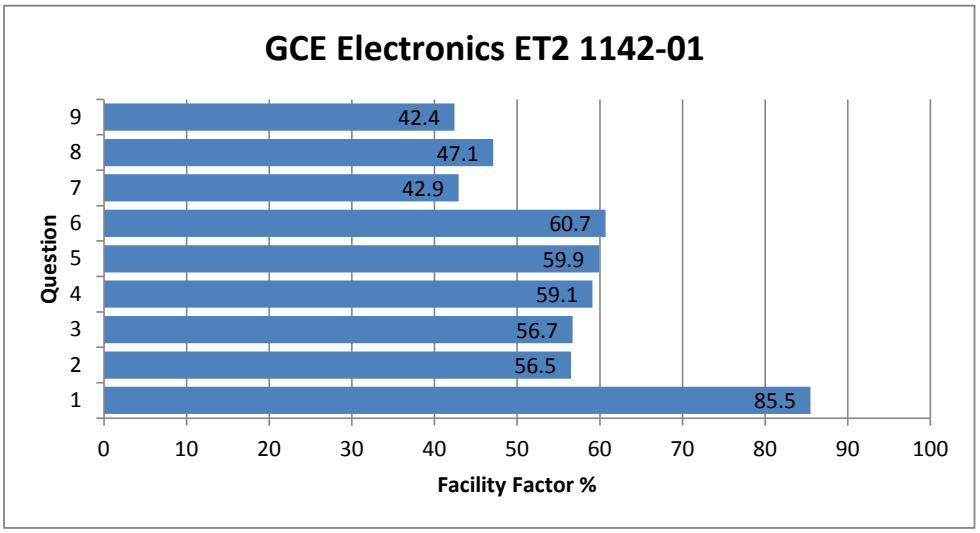
# WJEC 2014 Online Exam Review

## GCE Electronics ET2 1142-01

**Candidates' performance across questions**

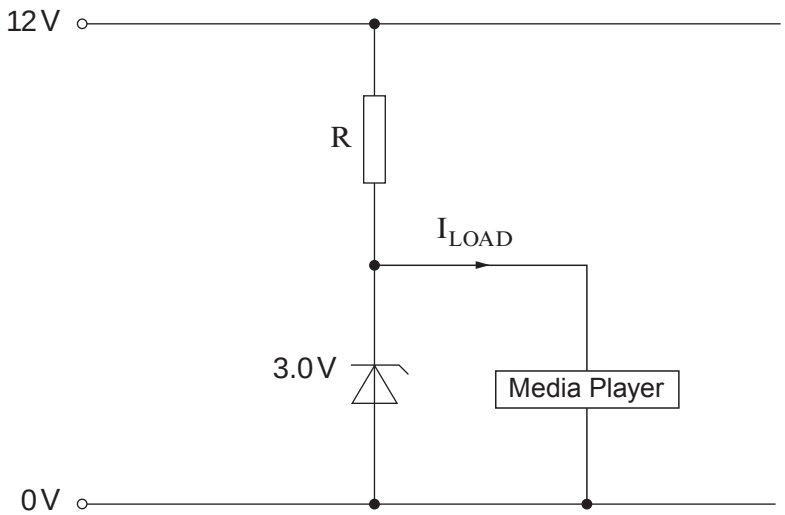
| Question Title | N | Mean | S D | Max Mark | F F | Attempt % |
|---|---|---|---|---|---|---|
| 1 | 883 | 5.1 | 1.5 | 6 | 85.5 | 99.1 |
| 2 | 857 | 3.4 | 2.1 | 6 | 56.5 | 96.2 |
| 3 | 883 | 4 | 2.4 | 7 | 56.7 | 99.1 |
| 4 | 870 | 3.5 | 2 | 6 | 59.1 | 97.6 |
| 5 | 868 | 4.8 | 2.5 | 8 | 59.9 | 97.4 |
| 6 | 843 | 3 | 1.7 | 5 | 60.7 | 94.6 |
| 7 | 839 | 3.4 | 2.5 | 8 | 42.9 | 94.2 |
| 8 | 862 | 3.3 | 1.7 | 7 | 47.1 | 96.8 |
| 9 | 831 | 3 | 2.5 | 7 | 42.4 | 93.3 |

7
8
9



Examiner only

**7.** A simple 3 V regulated power supply is required for a portable media player to be used with a 12 V car battery.




The zener diode requires a **minimum** current of 8 mA to maintain the zener voltage.

*(a)* The power supply should be able to supply load currents up to 250 mA. Calculate the ideal value of resistor R. [3]

.....

.....

.....

.....

*(b)* Select the preferred value of resistor that you would use from the E24 series. Give a reason for your choice. [1]

.....

.....

*(c)* The output of the car battery varies, and can reach 14.5 V. The battery output is now 14.5 V. Calculate:

(i) the voltage across the zener diode; ..... [1]

(ii) the voltage across resistor R; ..... [1]

(iii) the power dissipated in resistor R. [2]

.....

.....

