ELECTRONICS

OUTPUT DEVICES

1. Draw a trace you could expect on an oscilloscope screen for:
   a) an analogue signal,
   b) a digital signal.

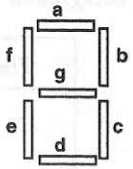
2. Devices can be analogue or digital. Classify the following input devices: microphone, switch, LDR, solar cell, capacitor, thermocouple, thermistor.

3. Devices can be analogue or digital. Classify the following output devices: motor, relay, solenoid, buzzer, loudspeaker, LED, 7-segment display.

4. State which output device you would use in the following situations:
   a) to broadcast the results of a race to the crowd at the track
   b) to show that a piece of equipment is on
   c) to display the time
   d) in the central locking of a car

5. State which output device you would use in the following situations:
   a) to record your voice
   b) to set a motor running when it gets cold
   c) to set a time delay on pedestrian lights
   d) to tell when it gets dark

6. In a seven segment display, the segments are as shown.
   a) State which segments are lit up to show the following numbers:
      i) 4
      ii) 7
      iii) 1
      iv) 2
   b) What number is shown when segments **a**, **b**, **c**, **d**, **g** are lit?



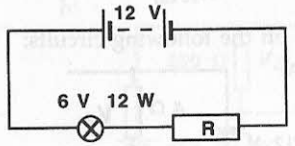
PROTECTIVE RESISTORS

7. An LED takes 10 mA and 1.5 V to work correctly.
   What value of series resistor is required if a 6 V battery is used?

8. An LED takes 15 mA and 2 V to work correctly.
   What value of series resistor is required if a 12 V battery is used?

9. a) An LED takes 10 mA and 2 V to work correctly.
      What value of series resistor is required if a 20 V supply is used?
   b) Draw a circuit diagram showing how the resistor, LED and supply are connected.

10. A 6 V, 12 W light bulb has to be run, at its normal rating, from a 12 V supply as shown.

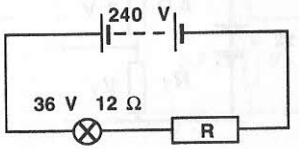


    a) Calculate the current through the bulb.
    b) Calculate the voltage across the resistor.
    c) Calculate the value of the resistor.

11. A 20 V supply is used with an 8 V, 24 W motor and therefore needs a protective resistor.
    a) Calculate the current through the motor.
    b) Calculate the voltage across the resistor.
    c) Calculate the resistance required.

12. A 120 V, 60 W motor is used with a 240V supply.
    Calculate the value of the resistor which should be used to run it at its normal rating.

13. A 240 V supply is used to run a 36 V, 18 Ω bulb as shown.



    a) Calculate the current through the bulb.
    b) Calculate the voltage across the resistor.
    c) Calculate the value of the resistor.

14. A 1.5 V cell is used with a 300 mV, 75 Ω component.
    What protective resistor is required?

15. *A 12 V supply is used with a 3 V, 6 W bulb. In order to protect it a 3 Ω resistor has been placed in series.*
    What additional series resistance would be needed to protect the bulb properly?

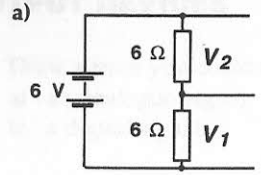
16. *A 500 V supply gives a current of 5 A for a large motor. The motor has a resistance of 95 Ω.*
    a) Explain why a protective resistor is required.
    b) Calculate the value.

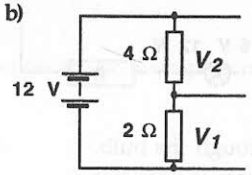
17. *An LED requires 10^{-2} A and 3.2 V to work correctly.*
    a) What protective resistor is required with a 9 V supply?
    b) Calculate the resistance of the LED.
    c) Calculate the power rating of the LED.

