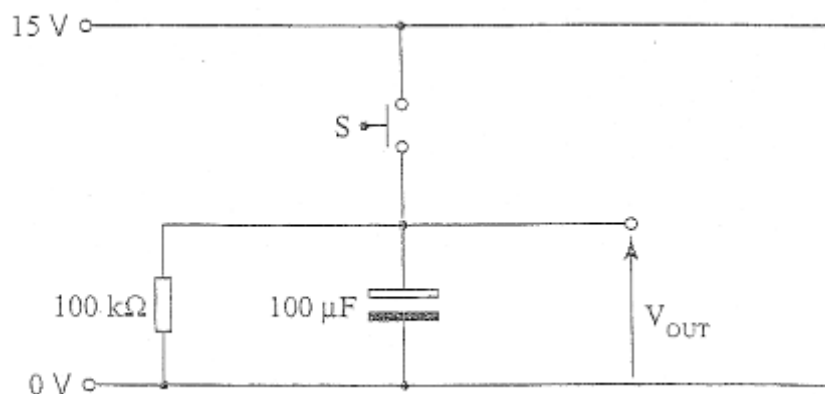


Capacitors

1. The following circuit is used to provide a time delay.



- (a) Calculate the time constant of the circuit.

.....
.....

[1]

- (b) When the switch S is momentarily closed the capacitor charges up to 15V. Calculate the output voltage 5 seconds after the switch is released.

.....
.....
.....

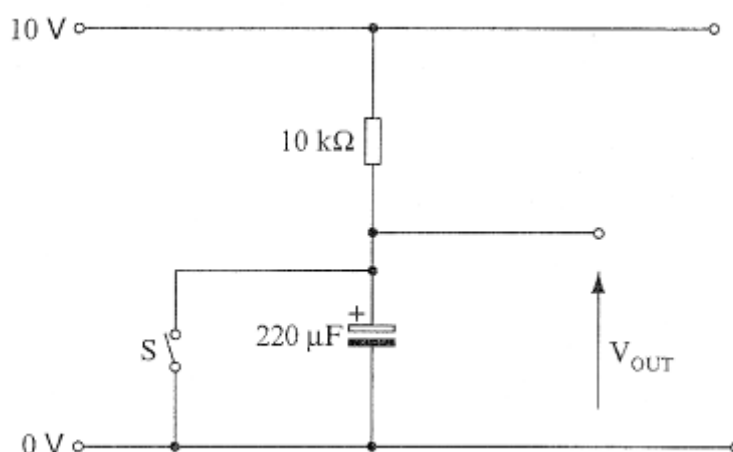
[2]

- (c) Calculate the time taken after the switch is released for the output voltage to fall from 15V to 3V.

.....
.....
.....
.....

[2]

3. The capacitor shown in the following circuit is initially discharged. The switch S is opened at time $t = 0$.



- (a) Calculate the time constant of the circuit.

.....

.....

[1]

- (b) Determine the time taken for V_{OUT} to reach 5V.

.....

.....

.....

[2]

- (c) Calculate the output voltage 20 seconds after the switch is opened.

.....

.....

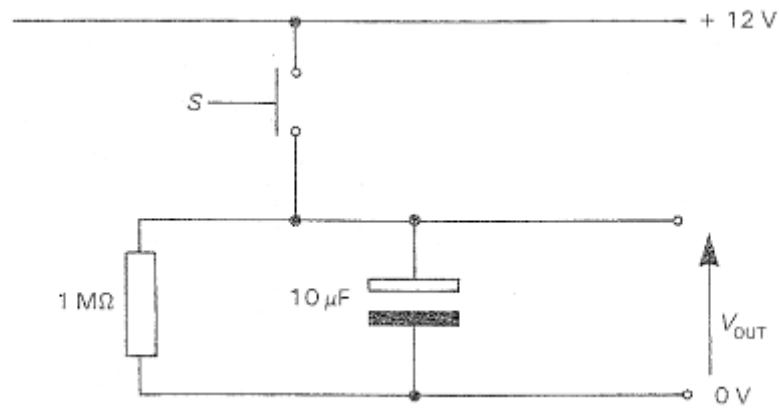
.....

.....

.....

[2]

6. The following circuit is used to provide a time delay. The capacitor charges up to 12V when switch S is momentarily closed.



- (i) Calculate the time constant of the circuit.

.....
.....

[1]

- (ii) Calculate the output voltage 3 seconds after the switch is released.