Examiner only

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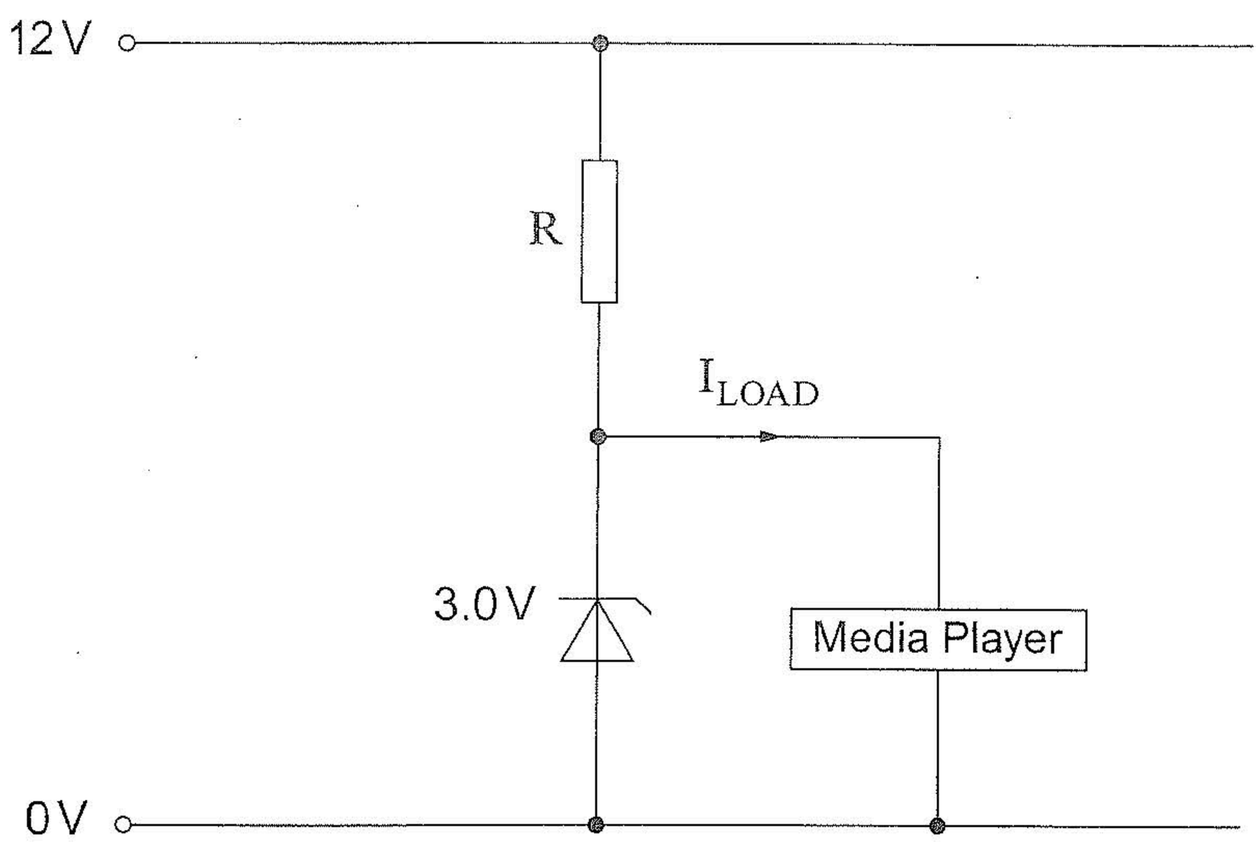



The zener diode requires a **minimum** current of 8 mA to maintain the zener voltage.

*(a)* The power supply should be able to supply load currents up to 250 mA. Calculate the ideal value of resistor R. [3]

258 mA ✓ $R = \frac{V}{I}$ $R = \frac{12}{258 \times 10^{-3}}$ X

R = 46.5 Ω ✓et

*(b)* Select the preferred value of resistor that you would use from the E24 series. Give a reason for your choice. [1]

47 Ω because it's the closest to the ideal value

*(c)* The output of the car battery varies, and can reach 14.5 V.
The battery output is now 14.5 V. Calculate:

(i) the voltage across the zener diode; 3 V [1]

(ii) the voltage across resistor R; V = IR : 14.5 − 3 = 11.5 [1]

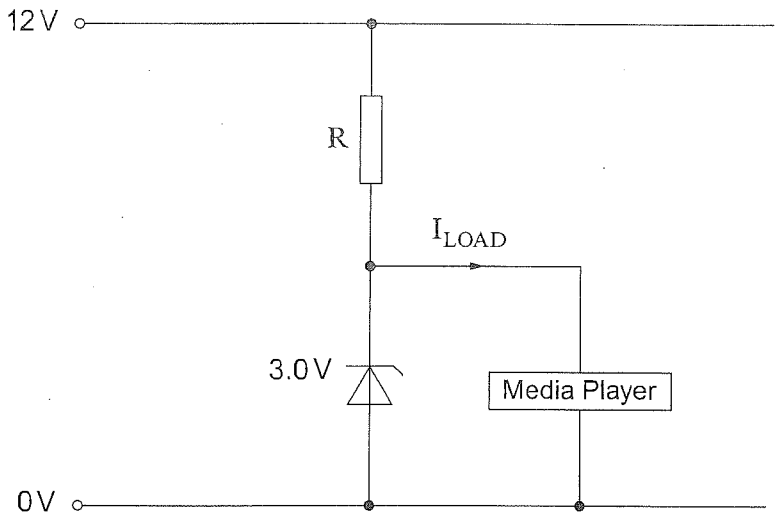
(iii) the power dissipated in resistor R. [2]

