**Cambridge International Examinations**

Cambridge International Advanced Subsidiary and Advanced Level

***ALL THE BEST – CODE-9702***

***TEST - NO-1***

***Time : 40 Mins*** ***Marks: 36 Marks***

Q.1. 9702/42/F/M/18

**8** **(a)** Two properties of an ideal operational amplifier (op-amp) are infinite bandwidth and infinite slew rate.

Explain what is meant by

**(i)** infinite bandwidth,

.....

.....[1]

**(ii)** infinite slew rate.

.....

.....[1]

**(b)** An ideal op-amp is incorporated into the circuit of Fig. 8.1.

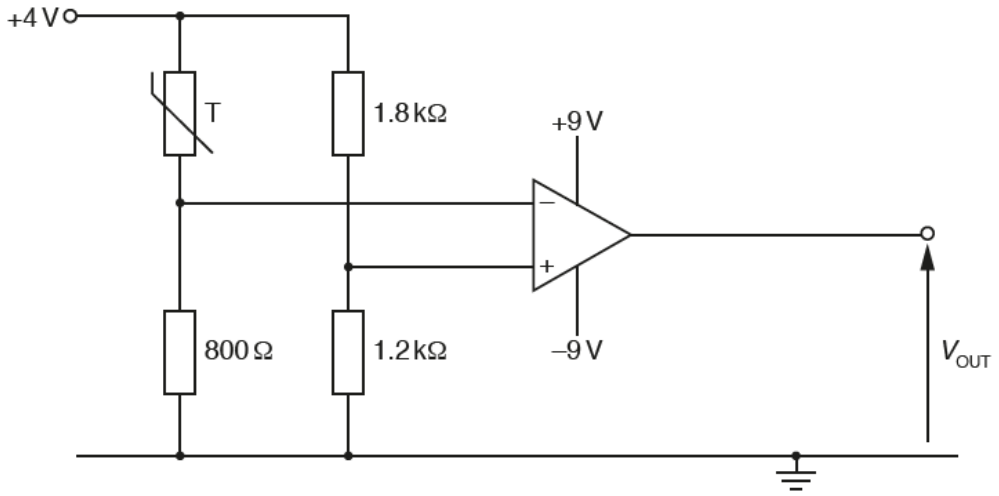


**Fig. 8.1**

**(i)** Determine the resistance $R_T$ of the thermistor T at which the output potential difference $V_{OUT}$ is zero.

$R_T$ = .....Ω [1]

**(ii)** The temperature of the thermistor is gradually increased so that its resistance decreases from $1.5R_T$ to $0.5R_T$.

On Fig. 8.2, draw a line to show the variation of the output potential difference $V_{OUT}$ with the thermistor resistance.

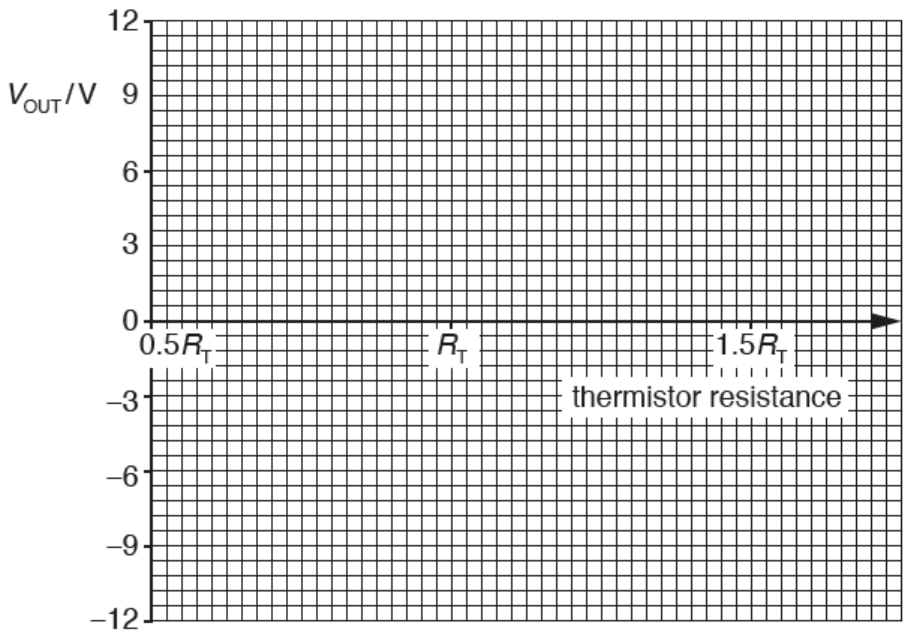


**Fig. 8.2**

[2]

**(iii)** On Fig. 8.1, draw the symbol for a light-emitting diode (LED), connected at the output of the circuit, such that it emits light when the resistance of the thermistor is less than $R_T$.

