

Electronics

Question paper 1

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Electronics
Sub Topic	
Paper Type	Theory
Booklet	Question paper 1

Time Allowed: 69 minutes

Score: /57

Percentage: /100

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

- 1 An operational amplifier (op-amp) is used in the comparator circuit of Fig. 10.1.

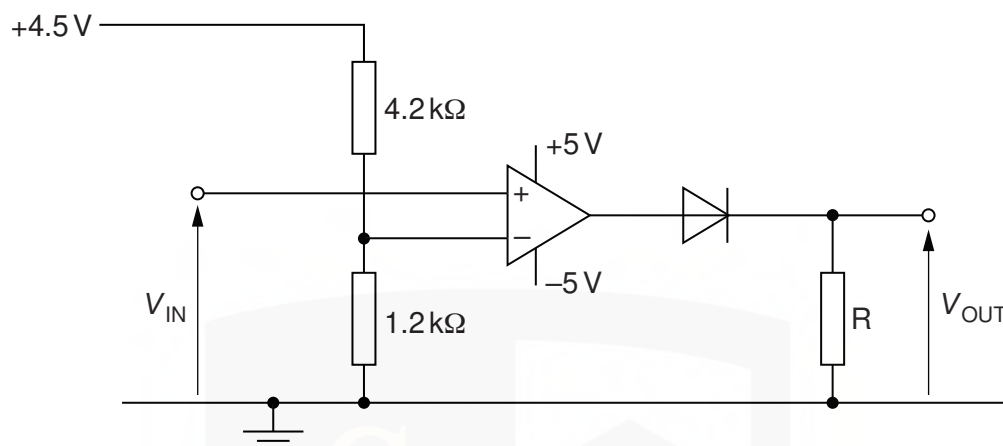


Fig. 10.1

- (a) (i) Show that the potential at the inverting input of the op-amp is +1.0V.

[1]

- (ii) Explain why the potential difference across resistor R is + 5V when V_{IN} is greater than 1.0V and is zero when V_{IN} is less than 1.0V.

$V_{IN} > 1.0V$:

.....

.....

$V_{IN} < 1.0V$:

.....

.....

[4]

(b) The variation with time t of the input voltage V_{IN} is shown in Fig. 10.2.

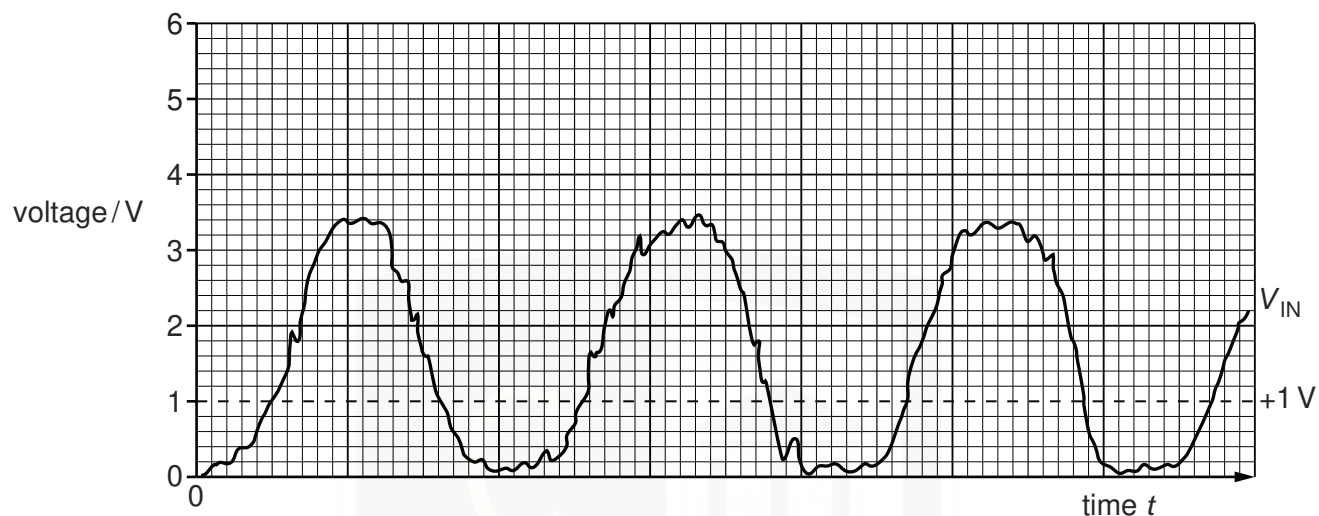


Fig. 10.2

- (i) On the axes of Fig. 10.2, draw the variation with time t of the output potential V_{OUT} . [2]
- (ii) Suggest a use for this type of circuit.