$P_W = IV = 0.25 \times 11.5$ $I = 11.5$

P = 2.8 W $I = \frac{47}{}$ = 0.25 A

Examiner only

7. A simple 3 V regulated power supply is required for a portable media player to be used with a 12 V car battery.




The zener diode requires a **minimum** current of 8 mA to maintain the zener voltage.

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258 mA ✓ $R = \frac{V}{I}$ $R = \frac{12}{258 \times 10^{-3}}$ ✗

$R = 46.5\,\Omega$ ✓et

$ 2

*(b)* Select the preferred value of resistor that you would use from the E24 series. Give a reason for your choice. [1]

47 Ω because it's the closest to the ideal value ✗

0

*(c)* The output of the car battery varies, and can reach 14.5 V. The battery output is now 14.5 V. Calculate:

(i) the voltage across the zener diode; 3 V ✓ [1]

1

(ii) the voltage across resistor R; 14.5 − 3 = 11.5 V ✓ [1]

1

(iii) the power dissipated in resistor R. [2]

$P_R = IV = 0.25 \times 11.5$ $I = 11.5$

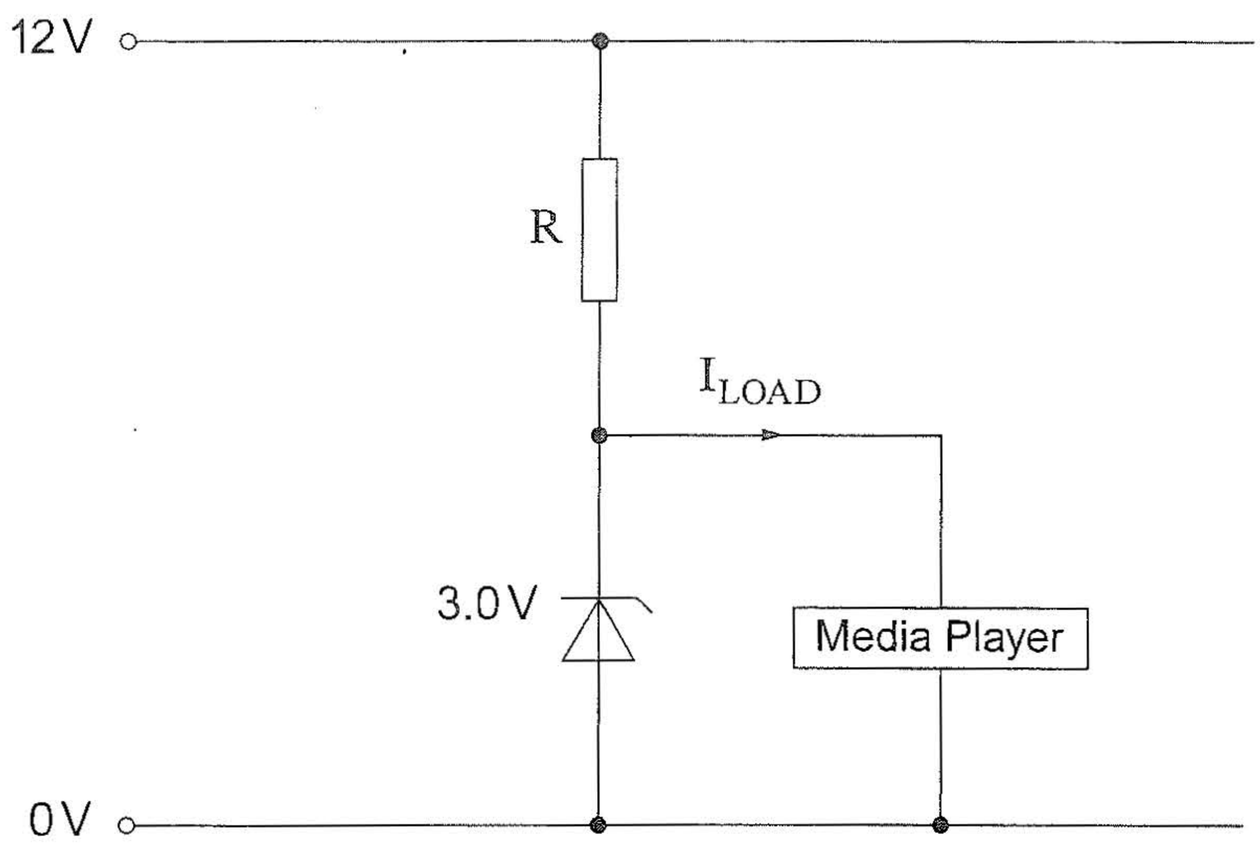
$P = 2.8$ W ✓et $I = \frac{4}{11.5}$ ✓et. $= 0.25$ A

2

8/6

Examiner only

7. A simple 3V regulated power supply is required for a portable media player to be used with a 12V car battery.




The zener diode requires a **minimum** current of 8mA to maintain the zener voltage.

