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.

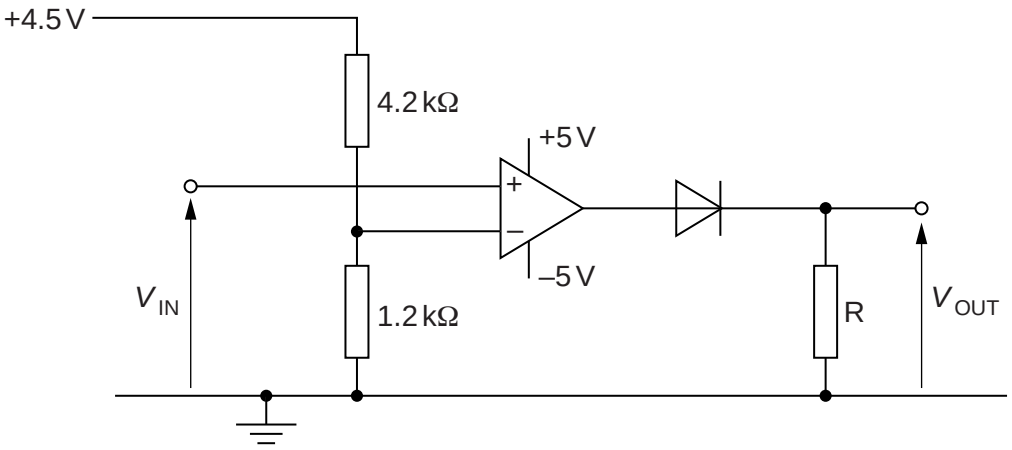

Fig. 10.1

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

[1]

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

V_{IN} > 1.0 V: .....

.....

.....

V_{IN} < 1.0 V: .....

.....

.....

[4]

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

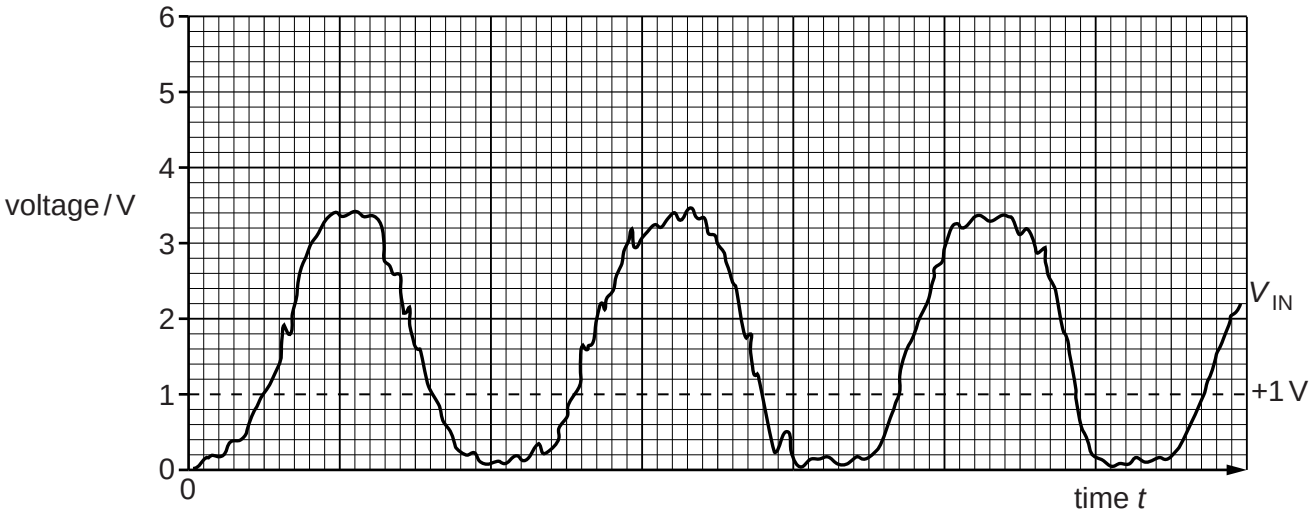

Fig. 10.2

(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.