.....

..... [1]

2 (a) An ideal operational amplifier (op-amp) has infinite open-loop gain and infinite input resistance

(impedance).

State three further properties of an ideal op-amp.

1.
2.
3.

[3]

(b) The circuit of Fig. 10.1 is used to detect changes in temperature.

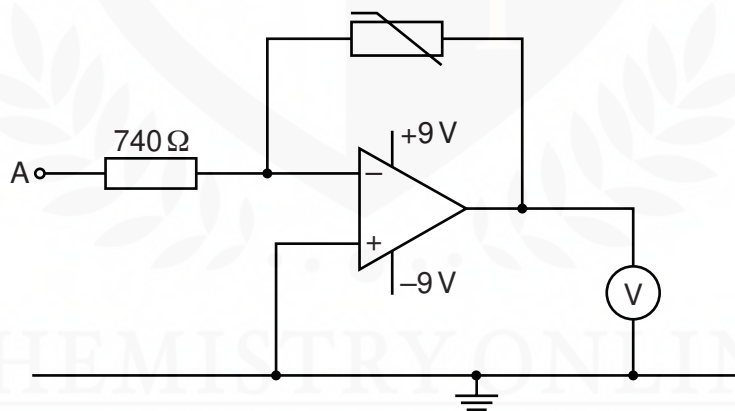


Fig. 10.1

The voltmeter has infinite resistance.

The variation with temperature θ of the resistance R of the thermistor is shown in Fig. 10.2.

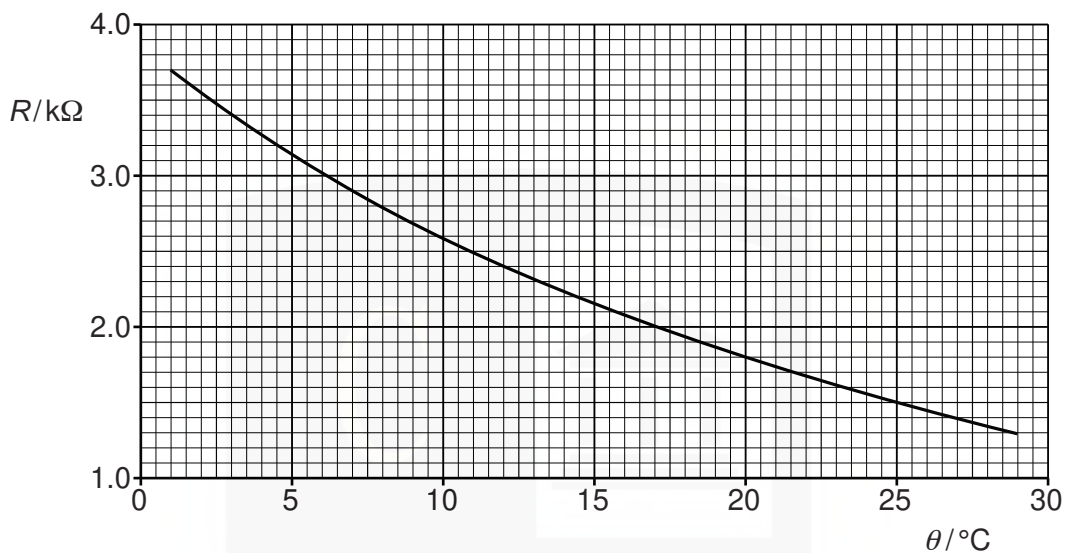


Fig. 10.2

- (i) When the thermistor is at a temperature of 1.0°C , the voltmeter reads $+1.0\text{ V}$.

