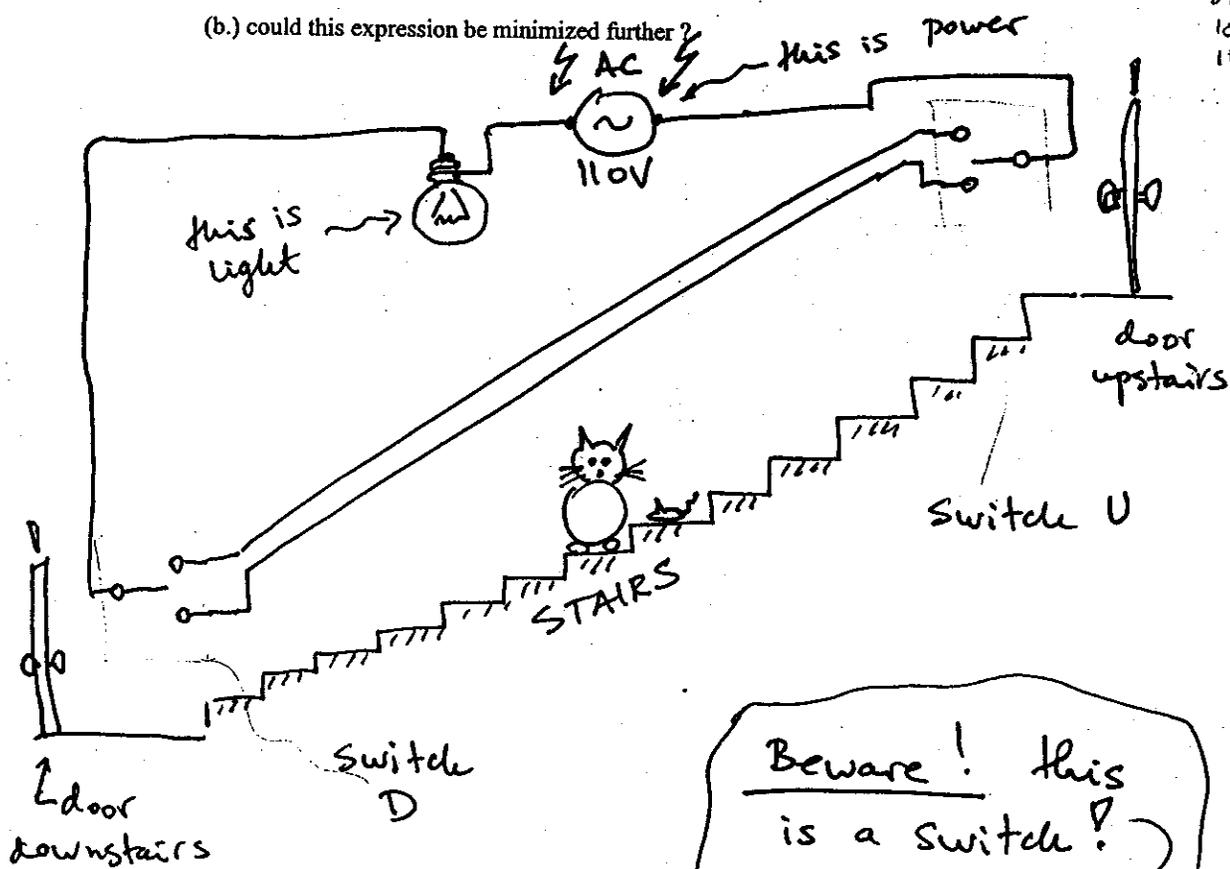
Hint it can be only in one position.

b) No, it can't be

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).

If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L=f(U,D)$. Write this expression and explain !

(b.) could this expression be minimized further ?

D	U	(f=1 for on)
0	0	
0	1	
1	0	
1	1	1

this is power

this is light

$110V$

STAIRS

Switch U

door upstairs

Switch D

door downstairs

$f = \bar{U}d + \bar{d}u + ud +$

Beware ! this is a switch !

with two positions

Hint it can be only in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).
If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L=f(U,D)$. Write this expression and explain !

(b.) could this expression be minimized further ?

AC

this is power

$\sim$

110V

this is light

door upstairs

Switch U

STAIRS

Switch D

door downstairs

Beware ! this is a switch !

with two positions
Hint it can be only in one position.

Ken Wallace

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).

If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. *L=f(U,D). Write this expression and explain !* $F = U D + \overline{U}\,\overline{D}$

UD means both on
$\overline{U}\overline{D}$ means both off

(b.) could this expression be minimized further ? no

this is power

this is AC
110V

this is light

door upstairs

Switch U

STAIRS

Switch D

door downstairs

Beware ! this is a switch !