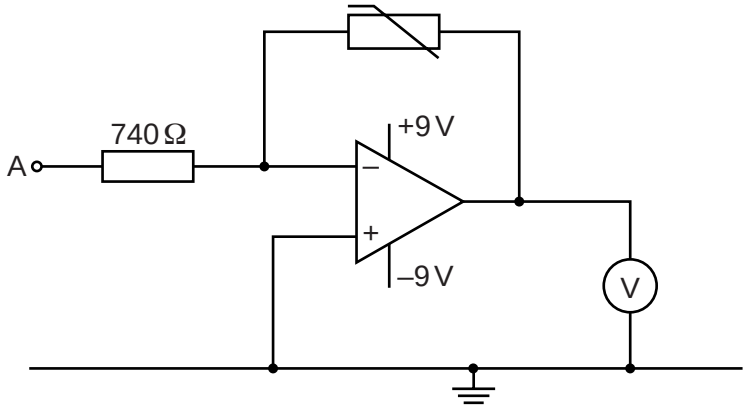

Fig. 10.1

The voltmeter has infinite resistance.

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

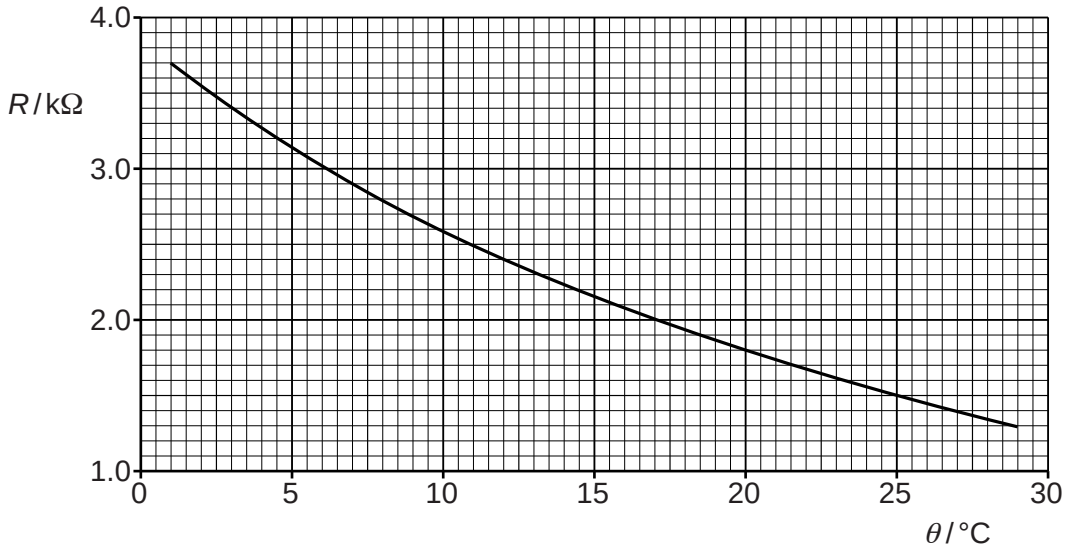

Fig. 10.2

(i) When the thermistor is at a temperature of 1.0 °C, the voltmeter reads +1.0 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.

voltmeter reading = ... V [2]

(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.

voltmeter reading = ... V [1]

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

.....

..... [1]