Show that, for the thermistor at 1.0°C , the potential at A is -0.20 V .

[4]

- (ii) The potential at A remains at -0.20 V .

Determine the voltmeter reading for a thermistor temperature of 15°C .

(c) The voltmeter reading for a thermistor temperature of 29°C is 0.35 V .

(i) Assuming a linear change of voltmeter reading with change of temperature over the range 1°C to 29°C , calculate the voltmeter reading at 15°C .

..... V [1]

(ii) Suggest why your answers in (b)(ii) and (c)(i) are not the same.

..... [1]

CHEMISTRY ONLINE
— TUITION —

3 A simplified block diagram of a mobile phone handset is shown in Fig. 13.1.

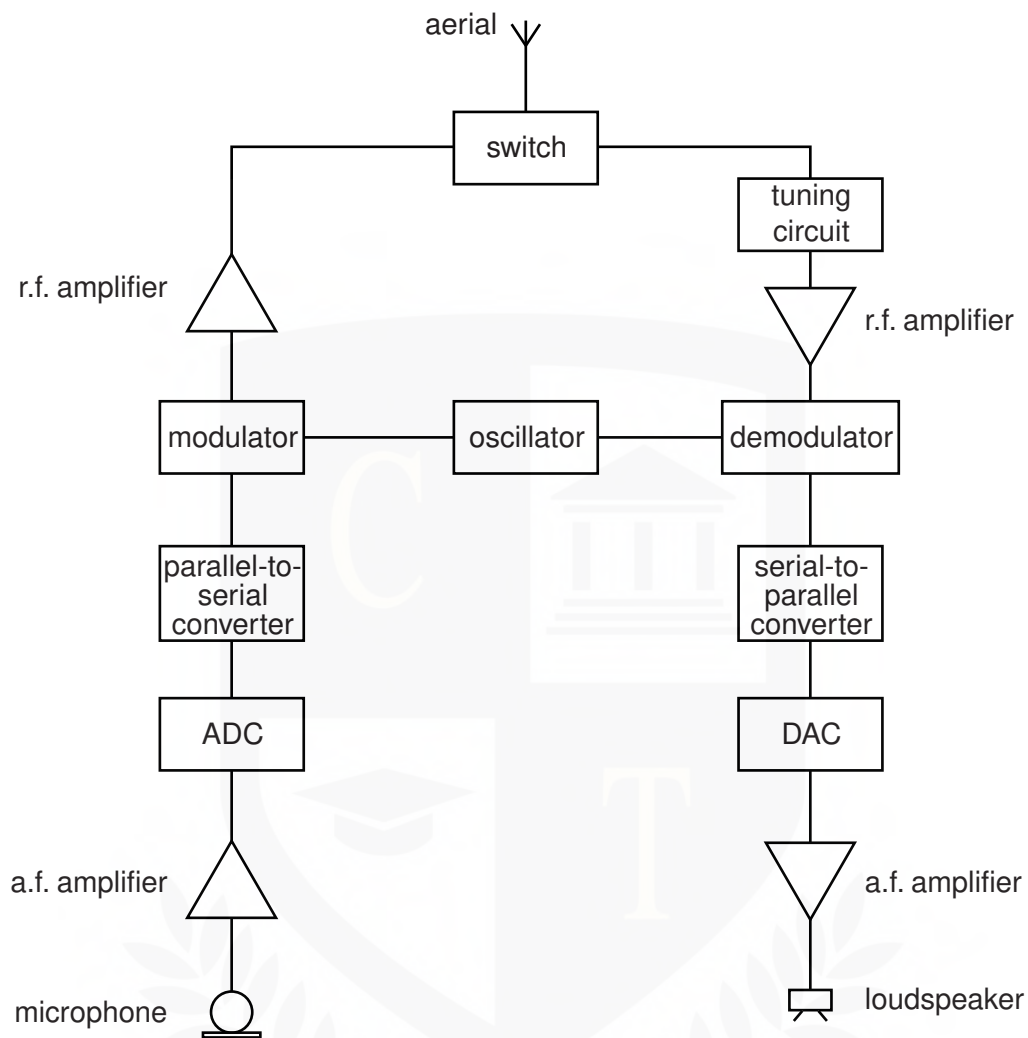


Fig. 13.1

State the purpose of

(a) the switch,

.....