with two positions
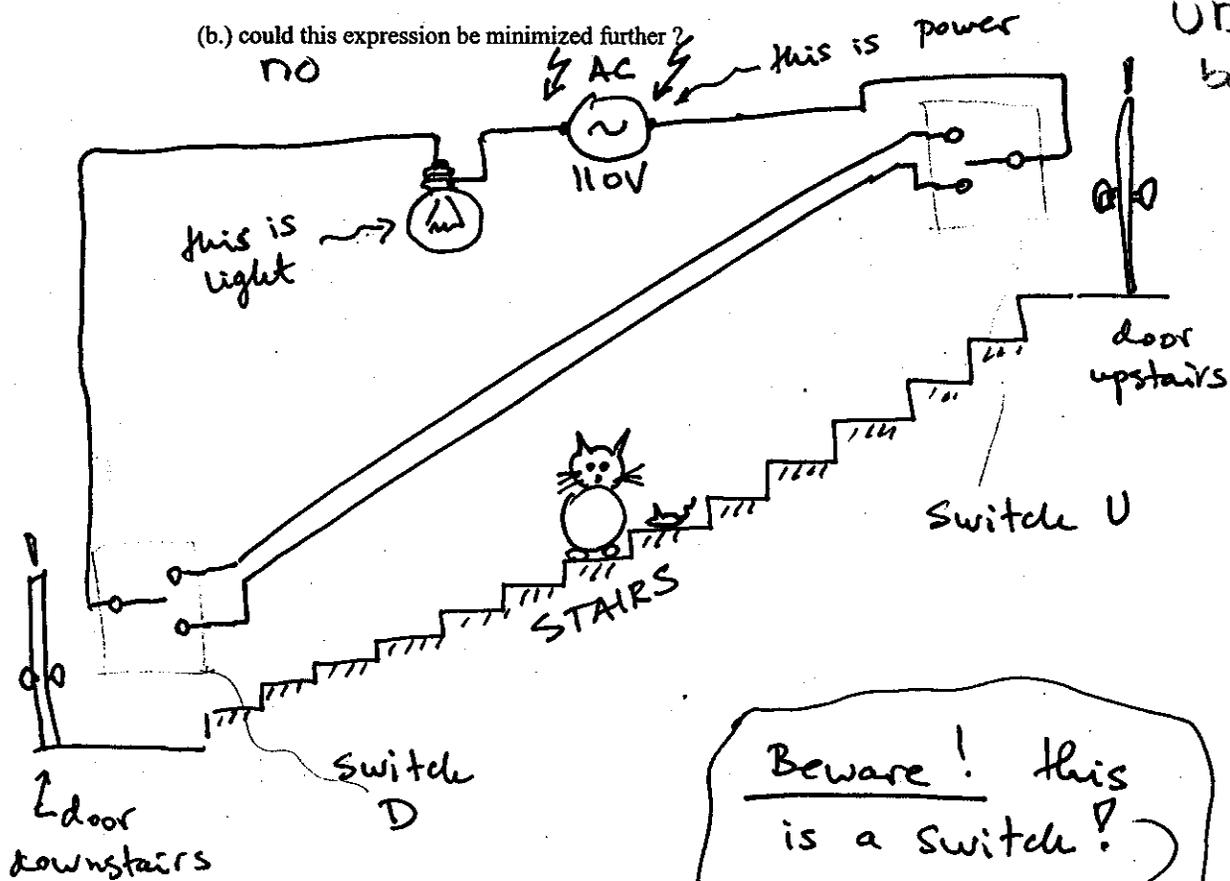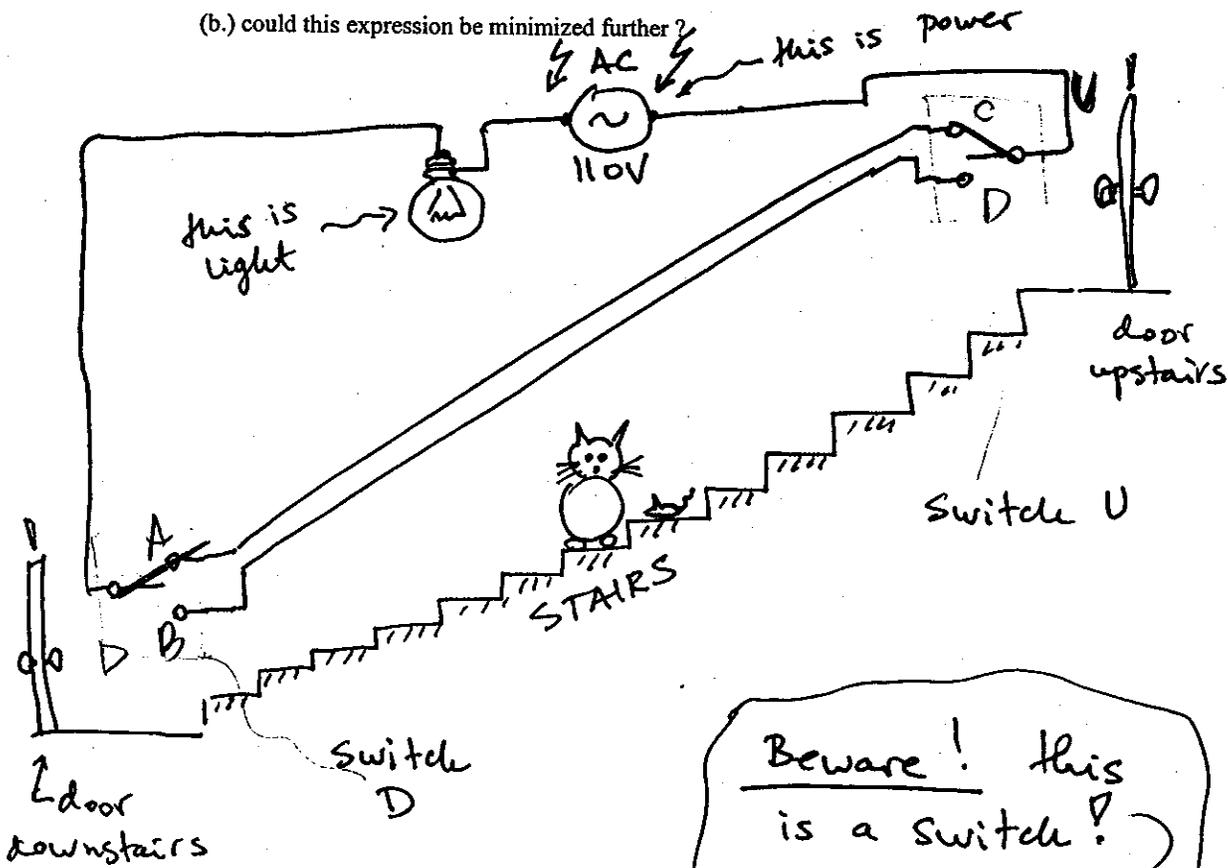Hint it can be only in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).
If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L=f(U,D)$. Write this expression and explain !

(b.) could this expression be minimized further ?

this is power

ẛ AC ẛ

$110V$

this is light

C

D

door upstairs

Switch U

A

D B

STAIRS

door downstairs

Switch D

Beware ! this is a switch ! with two positions Hint it can be only in one position.
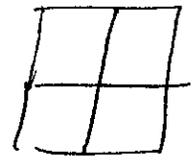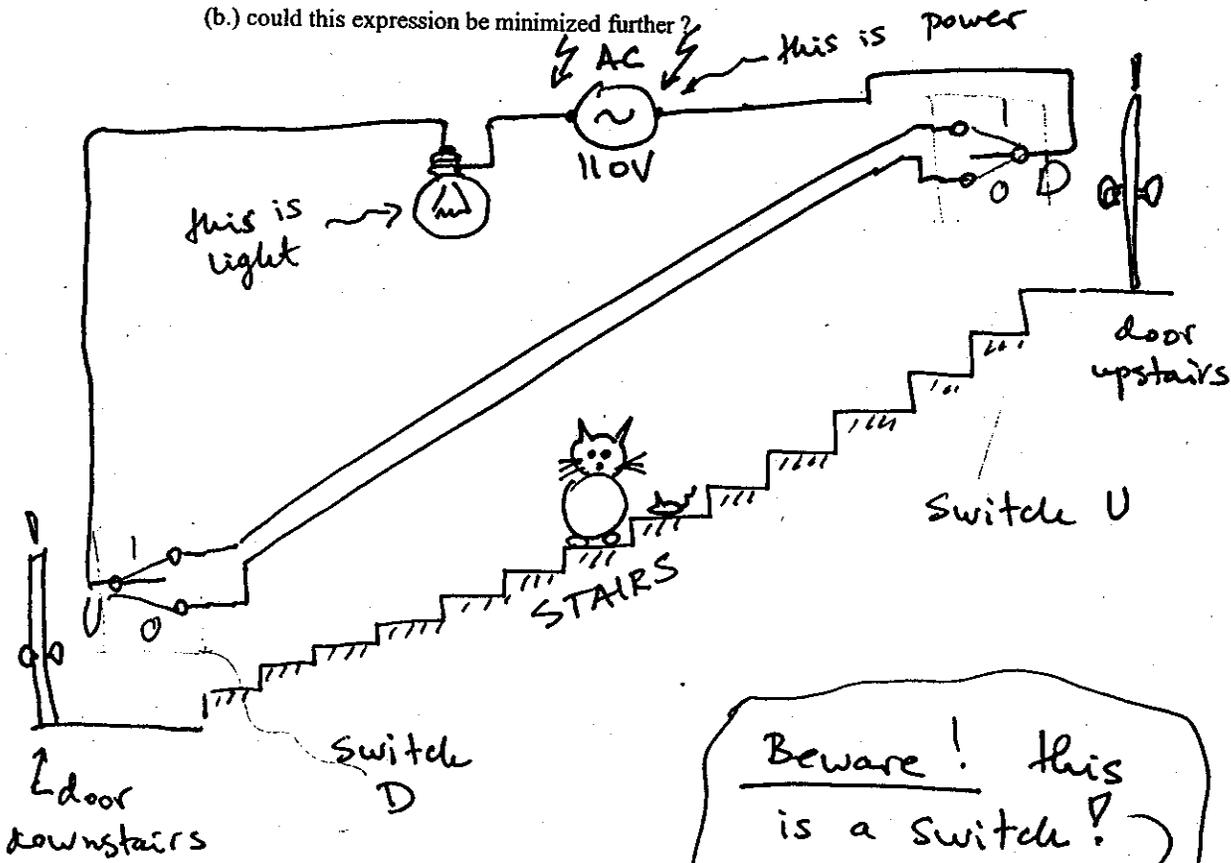
A)