[2]

[Total: 7]

2. 9702/42/F/M/18

**9** A thin slice of conducting material has its faces PQRS and VWXY normal to a uniform magnetic field of flux density *B*, as shown in Fig. 9.1.

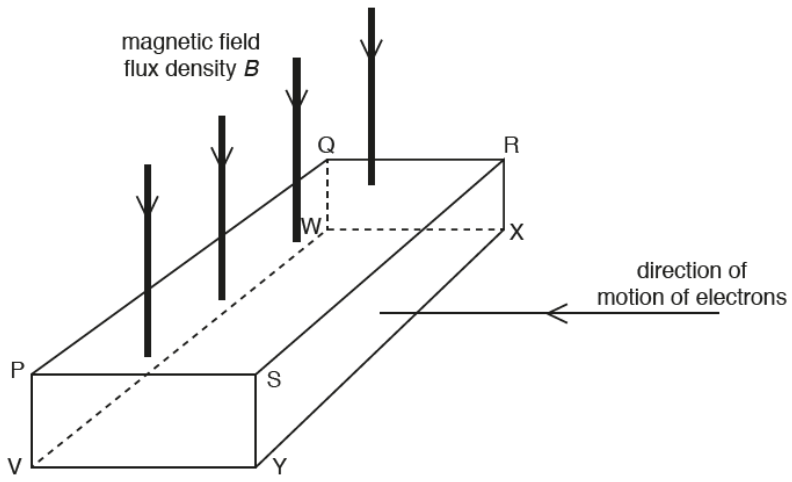


**Fig. 9.1**

Electrons enter the slice at right-angles to face SRXY.

A potential difference, the Hall voltage $V_H$, is developed between two faces of the slice.

**(a)** **(i)** Use letters from Fig. 9.1 to name the two faces between which the Hall voltage is developed.

..... and .....[1]

**(ii)** State and explain which of the two faces named in **(a)(i)** is the more positive.

.....

.....[2]

**(b)** The Hall voltage $V_H$ is given by the expression

$$V_H = \frac{BI}{ntq}.$$

**(i)** Use the letters in Fig. 9.1 to identify the distance $t$.

.....[1]

**(ii)** State the meaning of the symbol $n$.

.....

.....[1]

**(iii)** State and explain the effect, if any, on the polarity of the Hall voltage when negative charge carriers (electrons) are replaced with positive charge carriers, moving in the same direction towards the slice.

.....

.....

.....[2]

[Total: 7]

**6** A comparator circuit is designed to switch on a mains lamp when the ambient light level reaches a set value.
An incomplete diagram of the circuit is shown in Fig. 6.1.

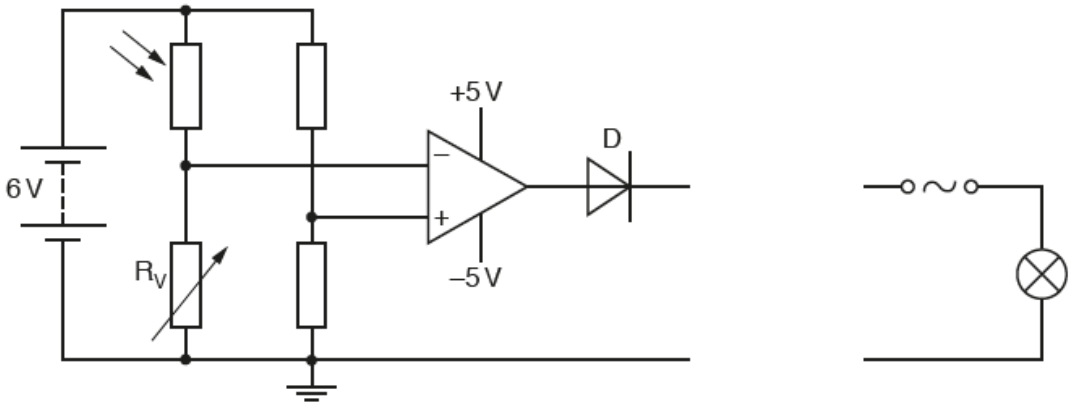


**Fig. 6.1**

**(a)** **(i)** A relay is required as part of the output device. This is not shown in Fig. 6.1. Explain why a relay is required.