.....

.....

..... [2]

(b) the tuning circuit.

.....

.....

.....

- 4 An electronic sensor may be represented by the block diagram of Fig. 10.1.

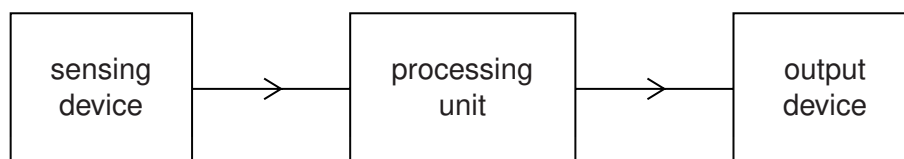


Fig. 10.1

- (a) State suitable sensing devices, one in each case, for the detection of

(i) change of temperature,

..... [1]

(ii) pressure changes in a sound wave.

..... [1]

- (b) The ideal operational amplifier (op-amp) shown in Fig. 10.2 is to be used as a processing unit.

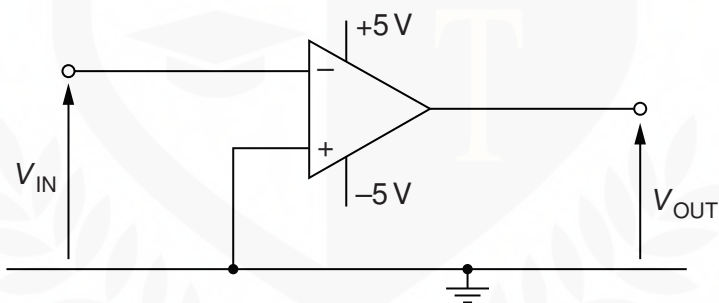


Fig. 10.2

- (i) State the value of the output potential V_{OUT} for an input potential V_{IN} of +0.5V. Explain your answer.

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

- (ii) A sensing device produces a variable potential V_{IN} . The variation with time t of V_{IN} is shown in Fig. 10.3.