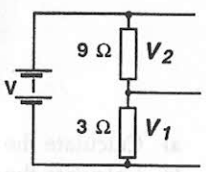
VOLTAGE DIVIDERS

$$V_{R_1} = \frac{R_1}{R_{total}} \times V_{supply}$$

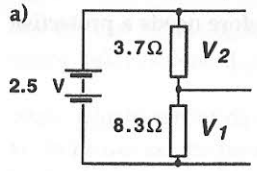
18. Find the voltages V_1 and V_2 in the following circuits:

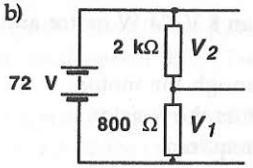
a)


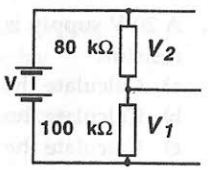
b)


c)


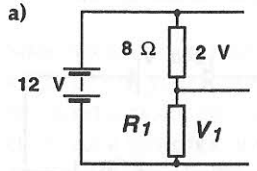
19. Find the voltages V_1 and V_2 in the following circuits:

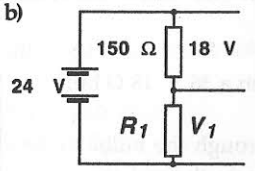
a)


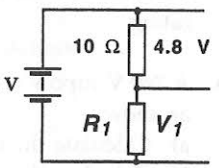
b)


c)


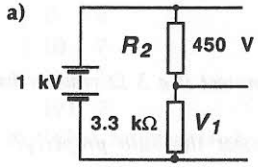
20. Find the resistance R_1 and the voltage V_1 in the following circuits:

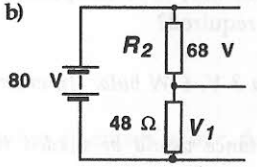
a)


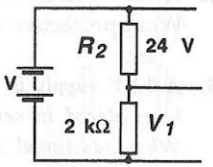
b)


c)


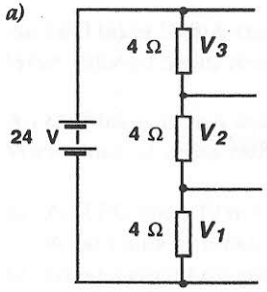
21. Find the resistance R_2 and the voltage V_1 in the following circuits:

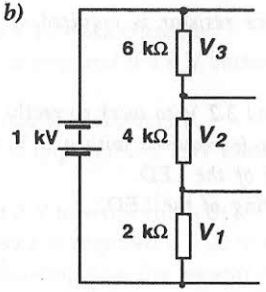
a)


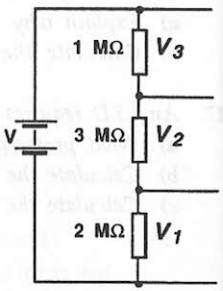
b)


c)


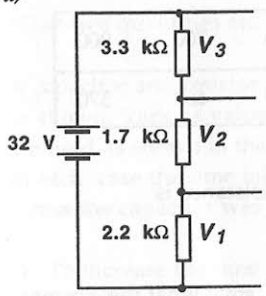
22. *Find the voltages V_1, V_2 and V_3 in the following circuits:*

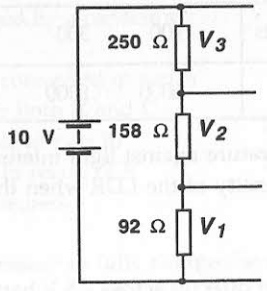
a)


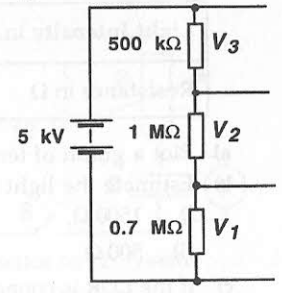
b)


c)


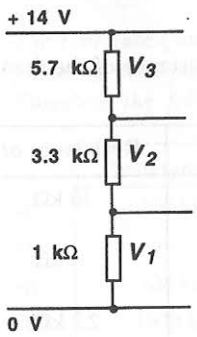
23. *Find the voltages V_1, V_2 and V_3 in the following circuits:*

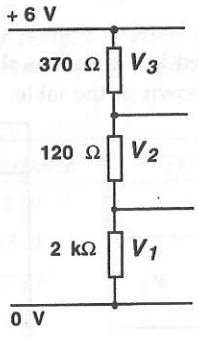
a)


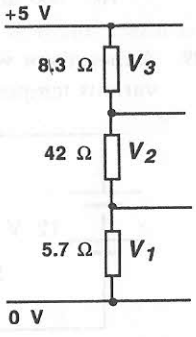
b)


c)


24. *Find the voltages V_1, V_2 and V_3 in the following circuits:*

a)


b)


c)


THERMISTORS AND LDRS

25. What happens to the resistance of a thermistor as the temperature increases?

26. What happens to the resistance of the LDR as the light intensity decreases?

27. A thermistor was used as the input of an electronic thermometer. In order to calibrate the thermometer, resistance was measured at various known temperatures and the following results were obtained.

