CHAPTER V : ELECTRONICS

Formative Practice 5.1 [Electron]

1. (a) What are thermionic emission and cathode rays?

(b) State the characteristics of cathode rays.

2. (a) State the function of the components of a cathode ray tube below:

(i) heating filament
(ii) cathode
(iii) anode
(iv) fluorescent screen

(b) Why must a cathode ray tube be in a state of vacuum?

3. When an electron beam moves from the cathode to the anode in a vacuum tube, state:

(a) the type of motion of the electron beam

(b) the transformation of energy

(c) the relationship between the voltage of E.H.T. power supply and the velocity of the electron

4. When an E.H.T. with power of 800 V is connected across the cathode and the anode, what is the velocity of the electron? What is the effect on the velocity of the electron if the voltage is increased by four times?
[Charge of an electron, $e = 1.6 \times 10^{-19}$ C, mass of an electron, $m = 9.11 \times 10^{-31}$ kg]

Formative Practice 5.2 [Semiconductor Diode]

1. What is the meaning of the following terms?
(a) Semiconductor diode
(b) Forward biased
(c) Rectification

2. Draw a full-wave rectification circuit using four semiconductor diodes. Then, sketch the voltage output displayed on the cathode ray oscilloscope if one of the semiconductor diodes is burnt.

3. (a) Name the electronic component that is used to smooth the output current of the full-wave rectification circuit.
   (b) Explain the working principle of the electronic component in 3(a).

Formative Practice 5.3 [Transistor]

1. Figure 5.20 shows the symbol for an electronic device.
   (a) What is the name of the electronic device?
   (b) What is the function of terminal *X* on the electronic device?

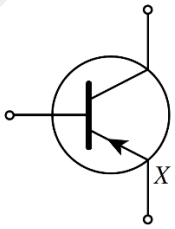


Figure 5.20

2. Figure 5.21 shows a transistor circuit which consists of two circuits, namely circuits *A* and *B*. When switch *S* is closed, bulb *P* is lighted dimly while bulb *Q* lights up brightly.

   (a) Name circuit *A* and circuit *B*.

   (b) Why does bulb *P* light up dimly when switch, *S* is closed?

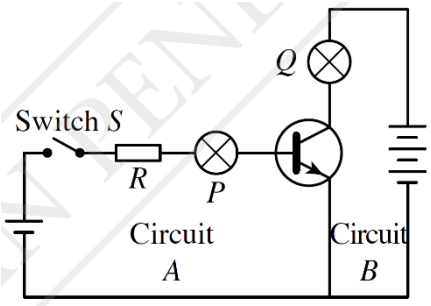


Figure 5.21

   (c) Draw the modifications to the transistor circuit if the npn transistor is replaced with a pnp transistor.

3. Figure 5.22 shows a temperature-controlled alarm circuit. Resistor, R has a resistance of 10 kΩ. The potential difference across XY must be at least 5.5 V to turn on the 6 V, 60 mA bulb. What is the resistance of the thermistor when the bulb lights up?