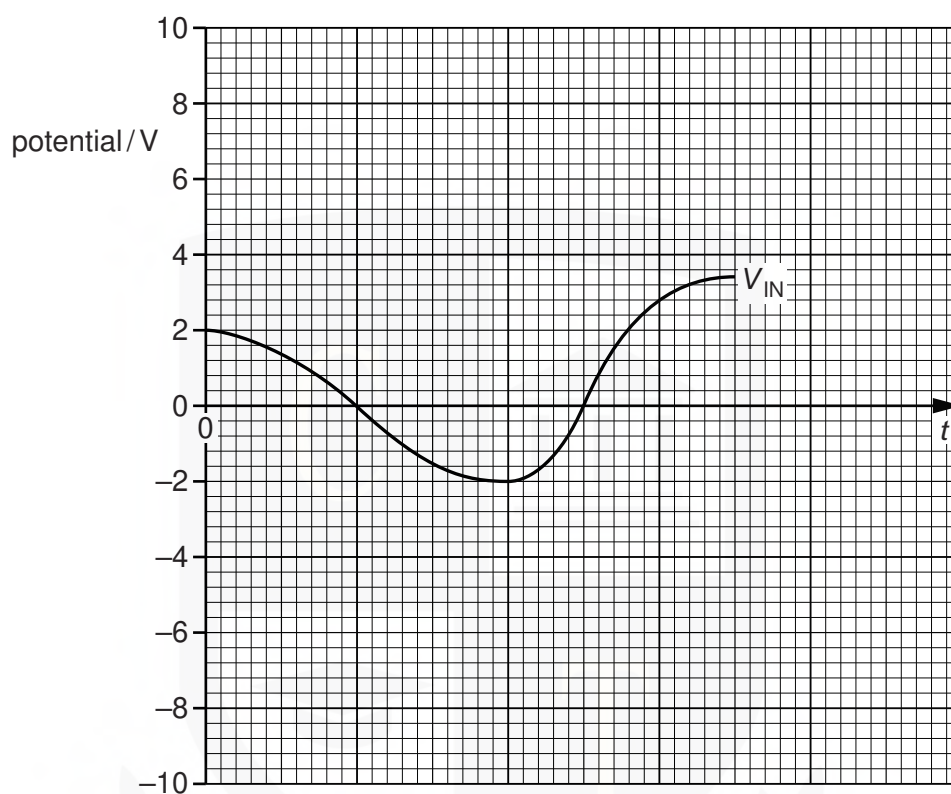


Fig. 10.3

On the axes of Fig. 10.3, sketch the variation with time t of the output potential V_{OUT} . [3]

CHEMISTRY ONLINE
— TUITION —

- 5 (a) A circuit incorporating an ideal operational amplifier (op-amp) is shown in Fig. 11.1.

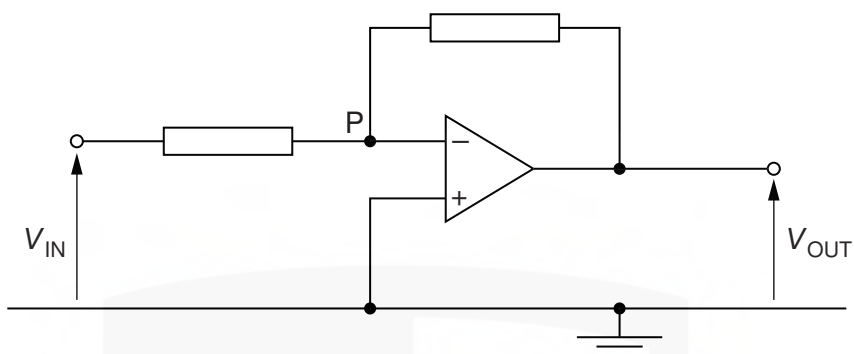


Fig. 11.1

- (i) State the name of this circuit.

..... [1]

- (ii) Explain why the point P is referred to as a *virtual earth*.

.....

 [3]

- (b) The circuit of Fig. 11.1 is modified, as shown in Fig. 11.2.

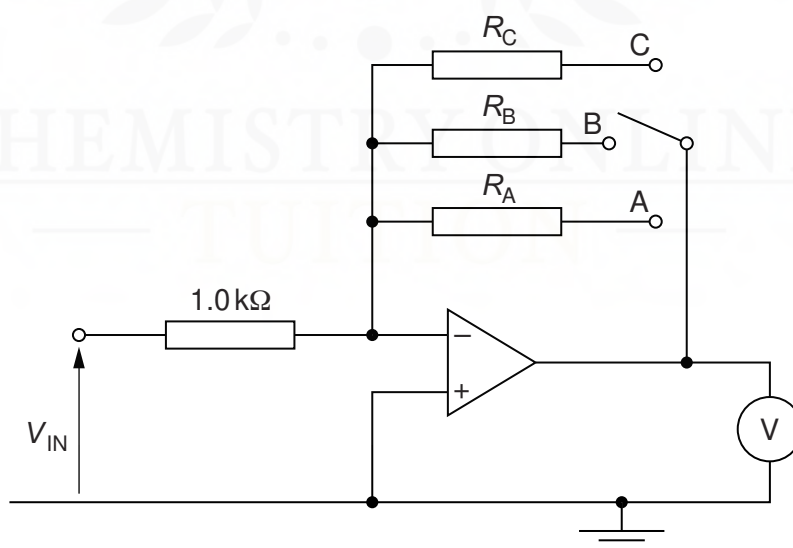


Fig. 11.2

The voltmeter has infinite resistance and its full-scale deflection is 1.0V.

The input potential to the circuit is V_{IN} .

The switch position may be changed in order to have different values of resistance in the circuit.