Temperature in °C	0	30	60	90	120	150	180
Resistance in Ω	1240	675	480	360	255	195	150

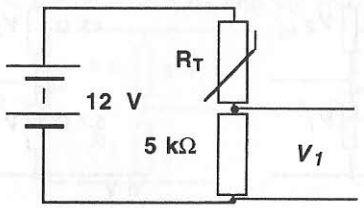
a) Plot a graph of temperature against resistance.
b) Estimate the resistance of the thermistor at
   i) 100 °C,
   ii) 75 °C.
c) If the thermistor is connected directly across a 12 V battery, what would the current be when the temperature is 37 °C?

28. An LDR was calibrated against known light intensities and the following results obtained.

Light Intensity in units	100	300	500	700	900
Resistance in Ω	4000	1300	690	460	370

a) Plot a graph of temperature against light intensity.
b) Estimate the light intensity of the LDR when the resistance is:
   i) 1500 Ω,
   ii) 500 Ω.
c) If the LDR is connected directly across a 5 V battery, state what the current would be when the light intensity is:
   i) 400 units,
   ii) 600 units.

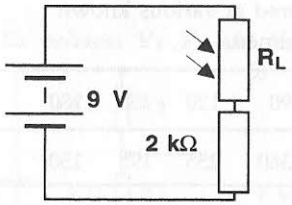
29. A thermistor was connected in a circuit as shown. The resistance of the themistor at various temperatures is shown in the table.



Temperature	Resistance of R_T
50 °C	10 kΩ
100 °C	3 kΩ
200 °C	2.2 kΩ

a) Calculate the current when the temperature is 50 °C.
b) Calculate V_1 when the temperature is 200 °C.
c) Calculate the current when the temperature is 100 °C.
d) Estimate the current when the temperature is 75 °C.

30. An LDR was connected in a circuit as shown. The resistance of the LDR at various light levels is shown in the table.



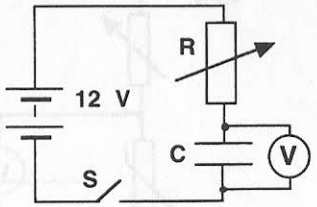
Light Level	Resistance of R_L
2.5 units	1800 Ω
5 units	800 Ω
10 units	520 Ω
20 units	400 Ω

a) Calculate the current when the light level is 2.5 units.
b) Calculate the current when the light level is 5 units.
c) Calculate the current when the light level is 10 units.
d) Calculate the current when the light level is 20 units.
e) Estimate the current when the light level is 30 units.

CAPACITORS

31. What **two** quantities are stored by a capacitor?

32. A capacitor and resistor are connected in series as shown. Various values for both R and C are used as shown in the table in part **b)**. In each case the time taken to reach 12 V across the capacitor was measured.



a) To increase the time necessary to fully charge the capacitor to 12 V, state whether
   i) the resistance should be increased or decreased,
   ii) the capacitance should be increased or decreased.

b) *The time taken for it to be fully charged is given by the 'time constant' which is found by multiplying the resistance by the capacitance. Complete the following table:*

	Resistance	*Capacitance*	*Time*
i)	*100 kΩ*	*1 μF*	-------
ii)	-------	*10 μF*	*1 s*
iii)	*100 kΩ*	*100 μF*	-------
iv)	*1000 kΩ*	*10 μF*	-------
v)	*10 MΩ*	*10 μF*	-------
vi)	*1 kΩ*	-------	*1 s*

33. The voltage across a capacitor was measured every second. The readings are shown.

Voltage in V	0	4	7.2	10	12.1	14	15	15.8	16	16	16	16
Time in s	0	1	2	3	4	5	6	7	8	9	10	11

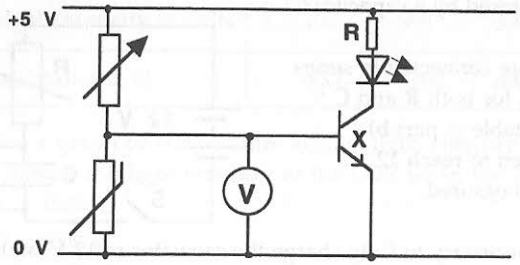
a) Plot a graph of voltage against time.
b) *What is the voltage of the battery?*
c) *What changes could you make to the circuit to increase the time taken for the voltage across the capacitor to reach 16 V?*