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

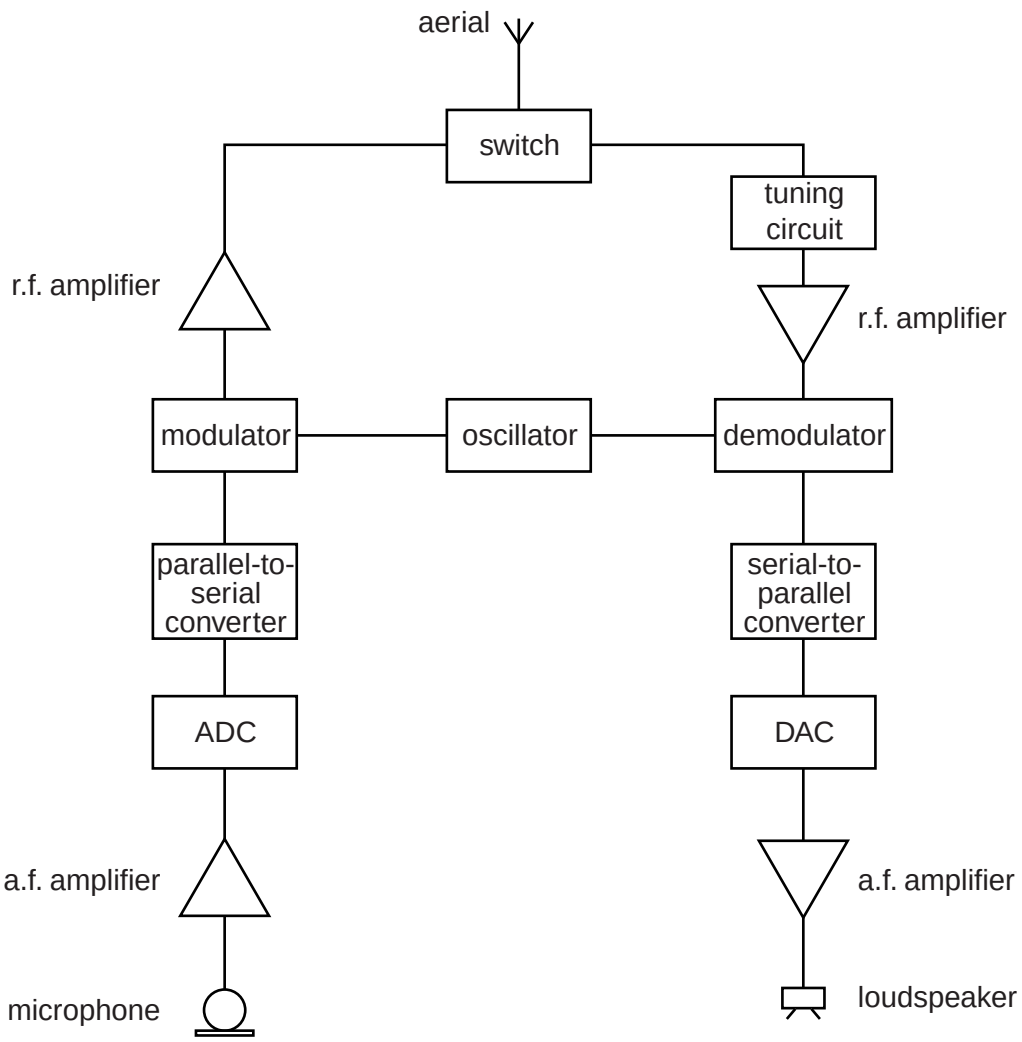

Fig. 13.1

State the purpose of

(a) the switch,

.....

.....

.....

..... [2]

(b) the tuning circuit.

.....

.....

.....

..... [2]

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

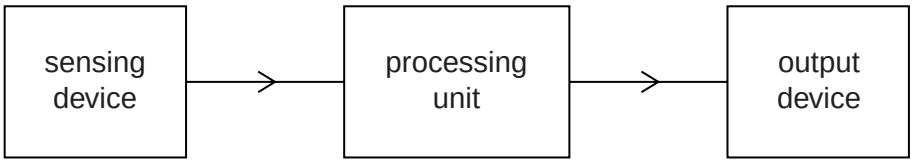

Fig. 10.1

(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.