- (i) The input potential V_{IN} and the switch position are varied.
For each switch position, the reading of the voltmeter is 1.0V.
Complete Fig. 11.3 for the switch positions shown.

switch position	V_{IN}/mV	resistance
A	10	$R_A = \dots\dots\dots$
B	100	$R_B = \dots\dots\dots$
C	$\dots\dots\dots$	$R_C = 1.0\text{ k}\Omega$

Fig. 11.3

[3]

- (ii) By reference to your answers in (i), suggest a use for the circuit of Fig. 11.2.

$\dots\dots\dots$
 $\dots\dots\dots$ [1]

CHEMISTRY ONLINE
— TUITION —

- 6 (a) State the function of a comparator circuit incorporating an operational amplifier (op-amp).

.....

 [3]

- (b) An ideal op-amp is incorporated into the circuit of Fig. 10.1.

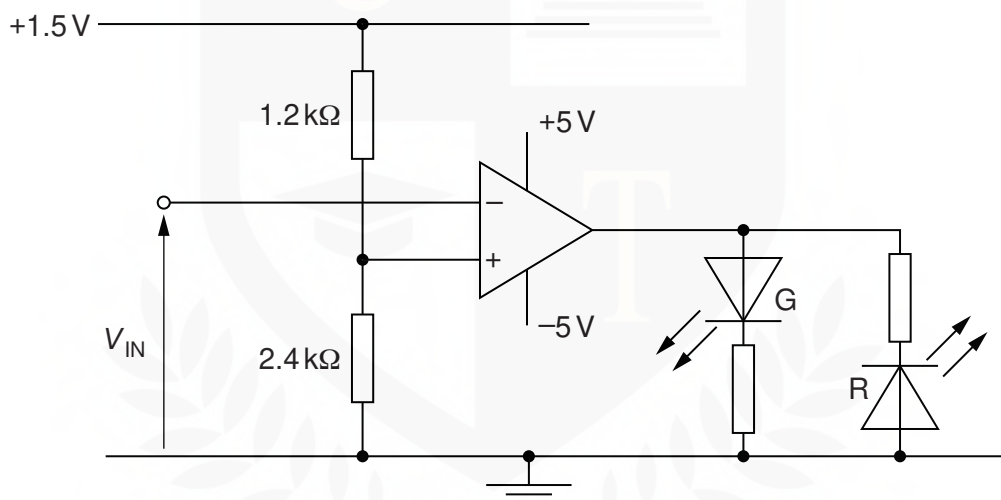


Fig. 10.1

- (i) On Fig. 10.1, draw a circle around the part of the circuit that is being used as an output device. [1]
- (ii) Show that the potential at the non-inverting input of the op-amp is 1.0V.

[1]

- (iii) The variation with time t of the potential V_{IN} at the inverting input of the op-amp is shown in Fig. 10.2.

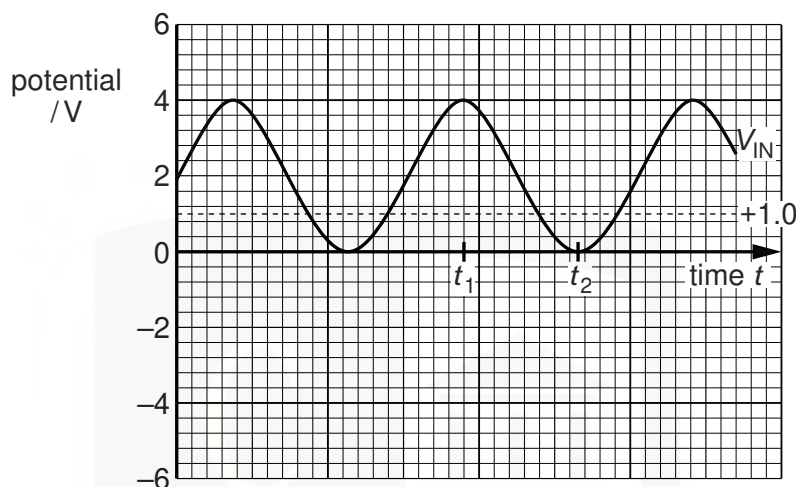


Fig. 10.2

- On the axes of Fig. 10.2, draw the variation with time t of the output potential of the op-amp. [3]
- State whether each diode is emitting light or is not emitting light at time t_1 and at time t_2 .