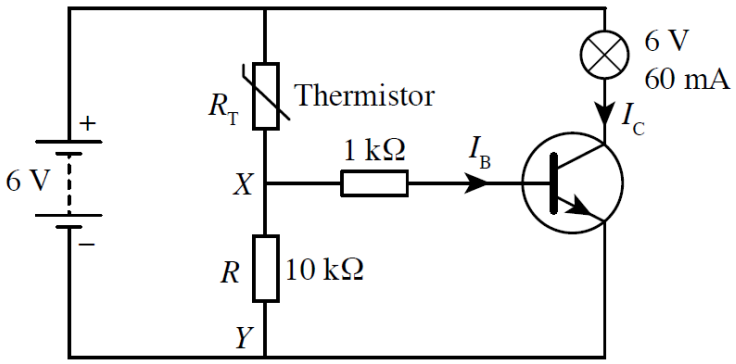


Figure 5.22

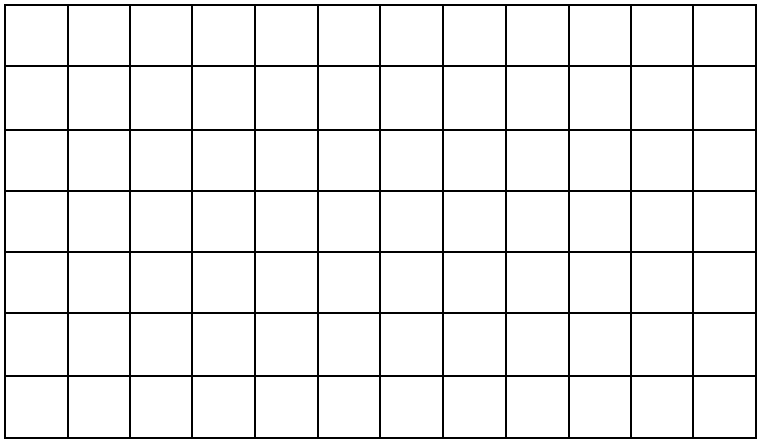
Summative Practice Electronics

1. (a) Using appropriate electronic symbols, draw a forward biased semiconductor diode in an electronic circuit.

(b) What will happen if the battery connection in 1(a) is reversed?

2. Figure 1 shows a half-wave rectification kit connected to an alternating current power supply and a cathode ray oscilloscope (C.R.O.).

(a) Sketch what is displayed on the cathode ray oscilloscope screen.



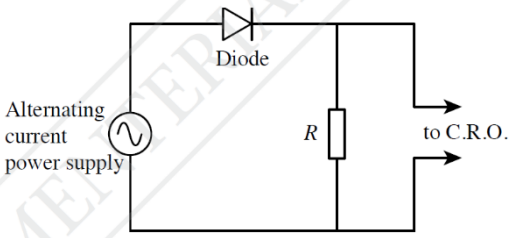
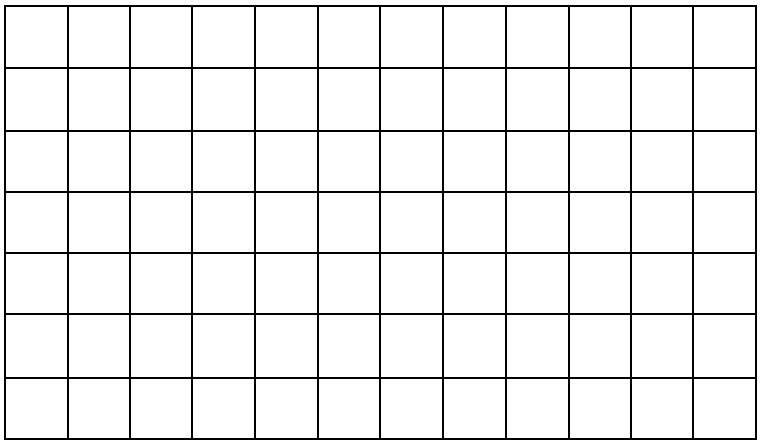


Figure 1

(b) If a capacitor is connected in parallel with the resistor, R, sketch the changes to what is displayed on the cathode ray oscilloscope screen.



3. Figure 2 shows a full-wave rectification kit connected to an alternating current power supply and a cathode ray oscilloscope.

(a) Draw arrows to show the flow of current through the diode during the positive half cycle and the negative half cycle.