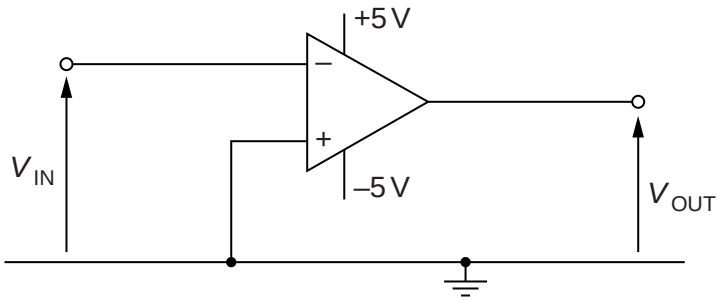

Fig. 10.2

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

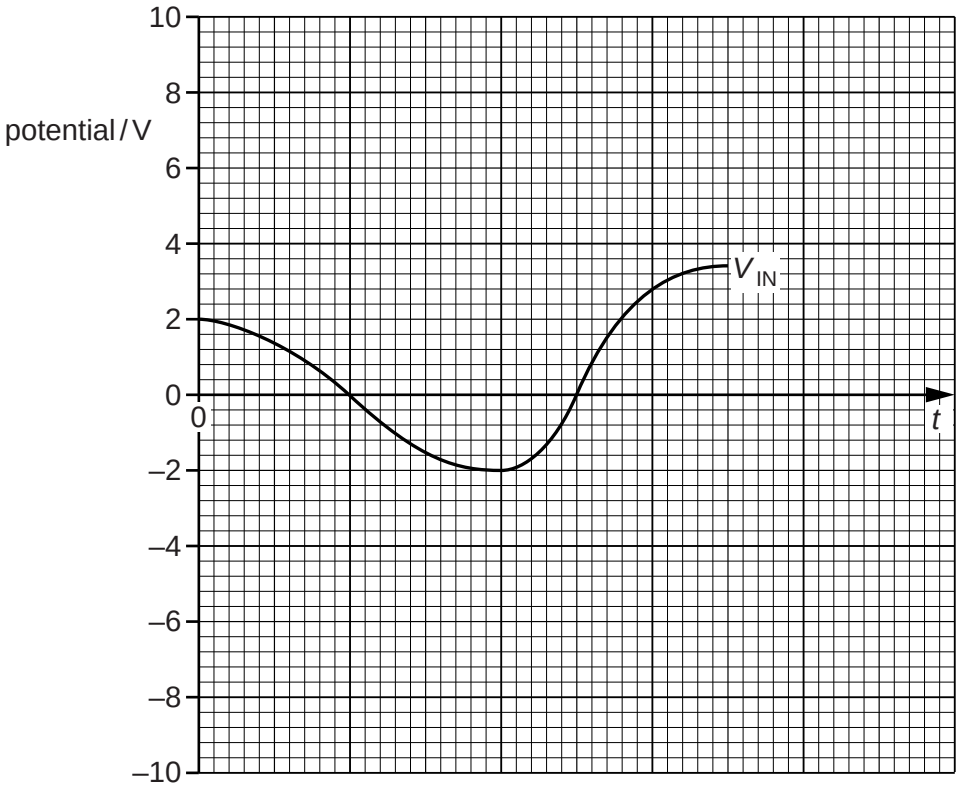

Fig. 10.3

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

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

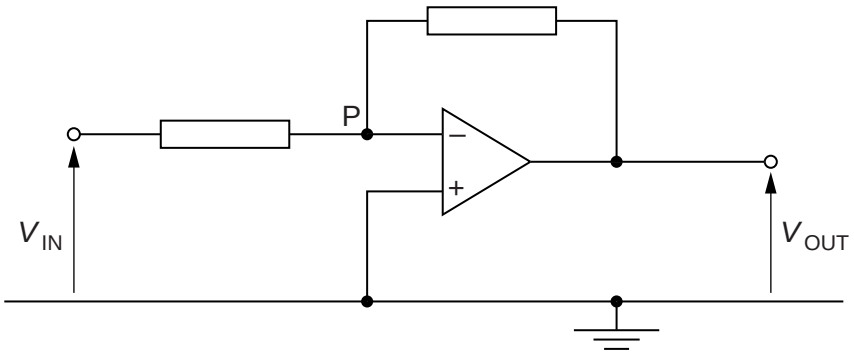

Fig. 11.1

(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.