At time t_1 , diode R will and diode G will

At time t_2 , diode R will and diode G will

[2]

CHEMISTRY ONLINE
— TUITION —

7 (a) State three properties of an ideal operational amplifier (op-amp).

1.
2.
3.

[3]

(b) An amplifier circuit is shown in Fig. 9.1.

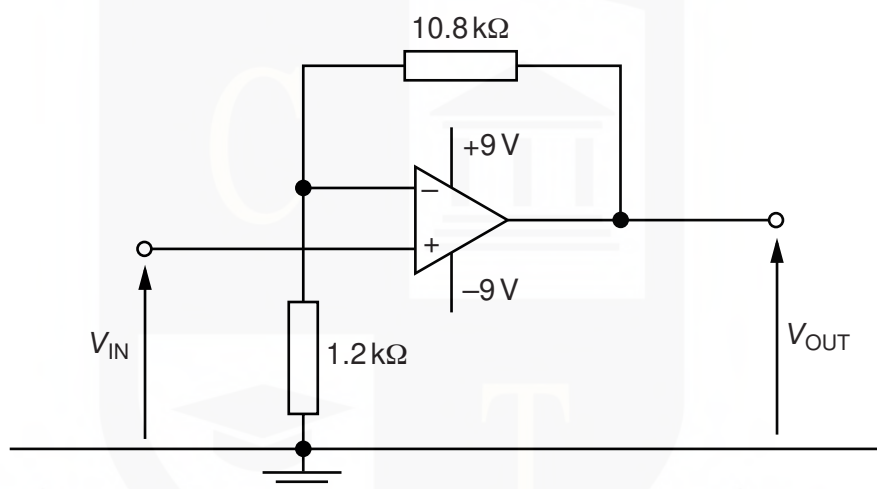


Fig. 9.1

(i) Calculate the gain of the amplifier circuit.

gain = [2]

(ii) The variation with time t of the input potential V_{IN} is shown in Fig. 9.2.

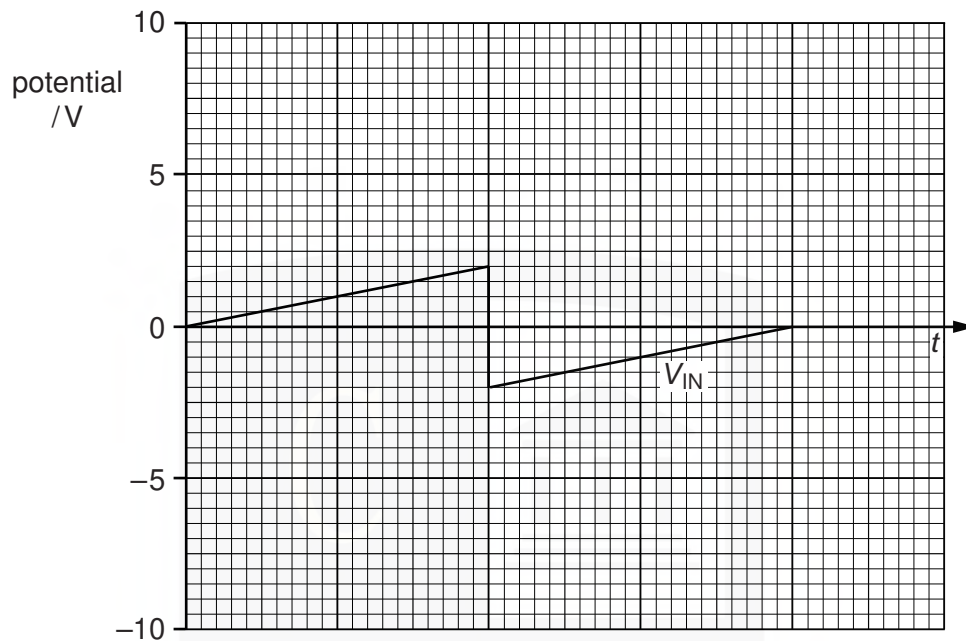


Fig. 9.2

On the axes of Fig. 9.2, show the variation with time t of the output potential V_{OUT} .
[3]