*(a)* The power supply should be able to supply load currents up to 250mA. Calculate the ideal value of resistor R. [3]

250 + 8 = 258 mA

12 - 3 = 9 9 ÷ 0.258 = 34.9

*(b)* Select the preferred value of resistor that you would use from the E24 series. Give a reason for your choice. [1]

330Ω because otherwise it could not support up to 250mA

*(c)* The output of the car battery varies, and can reach 14.5V. The battery output is now 14.5V. Calculate:

(i) the voltage across the zener diode; 3.625 [1]

(ii) the voltage across resistor R; 10.875 [1]

(iii) the power dissipated in resistor R. ecf. [2]

10.875 ÷ 33Ω X 10.875 = 3.58 W

Examiner only

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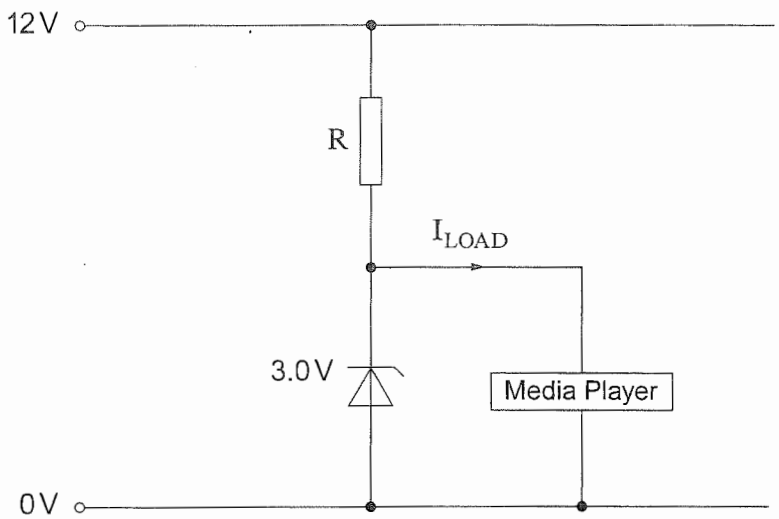



The zener diode requires a **minimum** current of 8 mA to maintain the zener voltage.

*(a)* The power supply should be able to supply load currents up to 250 mA. Calculate the ideal value of resistor R. [3] 3

250 + 8 = 258 mA ✓

12 − 3 = 9 ✓ 9 ÷ 0.258 = 34.9 ✓

*(b)* Select the preferred value of resistor that you would use from the E24 series. Give a reason for your choice. [1] 1

330 Ω because otherwise it could not support up to 250 mA ✓

*(c)* The output of the car battery varies, and can reach 14.5V. The battery output is now 14.5V. Calculate:

(i) the voltage across the zener diode; 3.625 [1] 0

(ii) the voltage across resistor R; 10.875 [1] 0

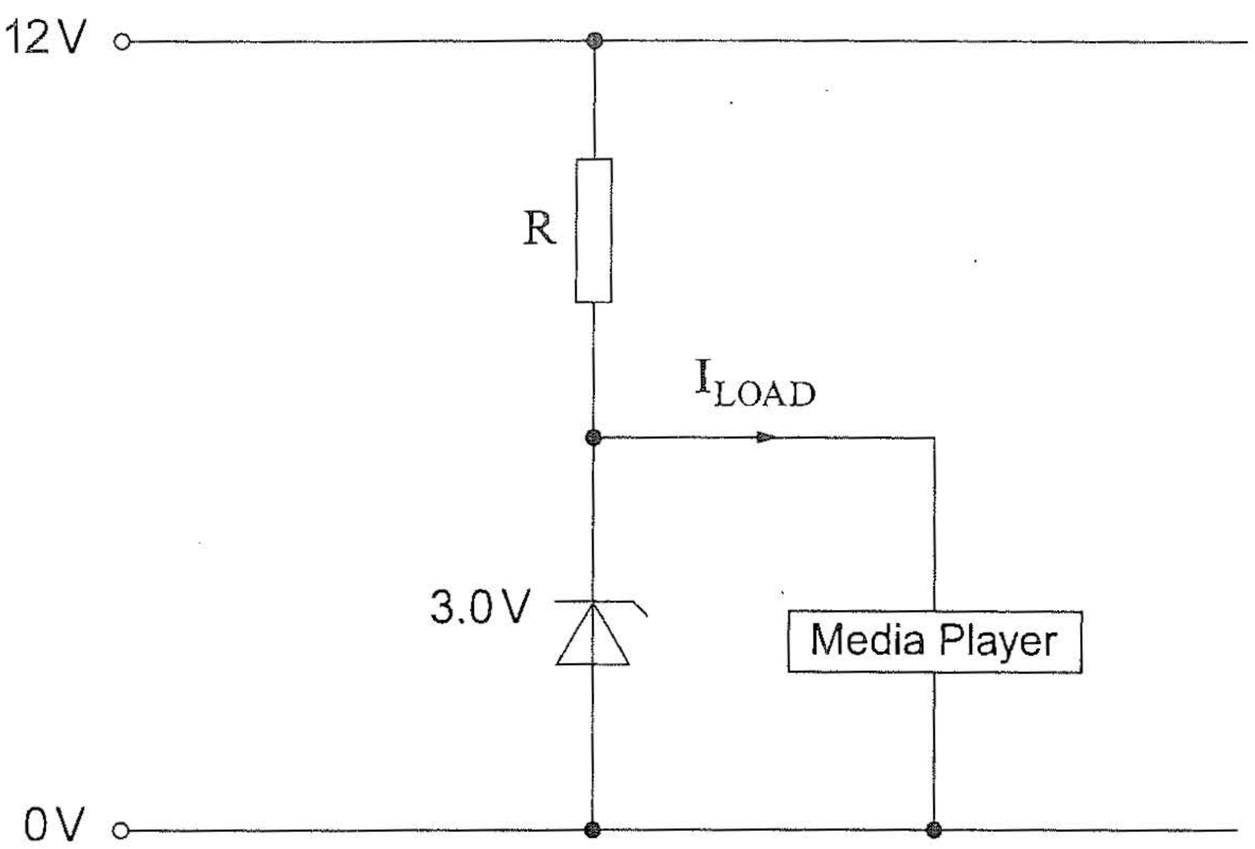
(iii) the power dissipated in resistor R. ecf. [2] 2