Key:
Positive cycle
Negative cycle

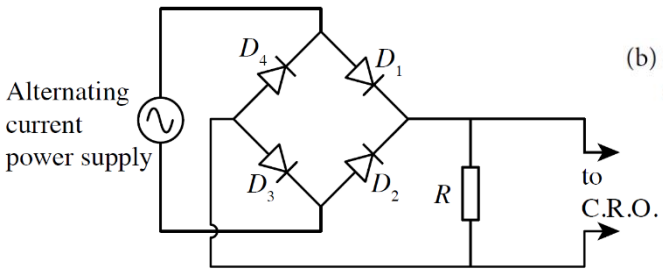
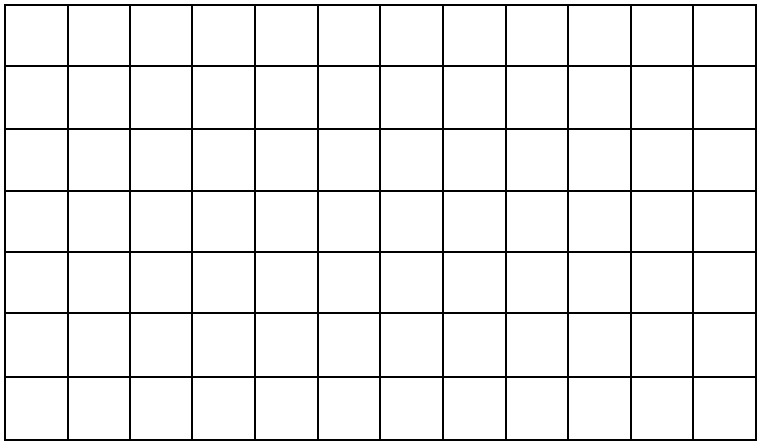


Figure 2

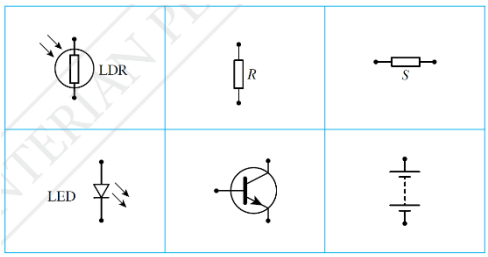
(b) Sketch what is displayed on the cathode ray oscilloscope screen if a capacitor is connected parallel to the resistor, R. What is the role of the capacitor?



(c) What will happen to the output current if the connection to diode, D_1 is reversed?

4. Table 1 shows the main components that are required for a transistor to function as an automatic light-controlled switch.

(a) Draw an automatic switch transistor circuit using the components provided in the table above.



(b) Discuss whether the LED is lighted when the LDR is under bright conditions.

(c) State the modification of the automatic switch transistor circuit to an automatic temperature-controlled alarm circuit so that the alarm will ring when its surrounding temperature becomes very high.

5. Figure 3 shows an electronic circuit used to study the function of a npn transistor in the circuit. Readings I_B and I_C are obtained from microammeter, A_1 and miliameter A_2 respectively. The rheostat is adjusted to obtain different values of I_B and I_C as shown in Table 2.

Table 2

I_B / μA	I_C / mA
0	0
20	2.1
40	4.2
60	6.3
80	8.4

(a) Plot the graph of I_C against I_B.

(b) Based on your graph in 5(a):

(i) state the relationship between I_B and I_C and explain your answer

(ii) state the roles of the transistor in the circuit and explain your answer

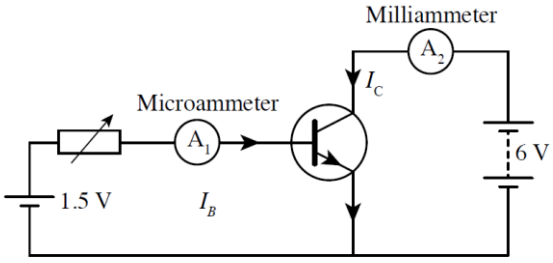


Figure 3

(c) Draw a new electronic circuit if the npn transistor is replaced with a pnp transistor.

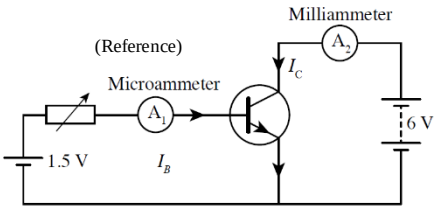


Figure 3

6. Amar carried out an electronic project to create an automatic switch circuit for a fire alarm system. Figure 4 shows an incomplete electronic circuit. Table 3 shows the symbols of nine possible components which may be used to complete the circuit.

(a) Based on your knowledge of electronics, select any suitable components from Table 3 to complete the transistor circuit as an automatic switch for a fire alarm system.

(b) State the justification for each of your choice.