.....

.....

.....[2]

**(ii)** On Fig. 6.1, draw the symbol for a relay connected in the circuit as part of the output device. [2]

**(b)** Describe the function of

**(i)** the variable resistor $R_V$,

.....

.....[1]

**(ii)** the diode D.

.....

.....[1]

**(c)** State whether the lamp will switch on as the light level increases or as it decreases. Explain your answer.

.....

.....

.....

.....

.....[3]

[Total: 9]

4. 9702/41/M/J/17

**7** An electron having charge $-q$ and mass $m$ is accelerated from rest in a vacuum through a potential difference $V$.
The electron then enters a region of uniform magnetic field of magnetic flux density $B$, as shown in Fig. 7.1.

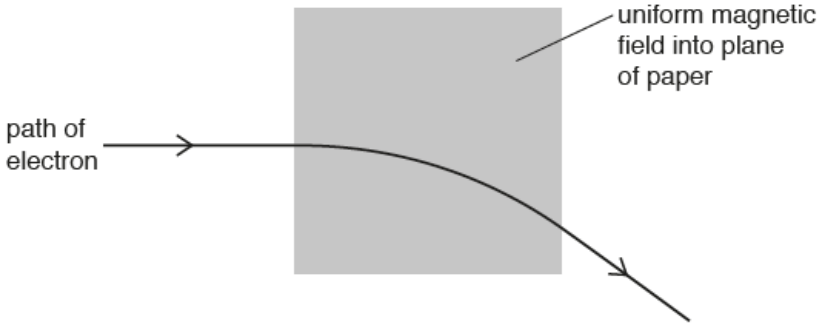


**Fig. 7.1**

The direction of the uniform magnetic field is into the plane of the paper.
The velocity of the electron as it enters the magnetic field is normal to the magnetic field.
The radius of the circular path of the electron in the magnetic field is $r$.

**(a)** Explain why the path of the electron in the magnetic field is the arc of a circle.

.....

.....

.....

.....[3]

**(b)** Show that the magnitude $p$ of the momentum of the electron as it enters the magnetic field is given by

$$p = \sqrt{(2mqV)}.$$

[2]

**(c)** The potential difference $V$ is 120 V. The radius $r$ of the circular arc is 7.4 cm.

Determine the magnitude $B$ of the magnetic flux density.

$B$ = ..... T [3]

**(d)** The potential difference $V$ in **(c)** is increased. The magnetic flux density $B$ remains unchanged.

By reference to the momentum of the electron, explain the effect of this increase on the radius $r$ of the path of the electron in the magnetic field.

.....

.....

.....[2]

[Total: 10]

5.

9702/42/M/J/17

**8** A student designs a circuit incorporating an operational amplifier (op-amp) as shown in Fig. 8.1.

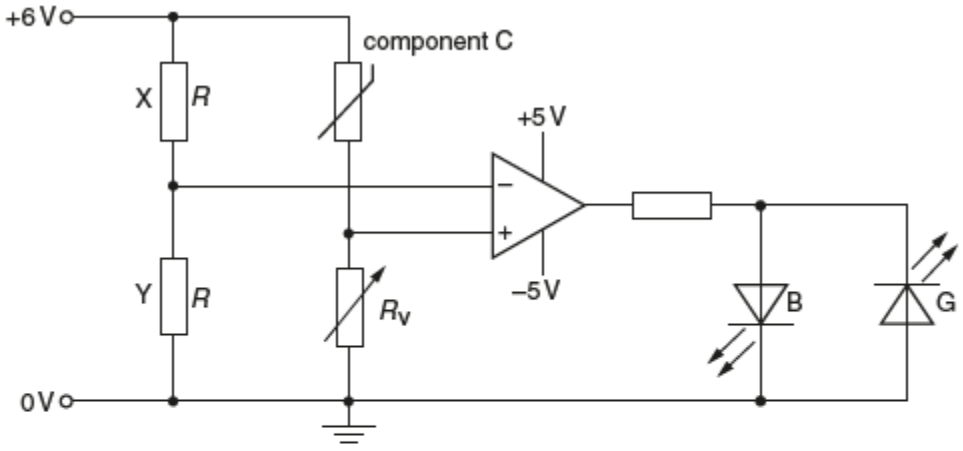


**Fig. 8.1**

**(a) (i)** On Fig. 8.1, draw a circle around the output device. [1]

**(ii)** State the purpose of this circuit.

.....

.....

.....[2]