$$F(a,b,c,d) = (AC) + (BD)$$

b) cannot be minimized

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).
If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. *L=f(U,D)*. *Write this expression and explain !*

(b.) could this expression be minimized further ?

this is power

AC

this is light

$110V$

door upstairs

Switch U

STAIRS

Switch D

door downstairs

Beware ! this is a Switch !

with two positions
Hint it can be only in one position.

a/ light on if U **and** D is on

light off iff U **or** D off

$U on = 1$
$U off = 0$
$D on = 1$
$D off = 0$

$\Rightarrow \boxed{L = U \cdot D}$

Truth table

D	V	L
0	0	0
0	1	0
1	0	0
1	1	1

b) It couldn't be minimize further

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).

If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L=f(U,D)$. Write this expression and explain !

$$f(U,D) = UD' + U'D$$

(b.) could this expression be minimized further ?

Yes, this is an XOR

AC

110V

this is light

this is power ← 2 cases

U is on
D is off

U is off
D is on

door upstairs

Switch U

STAIRS

Switch D

door downstairs

Beware ! this is a switch !

with two positions
Hint it can be only in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).

If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?
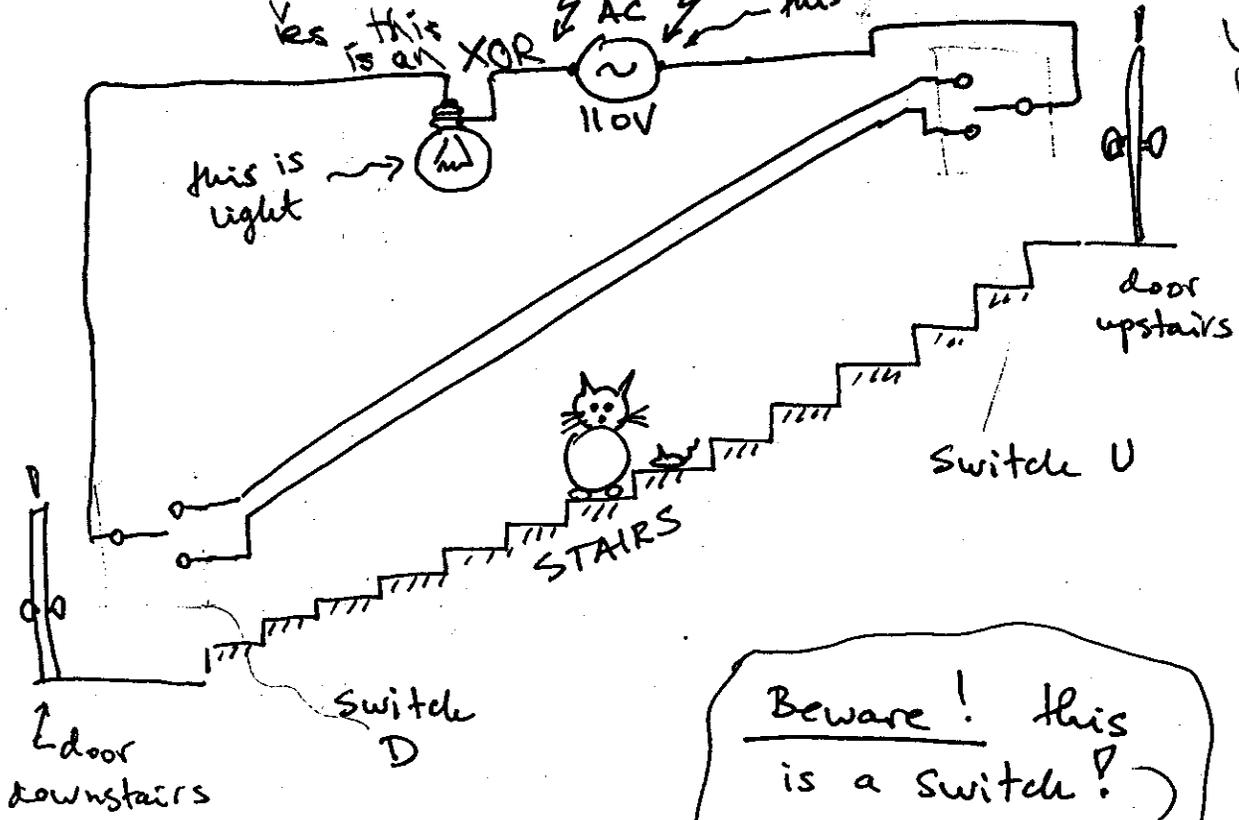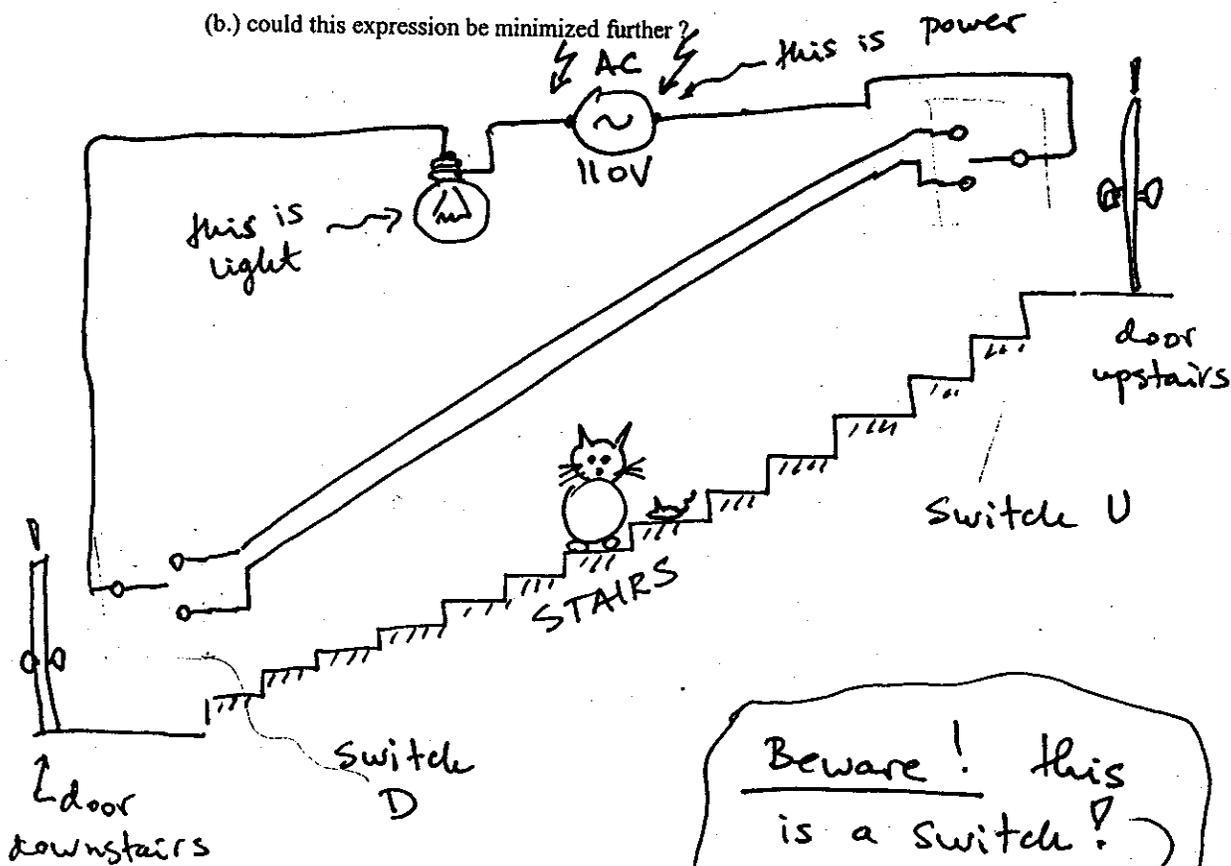
(a.) I.e. $L=f(U,D)$. Write this expression and explain !