.....
.....
.....

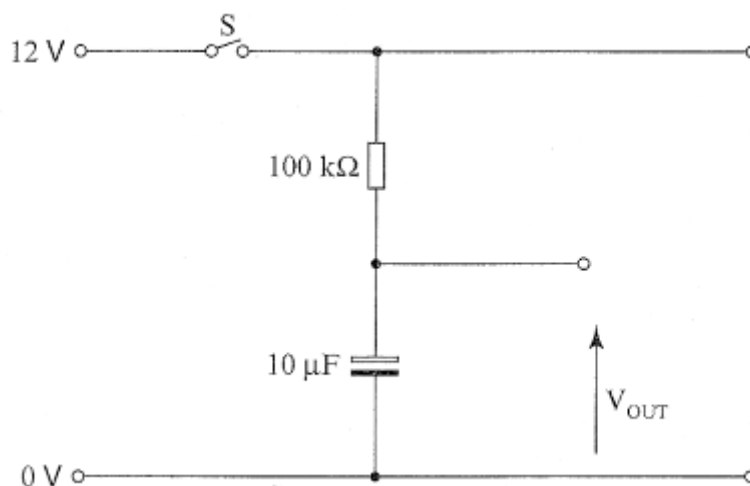
[2]

- (iii) Calculate the time taken after the switch is released for the output voltage to fall from 12V to 4V.

.....
.....
.....
.....

[2]

7. The capacitor shown in the following circuit is initially discharged.



- (a) Calculate the time constant of the circuit.

.....
.....

[1]

- (b) Switch S is closed at time $t = 0$.

- (i) Determine the time taken for V_{OUT} to reach half the supply voltage.

.....
.....
.....

[2]

- (ii) Calculate the output voltage 2s after the switch is closed.

.....
.....
.....

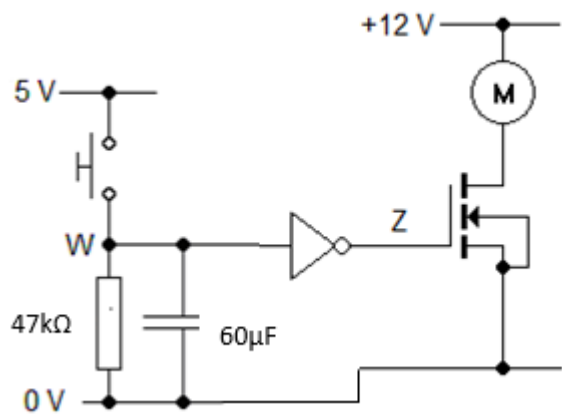
[2]

Monostable

Question 3 [Total: 19]

The circuit below contains an RC network.

The table shows the behaviour of the logic gate.



| signal w | signal z |
|----------|----------|
| < 2.5V | +5V |
| > 2.5V | 0 V |

(a) Show that the time constant is approximately 3s. [3]

(b) Explain why the motor is off as soon as the switch is pressed.

.....
.....
.....
..... [3]

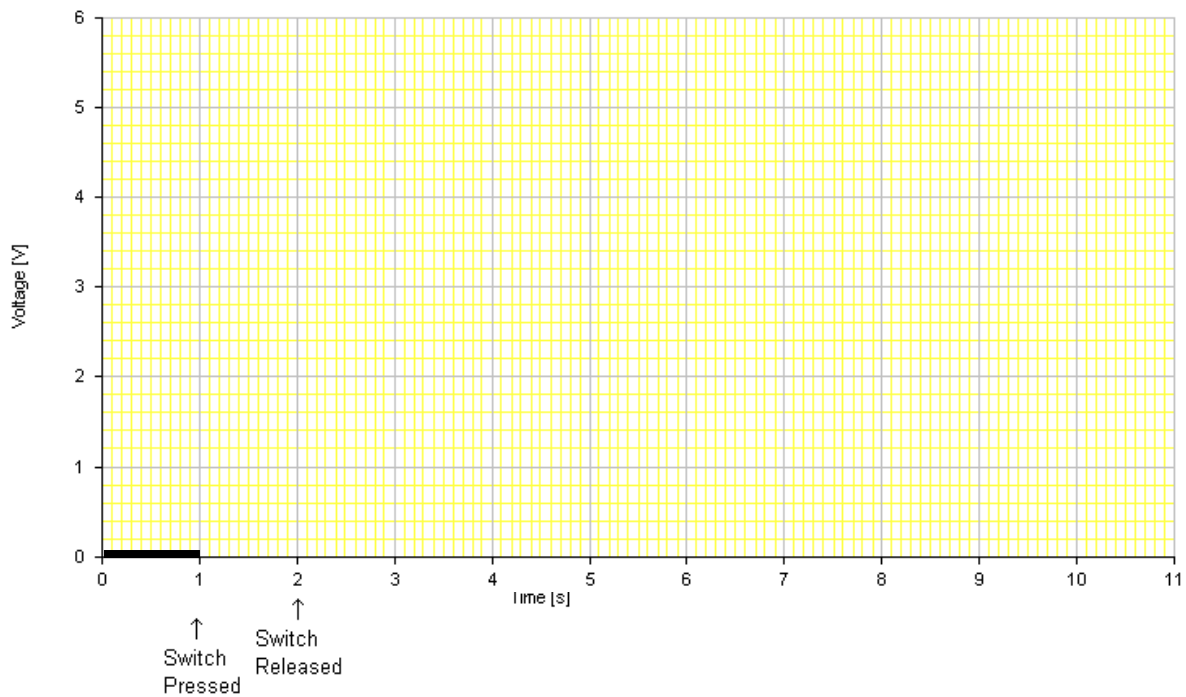
(c) Explain, in detail, what happens to the motor when the switch is released.