10.875 ÷ 3.81 × 10.875 = 3.58 W ✓

6

Examiner only

7. A simple 3 V regulated power supply is required for a portable media player to be used with a 12 V car battery.




The zener diode requires a **minimum** current of 8 mA to maintain the zener voltage.

*(a)* The power supply should be able to supply load currents up to 250 mA. Calculate the ideal value of resistor R. [3]

~~$\frac{12}{8\times10^{-3}} = 1500$~~ $12 - 0.7 = 11.3$ ✗

~~$\frac{11.3}{8\times10^{-3}} = 1412.5$~~ $250 + 8 = 258$

~~$\frac{11.3}{250\times10^{-3}} = 45.2$~~ $\frac{11.3}{258\times10^{-3}}$ ecf. $= 43.798$

$\approx 43.8\,\Omega$

*(b)* Select the preferred value of resistor that you would use from the E24 series. Give a reason for your choice. [1]

43 Ω so it can give more so it doesn't cut out

*(c)* The output of the car battery varies, and can reach 14.5 V.
The battery output is now 14.5 V. Calculate:

(i) the voltage across the zener diode; 3.625 [1]

(ii) the voltage across resistor R; 10.875 [1]

(iii) the power dissipated in resistor R. [2]

$P = VI$ $V = 10.875$ $P = 3.67$

$I = 0.34$

Examiner only

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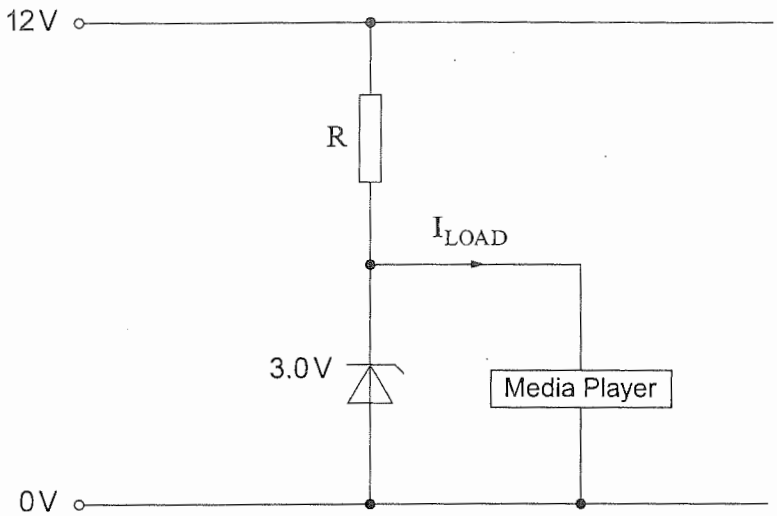


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~~$\frac{1.3}{8\times10^{-3}} = 1500$~~ $12 - 0.7 = 11.3$ ✗

~~$\frac{1.3}{8\times10^{-3}} = 1412.5$~~ $250 + 8 = 258$ ✓

~~$\frac{11.3}{250\times10^{-3}} = 45.2$~~ $\frac{11.3}{258\times10^{-3}} = 43.798$ ecf.