(b.) could this expression be minimized further ?

this is power

AC

$110V$

this is light

door upstairs

Switch U

STAIRS

Switch D

door downstairs

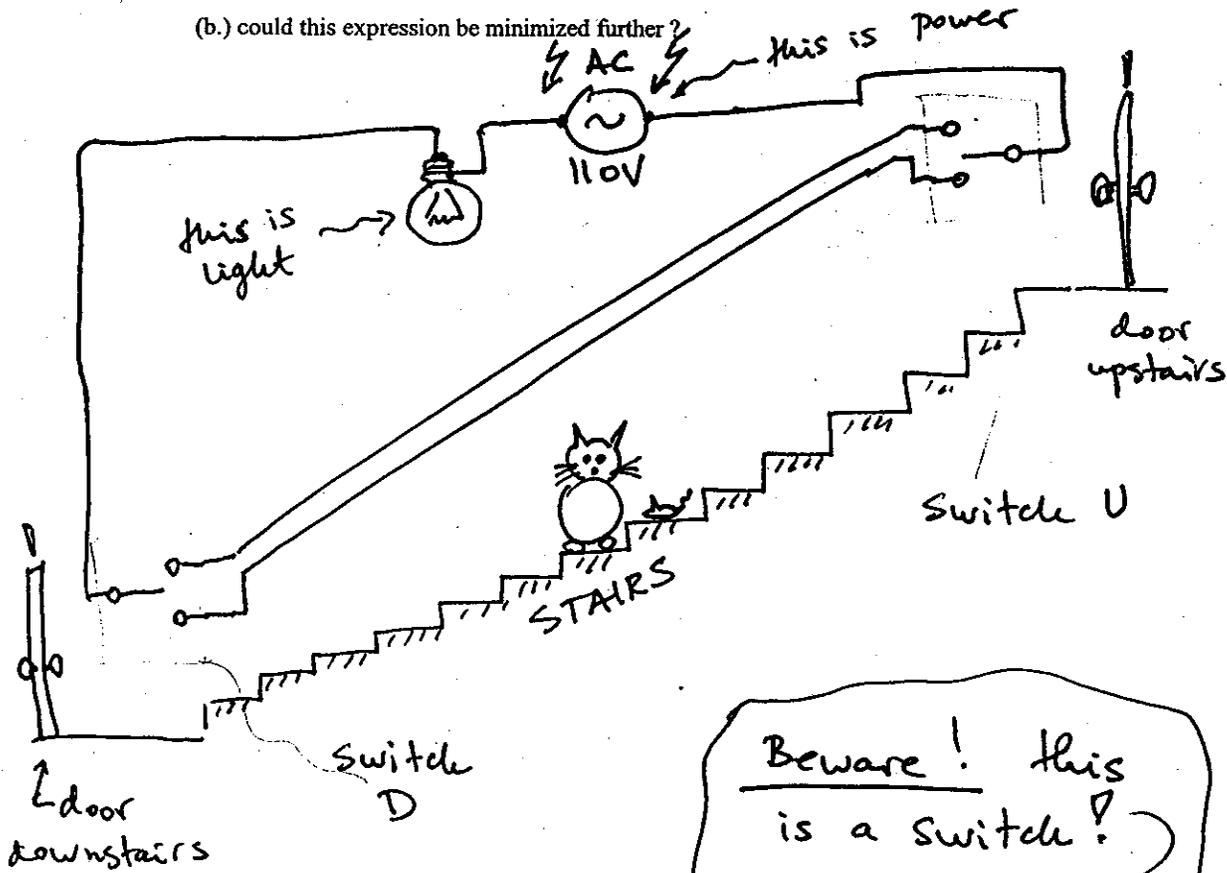Beware ! this is a switch !

with two positions

Hint it can be only in one position.

a) $L = f(U,D) = U\bar{D} + \bar{U}D + UD$

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).
If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L=f(U,D)$. Write this expression and explain !

(b.) could this expression be minimized further ?

this is power

AC

this is light

110V

door upstairs

Switch U

Beware ! this is a switch !

with two positions
Hint it can be only in one position.