.....
.....
.....
.....
.....
..... [4]

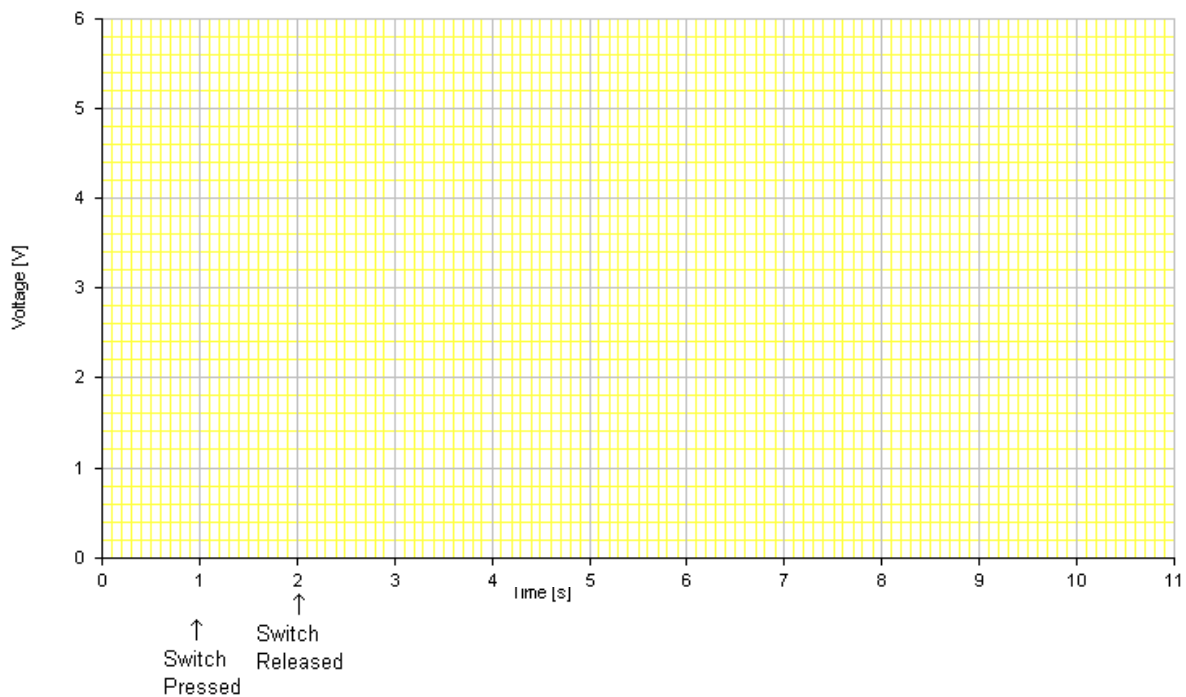
(d) Show that the time taken for W to fall from 5V to 2.5V when the switch is released is approx 2 second.