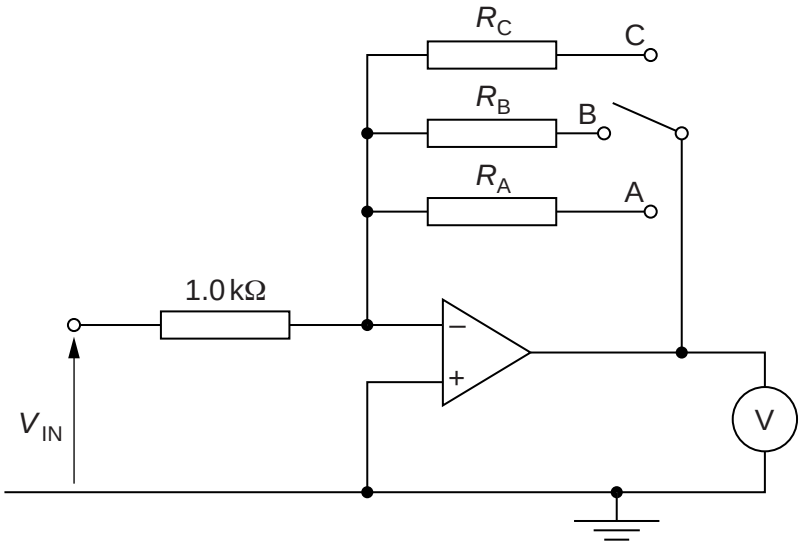

Fig. 11.2

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 = ...
B	100	R_B = ...
C	.....	R_C = 1.0 kΩ

Fig. 11.3

[3]

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

.....

..... [1]

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.

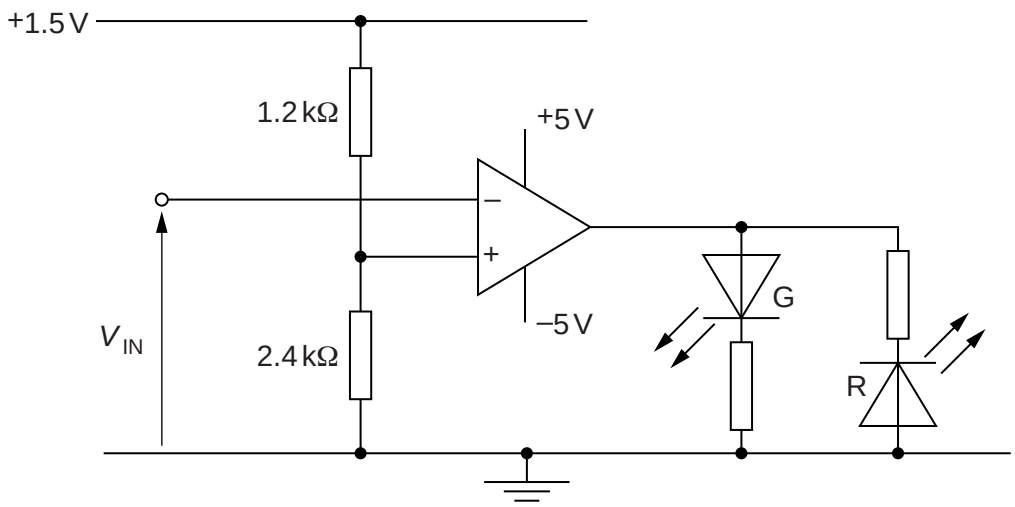

Fig. 10.1

(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 1.0 V.

[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.

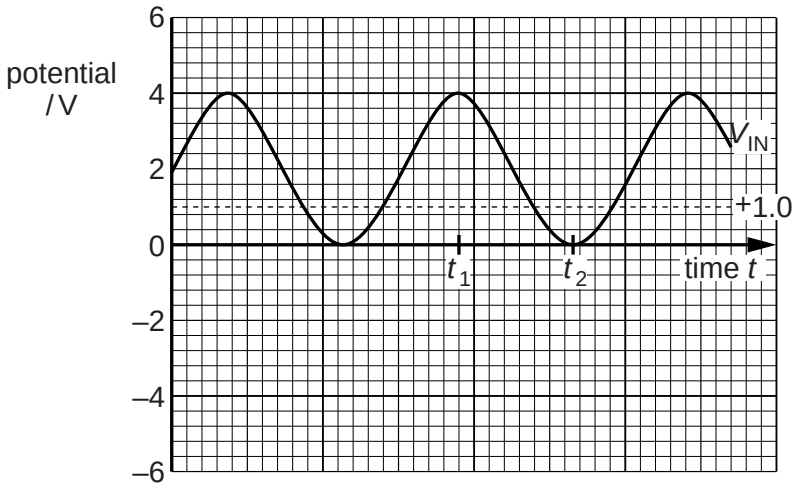

Fig. 10.2

1. On the axes of Fig. 10.2, draw the variation with time t of the output potential of the op-amp. [3]

2. 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]

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.