Switch D

door downstairs

a) $L = f(u,D) =$

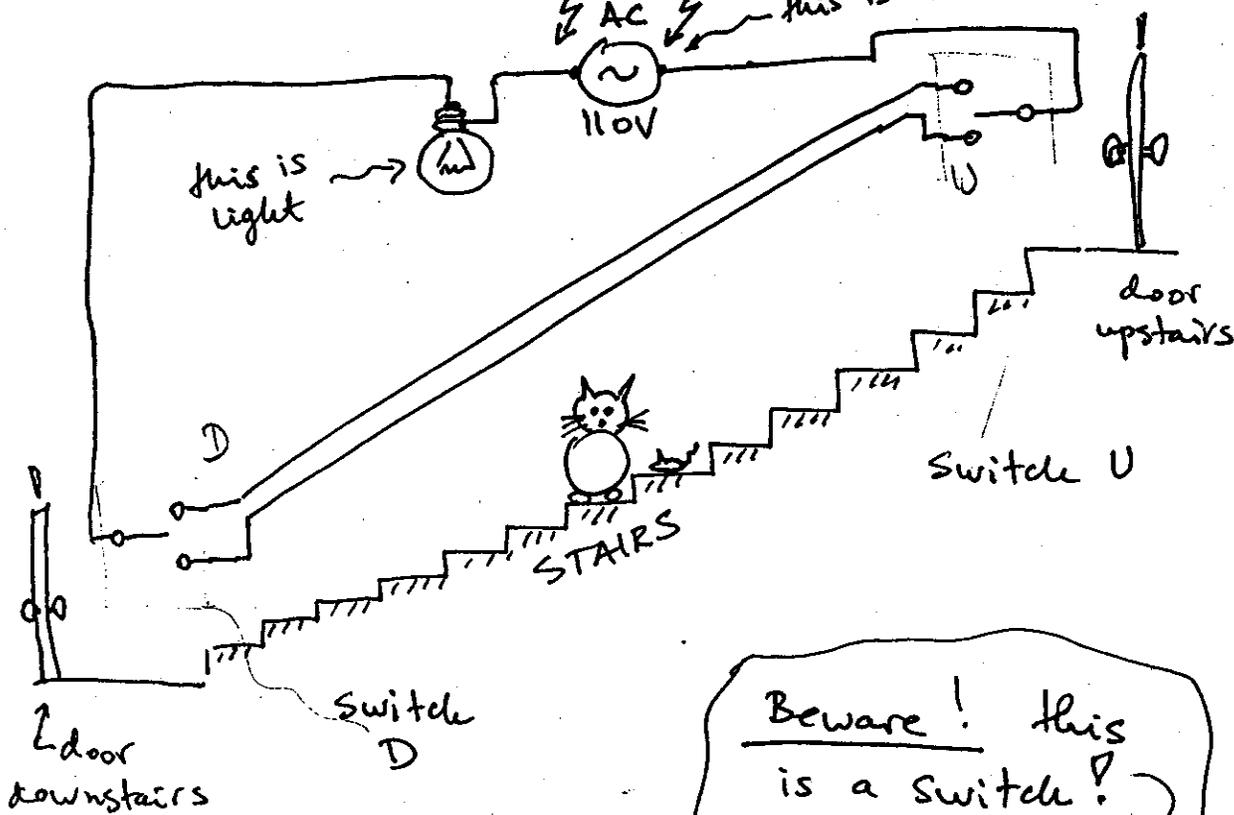| u	D	F
0	0	0
0	1	0
1	0	0
1	1	1

b) yes.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).

If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L = f(U,D)$. *Write this expression and explain !* $L = f(U,D) = U \cdot D$

(b.) could this expression be minimized further ? NO!

this is power

AC

$\sim$

110V

this is light $\rightarrow$

U

door upstairs

Switch U

D

STAIRS

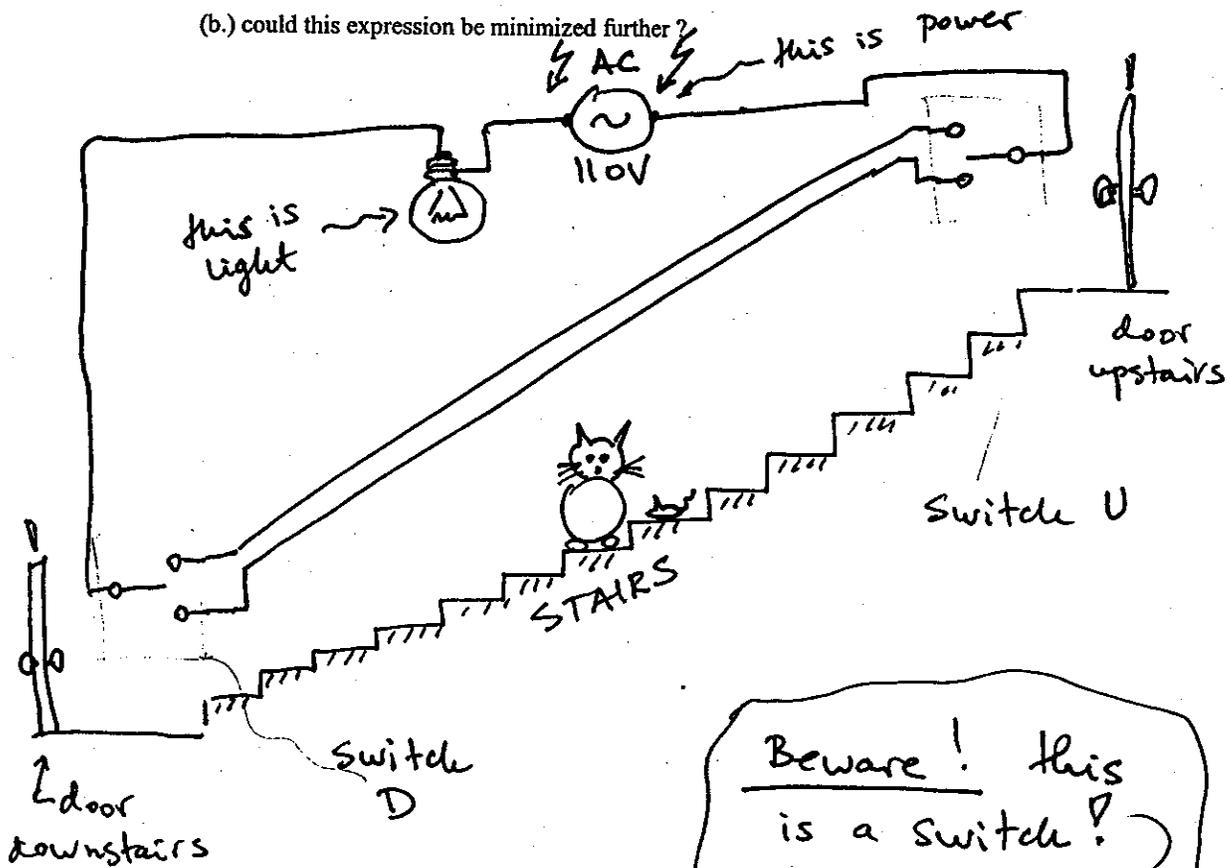this is the cat

door downstairs
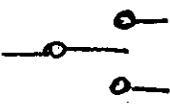
Switch D

Beware! this is a switch!

with two positions

Hint it can be only in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go-downstairs to turn the light OFF if you are exiting upstairs).
If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. *L=f(U,D). Write this expression and explain !*

(b.) could this expression be minimized further ?

this is power

⚡ AC ⚡

110V

this is → light

door upstairs

Switch U

this is light

STAIRS

Switch D

door downstairs

Beware ! this is a Switch !

with two positions
Hint it can be only in one position.

a)

U	D	f
0	0	1
1	0	0
0	1	0
1	1	1

$f(U,D) = (UD' + U'D) = (U'+D)(U+D')$

b.) $f(U,D) = (U \oplus D)$ (exclusive or) complemented

when both are in the same position (0 or 1) the light is on.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).