Table 3

Capasitor	Diode	Thermistor
Rheostat	Electric bell	Battery
Resistor	Transformer	A.C. power supply

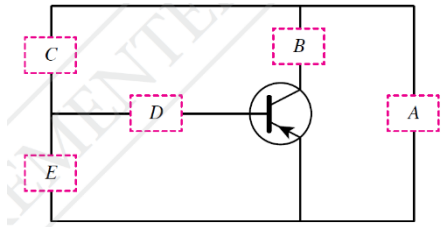


Figure 4

Kalau ada salah mohon maafkan, kalau ada perasaan mohon ungkapkan

Formative Practice 5.1

1. (a) Thermionic emission is the emission of electrons from a heated metallic surface. The cathode rays are high-speed electron beams in a vacuum tube.
(b) Cathode rays are negatively charged, possess momentum and kinetic energy, move in straight lines and can be deflected by electric fields and magnetic fields.

2. (a) (i) Heats the cathode to a high temperature
(ii) Emits electrons (thermionic emission)
(iii) Accelerates the electron beam until it reaches a high velocity
(iv) Produces light spots when high-velocity electron beams hit the fluorescent screen
(b) So that the electrons do not collide with the air molecules.

3. (a) Uniform acceleration
(b) Electrical potential energy is converted into kinetic energy of electron
(c) $eV = \frac{1}{2}mv^2_{max}$
that is e = charge of an electron (1.6×10^{-19} C)
V = potential difference between cathode and anode
m = mass of electron (9.1×10^{-31} kg)
v_{max} = maximum velocity of electron

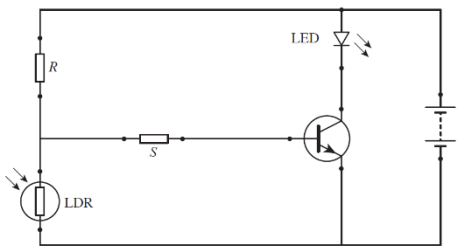
4. $v = \sqrt{\frac{2eV}{m}}$

$= \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 800}{9.1 \times 10^{-31}}}$

$= 1.68 \times 10^7$ m s^{-1}

The electron velocity will be doubled if the potential difference is increased by four time

4. (a)

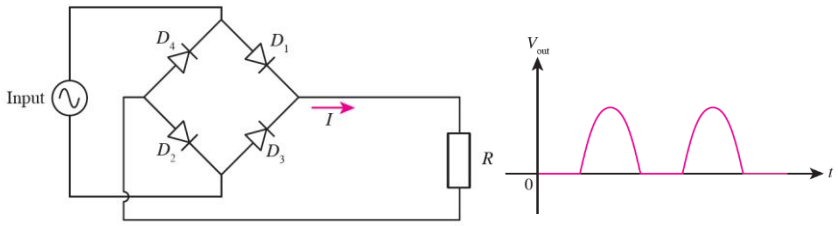


(b) Under bright conditions, LDR resistance becomes low.
Therefore, the voltage across LDR decreases but the voltage across R is increased. The I_B is low and the transistor is turned off. The I_C will be low and the LED will not light up.
(c) Replace LED with an alarm, replace resistor with a thermistor and the LDR with a resistor.

Formative Practice 5.2

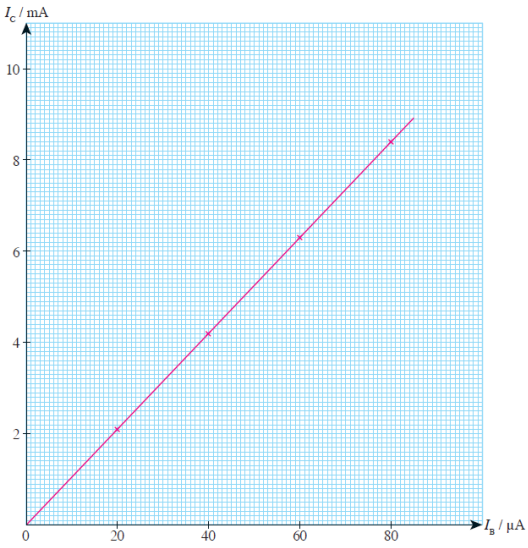
1. (a) An electronic component which allows electric current to flow in one direction only.
(b) A situation when the positive terminal of a dry cell is connected to the anode of diode and the negative terminal is connected to the cathode of diode, enabling electric current to flow in a circuit.
(c) Conversion of an alternating current to a direct current.