.....
.....
.....
.....
..... [2]

(e) Complete the graph below to show how the voltage at **W** changes with time as the switch is pressed and released. **[4]**

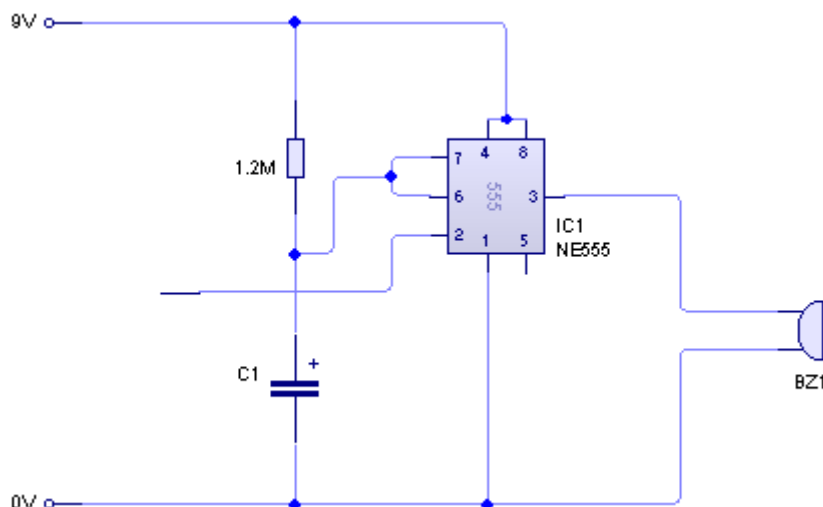


(f) Use the data in the table of the circuit to draw a graph showing how the voltage at **Z** changes with time as the switch is pressed and released. **[3]**



A 555 monostable is used in an alarm system. When a push switch is momentarily closed a buzzer sounds for 1 minute.

- (a) Add a switch and any other necessary component to the diagram below to complete the trigger section of the monostable.



[2]

- (b) Draw a sketch to illustrate the shape of the waveform produced at the output of the monostable when the pressure switch is momentarily pressed. Label the time axis to indicate when the switch was pressed and provide a suitable scale.



[2]

- (c) Calculate a suitable value for capacitor C to allow the buzzer to come on for one minute when the pressure switch is momentarily pressed.

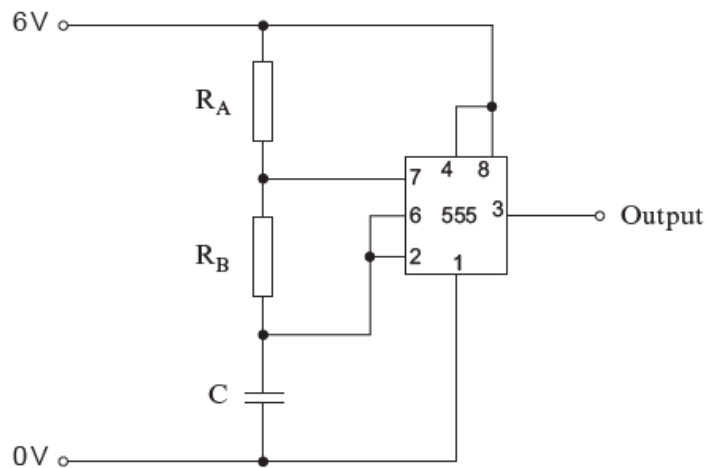
.....

.....

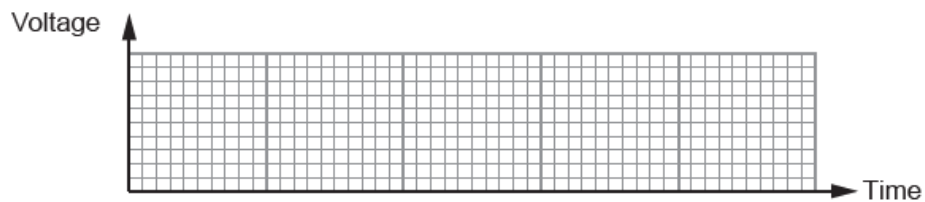
.....

[2]

6. The diagram shows a 555 astable circuit.



- (a) The output signal has a mark:space ratio of 3:1. Sketch one cycle of the output signal. Label the **mark** T_1 and the **space** T_2 . [2]



- (b) The *space* T_2 has a duration of 20ms. Calculate the value of resistor R_B that will produce the *space* T_2 when $C = 2.2 \mu\text{F}$. [2]

.....

.....

.....

- (c) Determine the value of resistor R_A . [1]

.....

.....

.....

Draw a Relaxation Oscillator using a Schmitt trigger NOT gate. Using a 1K resistor calculate the value of any other components used.