If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

0 — OFF
1 — ON

(a.) I.e. $L = f(U,D)$. *Write this expression and explain !*

$L = U + D$ IF D = 0 (off) and U = 1 (on) then L = 1 (on).

(b.) could this expression be minimized further ?

If D = 1 and U = 0 then L
If D = 0 and U = 0 then L
If D = 1 and U = 1 then .

no. this is already the minimized expression

AC

this is power

110V

this is → light

this is ⤳ light

door upstairs

Switch U (0, 1)

STAIRS

Switch D (0,1)

door downstairs

Beware ! this is a switch !

with two positions
Hint it can be only in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).
If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?
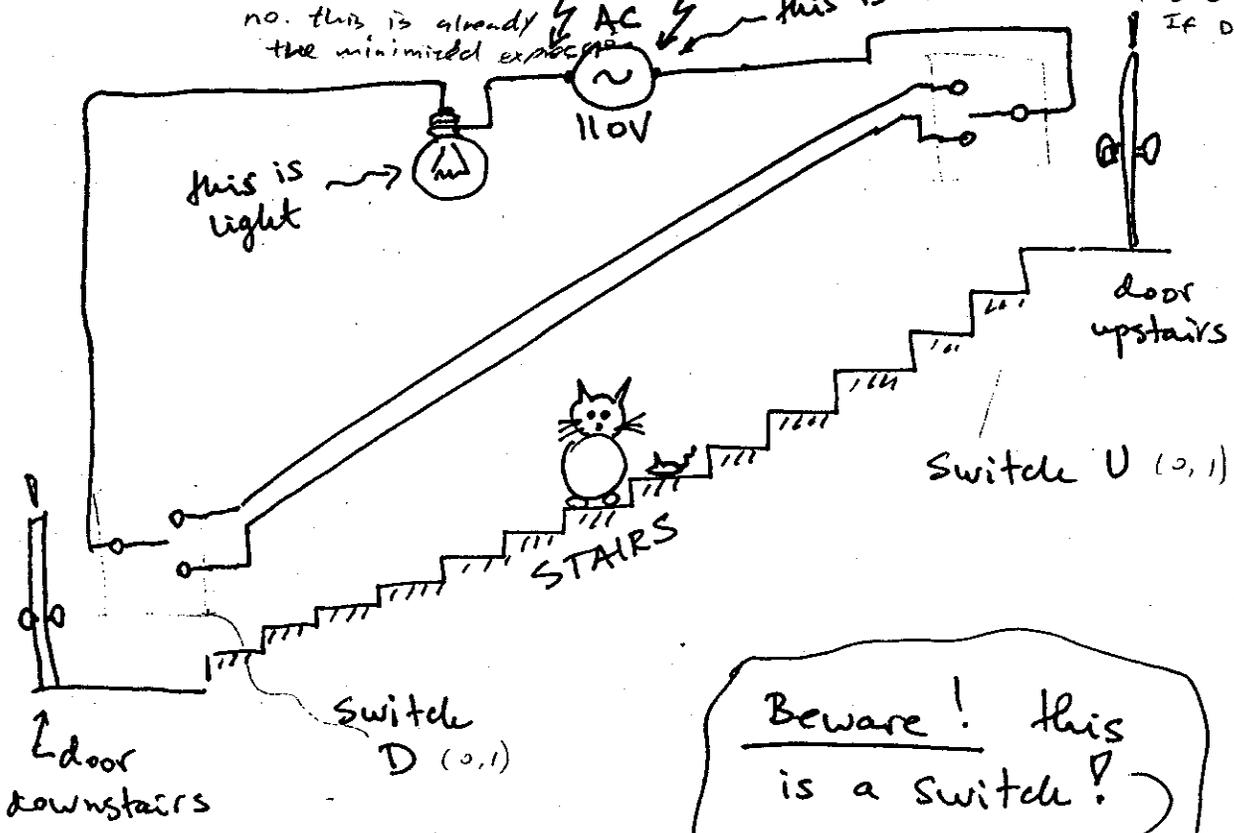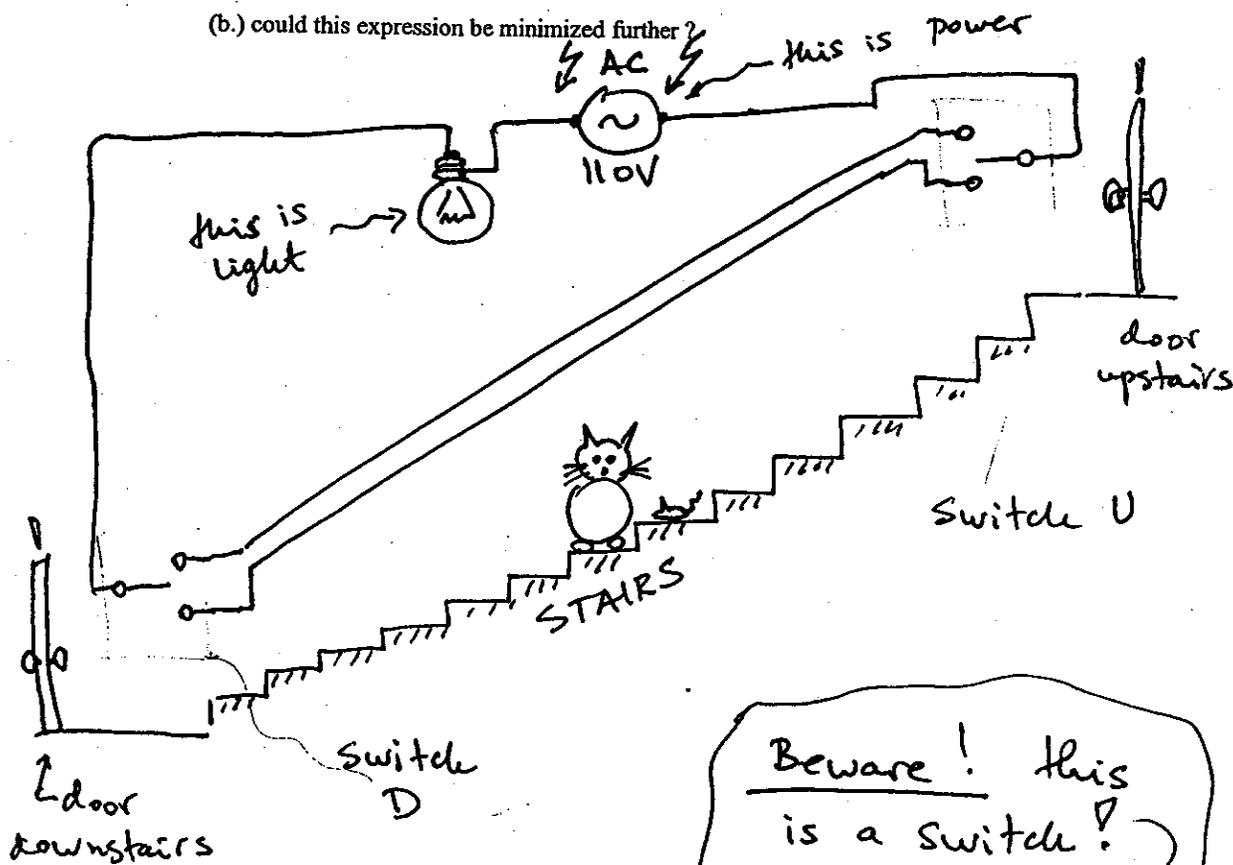
(a.) I.e. $L=f(U,D)$. *Write this expression and explain !*