$= 43.8\ \Omega$ ✓

2

*(b)* Select the preferred value of resistor that you would use from the E24 series. Give a reason for your choice. [1]

43 Ω so it can give more so it doesn't cut out ✓

1

*(c)* The output of the car battery varies, and can reach 14.5 V. The battery output is now 14.5 V. Calculate:

(i) the voltage across the zener diode; 3.625 [1]

0

(ii) the voltage across resistor R; 10.875 [1]

0

(iii) the power dissipated in resistor R. [2]

$P = VI$ $V = 10.875$ $P = 3.67$

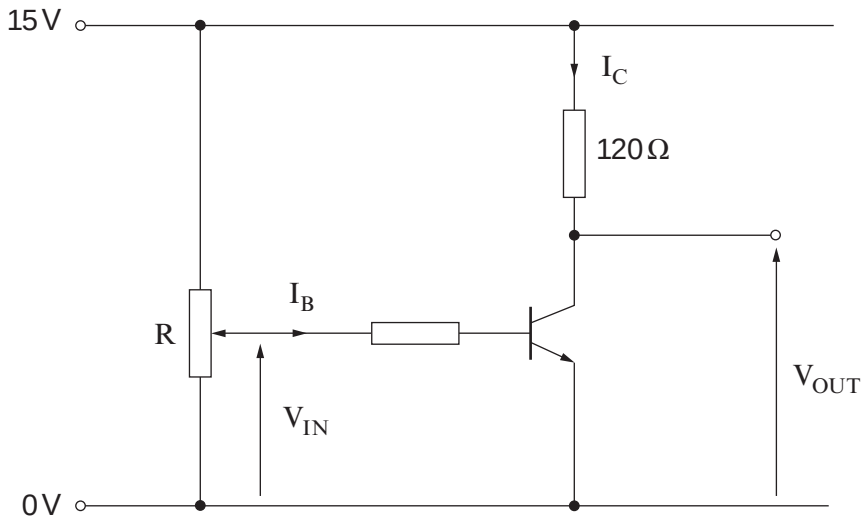
$I = 0.34$ ✗

0

3

Examiner only

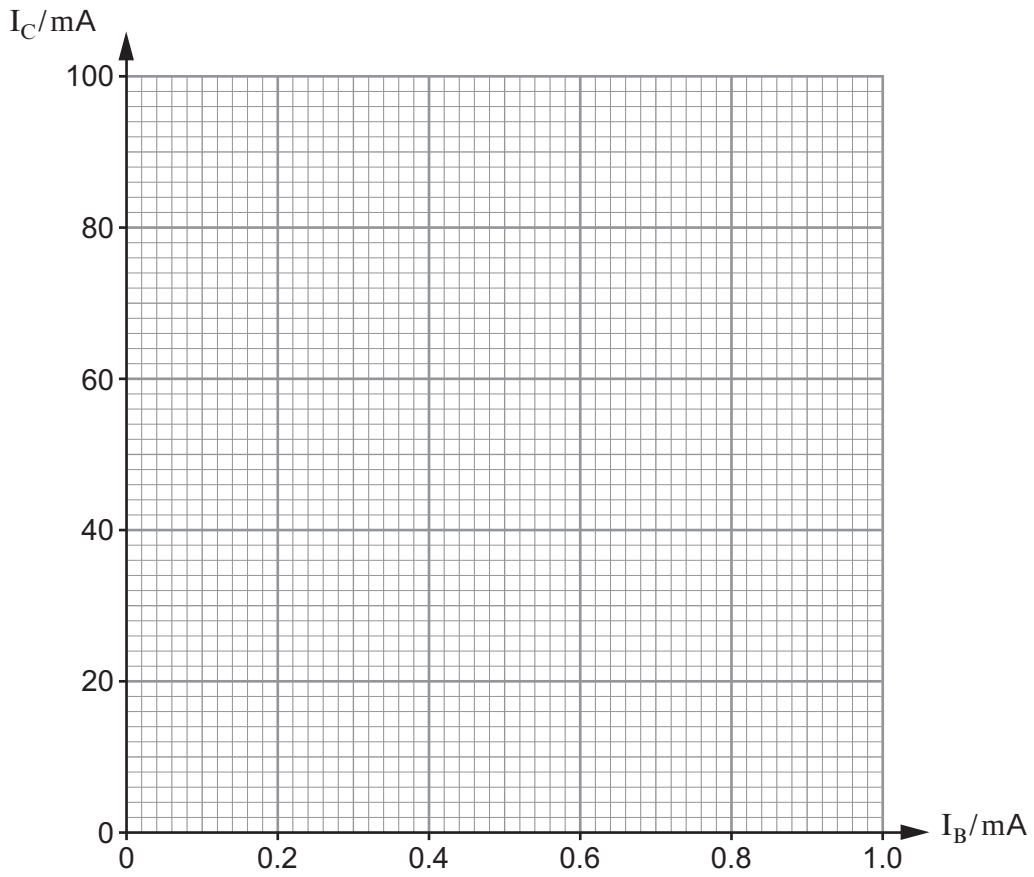
**8.** The following circuit is set up to investigate a transistor switching circuit.




Potentiometer R is varied and readings of $V_{IN}$, $V_{OUT}$, $I_B$ and $I_C$ are taken.

*(a)* As the base current is increased from 0.2 to 0.8 mA the collector current increases from 16 to 64 mA and the transistor does not saturate.