2.



3. (a) Capacitor
(b) The capacitor is connected in parallel with the load.
When the potential difference increases, the capacitor will be charged and energy is stored in the capacitor.
When the potential difference decreases, the capacitor will be discharged so that the output current does not fall to zero value. The energy stored in the capacitor will maintain the potential difference across the resistor.
From the shape of the smoothed output wave, it shows that the capacitor functions as a current smoother.

5. (a)

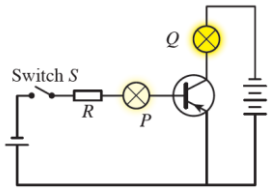


(b) (i) I_C is directly proportional to I_B. The graph of I_C against I_B shows a straight line passing through the origin with a positive gradient.
(ii) – Transistors play a role as current amplifiers.
– The graph has a positive gradient and is a straight line, so the collector current changes proportionally with the base current.
– The gradient of the graph is 105, thefore the amplification factor is 105.

Formative Practice 5.3

1. (a) pnp transistor
(b) Supply charge carriers to the collector

2. (a) A is the base circuit and B is the collector circuit.
(b) The current flowing through bulb P is very small.
(c)



3. Potential difference, $V_0 = 6$ V
Resistance, $R = 10$ kΩ
Potential difference across XY, $V_{XY} = 5.5$ V

$V_{XY} = \frac{10}{10 + R_T} \times 6$

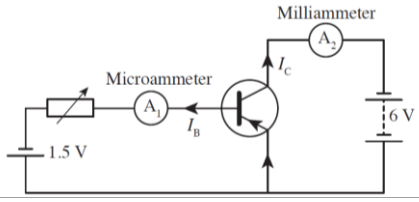
$5.5 = \frac{10}{10 + R_T} \times 6$

Thermistor resistance, $R_T = \frac{60}{5.5} - 10$

$= 10.9 - 10$

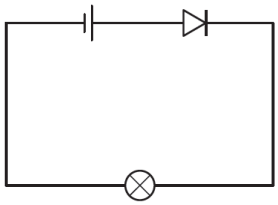
$= 0.9$ kΩ

(c)

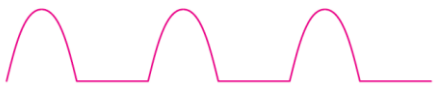


Summative Practice

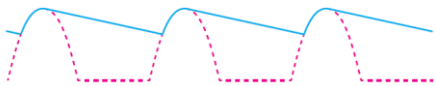
1. (a)



2. (a)

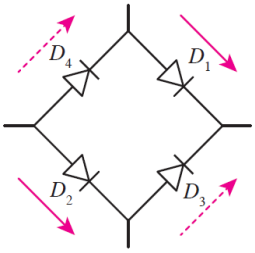


(b)



(b) The bulb does not light up because the diode is a in reverse biased state.

3. (a)

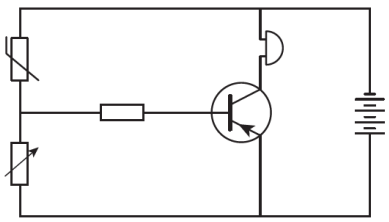


(b) The capacitor acts as a current smoother

(b)

(c) Half-wave rectification will occur

6. (a)



	Component	Suitability
A	Battery	A transistor only functions in a direct current power supply (negative terminals are shown above because a pnp transistor is used)
B	Electric bell	To produce a sound in the event of a fire
C	Thermistor	Its resistance will decrease when the surrounding temperature increases
D	Resistor	Acts as a protector / limiter of current to the very thin base of the transistor
E	Rheostat	The resistance of a rheostat can be initially adjusted according to the surrounding temperature in order to supply a suitable voltage across it to turn on the transistor in an emergency situation