34. Suggest a possible use for a capacitor and resistor combination as an input device.

35. a) *Sketch a graph to show how the voltage across the capacitor varies with time, from the instant that the switch is closed.*
    b) *What will be the final voltage across the capacitor?*

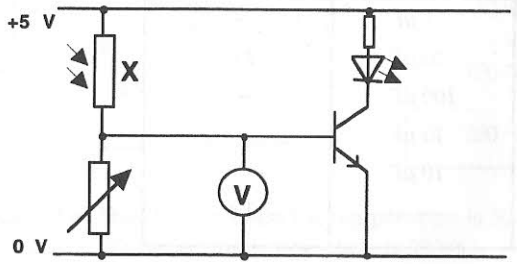
SWITCHING CIRCUITS

36.



a) Name the component labelled **X**.
b) What happens to the voltage across the thermistor as the temperature decreases?
c) Approximately, what voltage is required for the LED to light?
d) What is the function of the resistor **R**?
e) Why is a variable resistor used?
f) Suggest a use for this circuit.

37.

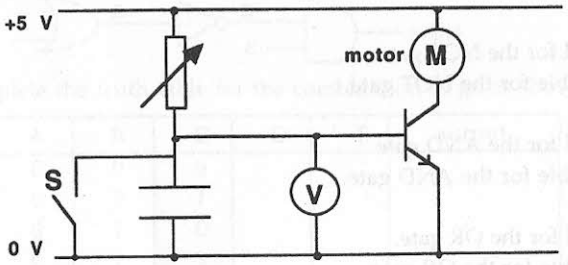


a) Name the component labelled **X**.
b) What happens to the voltage across the LDR as the light intensity increases?
c) What happens to the voltage across the variable resistor as the light intensity increases?
d) When will the LED light, as it gets dark or as it gets light?
e) What change could be made to the circuit to allow the other possibility mentioned in part **d)**?
f) Suggest a use for this circuit.

38. Draw a circuit which would switch on a buzzer and sound an alarm if a greenhouse was over heating.

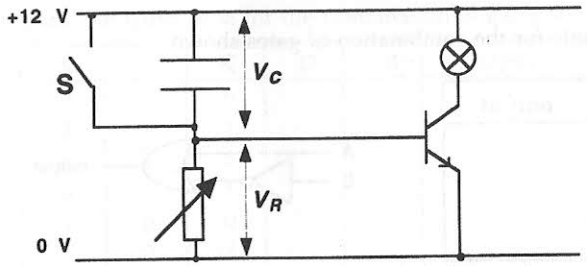
39. Draw a circuit which would use a motor to open curtains as soon as it was fully light.

40.



a) What is the function of the switch **S**?
b) What happens to the voltage across the capacitor when the switch is first opened?
c) When will the motor come on?
d) Why is a variable resistor included?
e) Suggest a use for this circuit.

41. A courtesy light in a car can be connected as shown.



When the car door is shut, switch **S** is open.

a) i) Is the capacitor charged or discharged?
ii) What is the voltage V_R?
iii) What is the voltage V_C?
iv) Is the courtesy light on or off?

b) The car door opens and the switch closes.
i) What happens to the capacitor?
ii) What is the final voltage V_R?
iii) What is the final voltage V_C?
iv) Is the courtesy light on or off?

LOGIC GATES

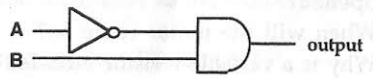
42. **a)** Draw the symbol for the NOT gate.
b) Give the truth table for the NOT gate.

43. **a)** Draw the symbol for the AND gate.
b) Give the truth table for the AND gate.

44. **a)** Draw the symbol for the OR gate.
b) Give the truth table for the OR gate.

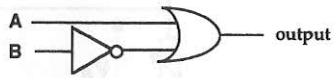
45. Complete the truth table for the combination of gates shown:

A	B	output
0	0	
0	1	
1	0	
1	1	

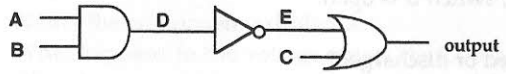


46 Complete the truth table for the combination of gates shown:

A	B	output
0	0	
0	1	
1	0	
1	1	

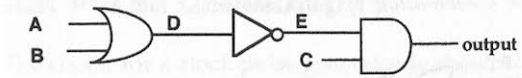


47. Complete the truth table for the combination of gates shown:



A	B	C	D	E	output
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

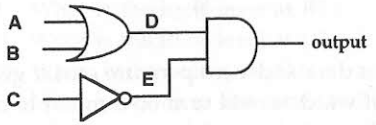
48.