(i) Complete the graph below to show how the ammeter readings change as $I_B$ is increased from 0 to 1 mA. The transistor does not saturate. [1]



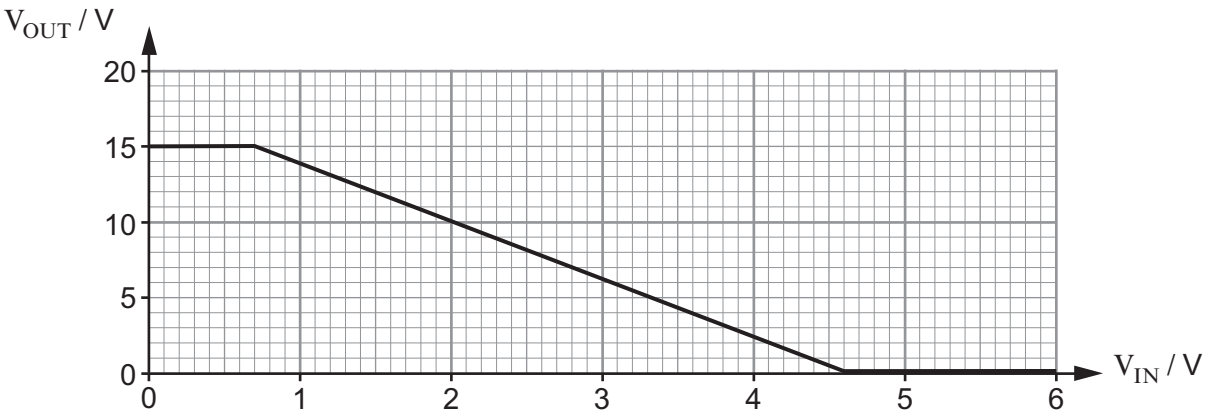
Examiner only

(ii) Determine the current gain ($h_{FE}$) of the transistor. [1]

.....

.....

*(b)* A second graph was drawn to show how $V_{OUT}$ changed as $V_{IN}$ was increased from 0 to 6 V.




Use the graph to determine:

(i) the minimum value of $V_{IN}$ required to saturate the transistor;

..... [1]

(ii) the value of $V_{OUT}$, when $V_{IN}$ = 3.1 V.

..... [1]

*(c)* $V_{IN}$ = 3.1 V and the load resistor = 120 Ω.

Calculate the collector current and the power dissipated in the transistor. [3]

.....

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**TURN OVER FOR THE LAST QUESTION.**

Examiner only

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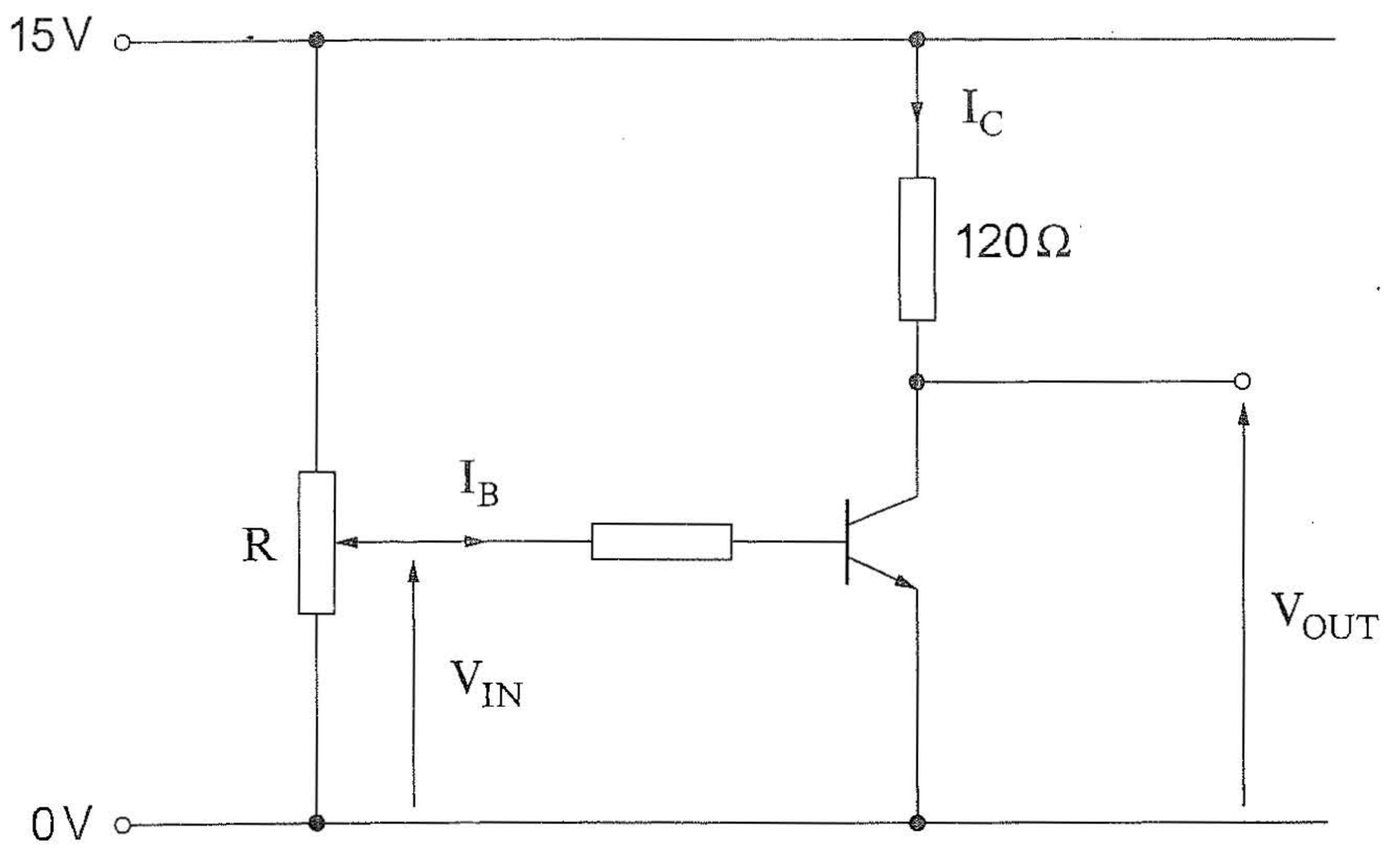