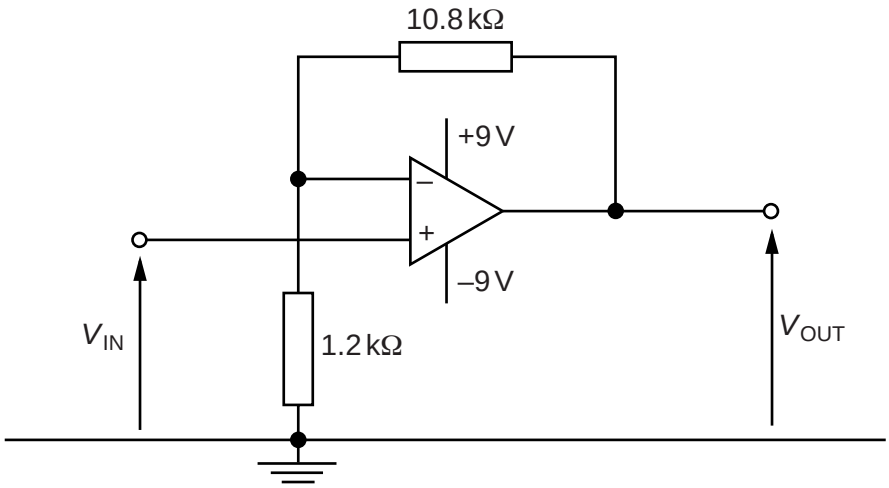

Fig. 9.1

(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.

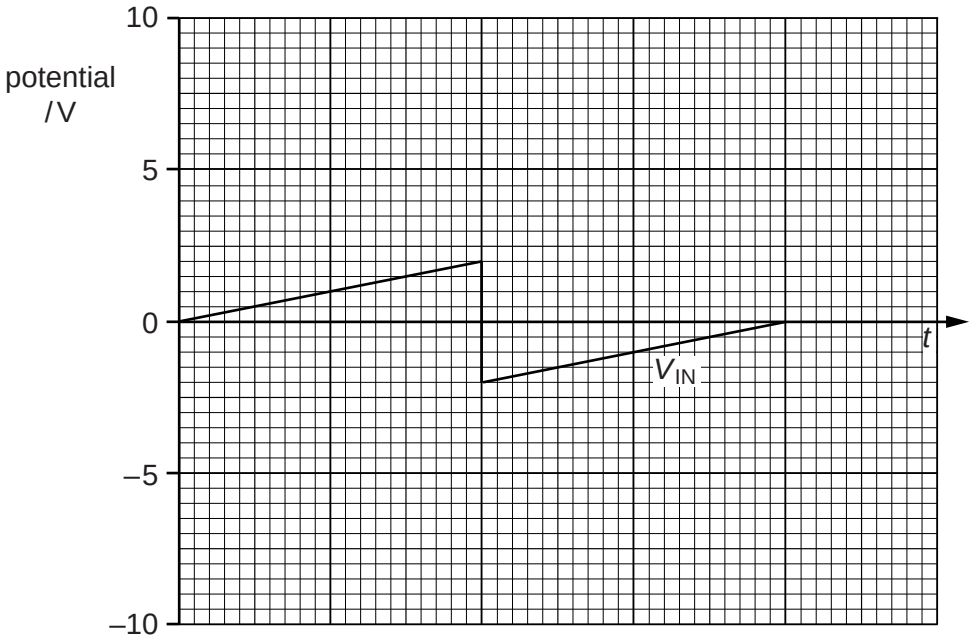

Fig. 9.2

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