(b.) could this expression be minimized further ?

this is power

ξ AC ξ

$\sim$

110V

this is light $\rightarrow$

door upstairs

Switch U

STAIRS

Switch D

door downstairs

a)

Beware ! this is a switch !

with two positions
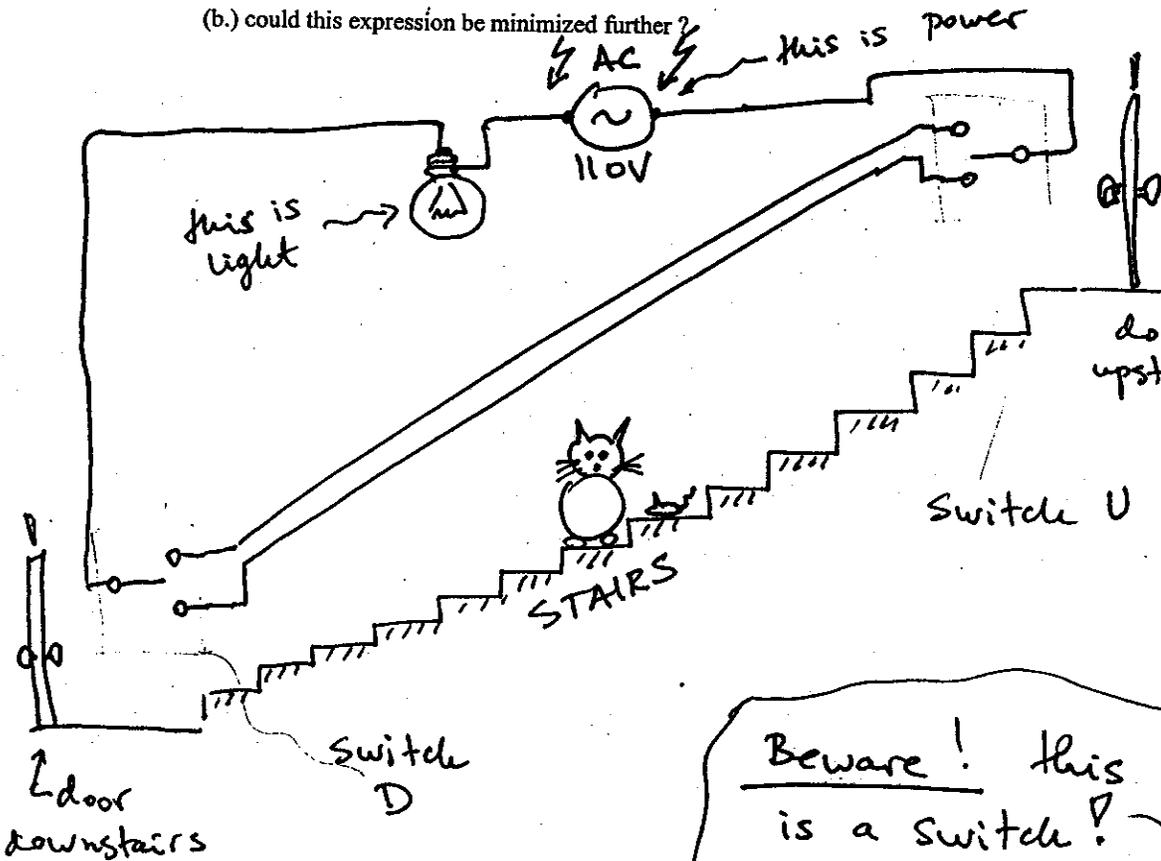Hint it can be only in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).

If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L = f(U,D)$. *Write this expression and explain !* $L = \overline{D}\overline{U} \oplus \overline{D}U$ because when you tu switch D, U will be off t and vice vers But either one on (downstair o upstair), the light wil be on. Eithe one switch off, the oth will still be on, but the light off