Complete the truth table for the combination of gates shown:

A	B	C	D	E	output
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

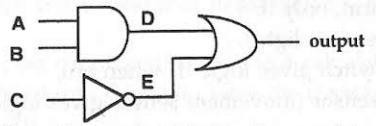
49.



Complete the truth table for the combination of gates shown:

A	B	C	D	E	output
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

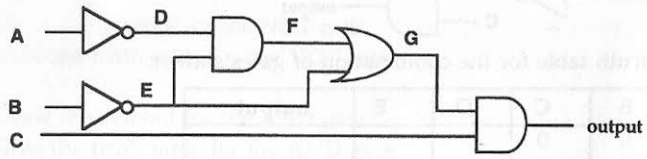
50.



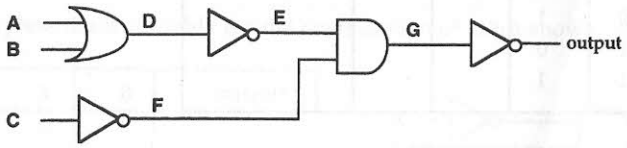
Complete the truth table for the combination of gates shown:

A	B	C	D	E	output
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

51. *Draw up the truth table for the combination of gates shown:*



52. *Draw up the truth table for the combination of gates shown:*



53. A light sensor gives a logic '1' when it is dark and a temperature sensor gives a logic '1' when it is hot. Design a logic circuit which would turn on a motor to open greenhouse windows when it is daylight **and** gets too hot.

54. Design a logic circuit which will allow a display cabinet to be opened, only if:
the main switch is on,
the alarm button is **not** pressed,
the switch for the cabinet is pressed.

55. Design a logic circuit which allows a washing machine motor to switch on, only if:
the water reaches a certain level (pressure sensor gives logic '1'),
the water is up to temperature (temperature sensor gives logic '0'),
the door is shut (switch gives logic '1').

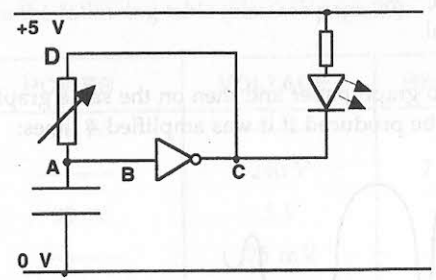
56. A security system has to activate an alarm, only if:
it is dark (light sensor give logic '1' when it is light),
the main control switch has been set (switch gives logic '1' when on),
an intruder is sensed by a movement sensor (movement sensor gives logic '1' when there is movement).
Design the logic system which would be required.

57. *A motor has a cut off system which protects the motor from damage. The cut off only works if the motor is running **and** it has overheated for more than 10 s. Design a logic circuit to do this and suggest suitable input devices.*

58. *A hi-fi system has to operate a lighting display, so that the lights flash every time the sound level reaches a certain volume, **or** it has been more than 10 s since the previous flash.*
Design a logic circuit to do this and suggest suitable input and output devices.

CLOCK PULSE GENERATORS

59. The circuit for a clock pulse generator is shown.



a) The capacitor is initially uncharged.
   i) What is the voltage at **A**?
   ii) What is the logic level at **B**?
   iii) What is the logic level at **C**?
   iv) What is the voltage at **D**?
b) i) What happens to the capacitor?
   ii) What is the voltage at **A** now?
   iii) What is the logic level at **B** now?
   iv) What is the logic level at **C** now?
   v) What is the voltage at **D** now?
c) What happens to the capacitor?
d) Why does this give pulses?

60. a) Sketch the output from a clock pulse generator with a capacitor of 10 μF and a resistor of 100 kΩ (medium **C** and **R**).
b) Sketch the output which would be produced with a capacitor of 100 μF and a resistor of 1000 kΩ (large **C** and **R**).
c) Sketch the output which would be produced with a capacitor of 1 μF and a resistor of 10 kΩ (small **C** and **R**).

61. A counter circuit can be used in a calculator but the output is in binary and has to be converted into decimal. Give the decimal equivalents of:
a) 1001,
b) 1101,
c) 0110,
d) 100101,
e) 10101001.

62. Give the binary equivalents of:
a) 7,
b) 11,
c) 31,
d) 275,
e) 1436.