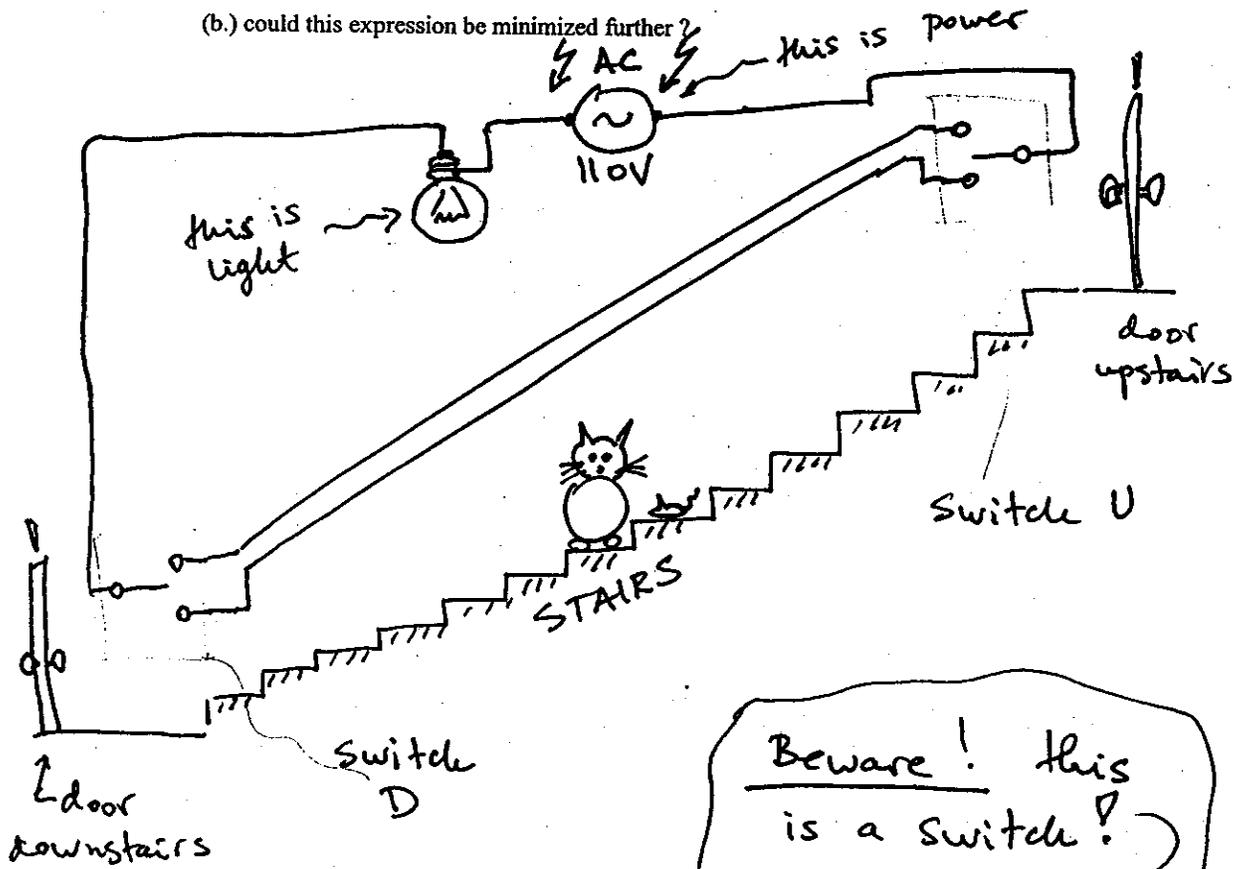(b.) could this expression be minimized further ?

this is power

AC

110V

this is light

door upstairs

Switch U

this is a Switch !

Switch D

door downstairs

STAIRS

Beware ! this is a Switch ? with two positions Hint it can be only in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).
If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L=f(U,D)$. *Write this expression and explain !*

(b.) could this expression be minimized further ?

$\frac{\zeta}{} \text{ AC } \frac{\zeta}{}$ — this is power

$\sim$
110V

this is → (light)
light

STAIRS

Switch U

door
upstairs

Switch
D

door
downstairs

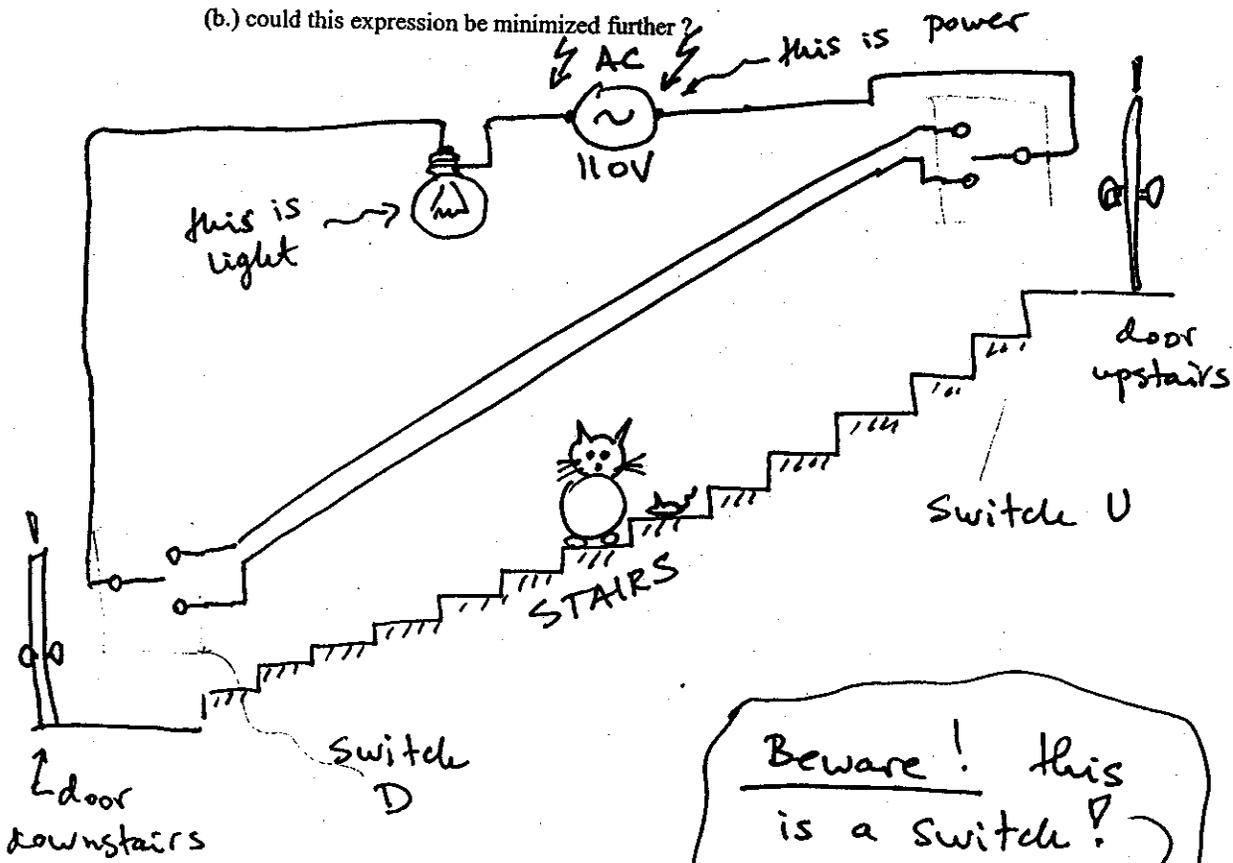| U	D	L
0	0	0
1	1	1

$L = U D$

Beware ! this
is a switch !

with two positions
Hint it can be only
in one position.

Problem #2: Given is a famous staircase wiring diagram with the switch arrangement that can turn light OFF or ON on both sides of the stairs. (you do not need to go downstairs to turn the light OFF if you are exiting upstairs).

If you designate the downstairs switch as D (which can have values 0, 1) and upstairs switch as U (0,1), what is the logic function (logic expression) for the light being ON ?

(a.) I.e. $L=f(U,D)$. *Write this expression and explain !*

(b.) could this expression be minimized further ?

this is power

⚡ AC ⚡

~

$11 0V$

this is light

door upstairs

Switch U

STAIRS

Switch D

door downstairs

Beware ! this is a switch !

with two positions

Hint it can be only in one position.

$$\underbrace{U} \quad \underbrace{D}$$

$$1.) \quad L = f(U,D) = (UD' + DU')$$

⇓

Since U can be on when D is off ;
D is on when U is off :

$$b.) \quad UD' + DU' \Rightarrow NO \quad \text{i can't be minimize further .}$$