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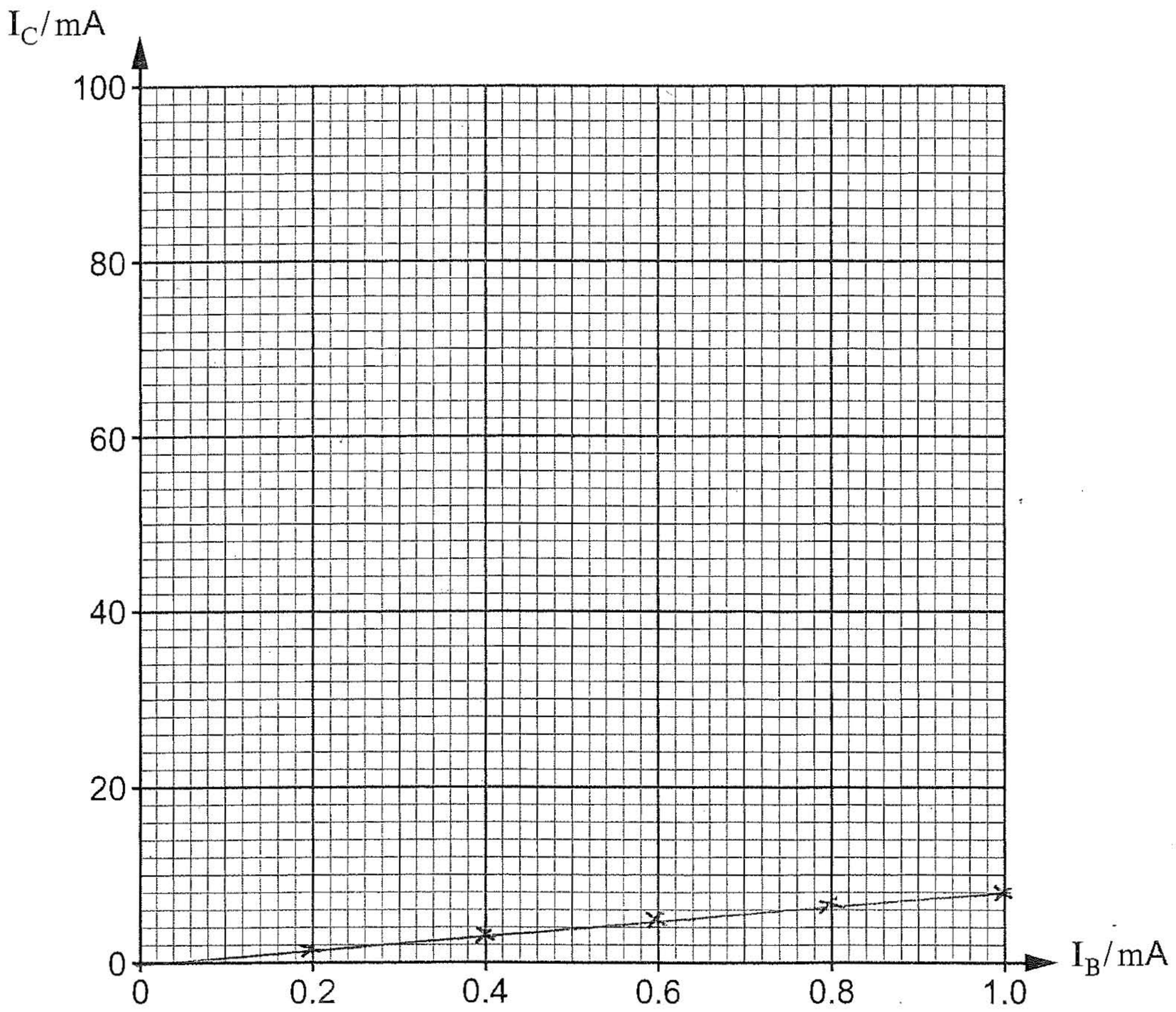
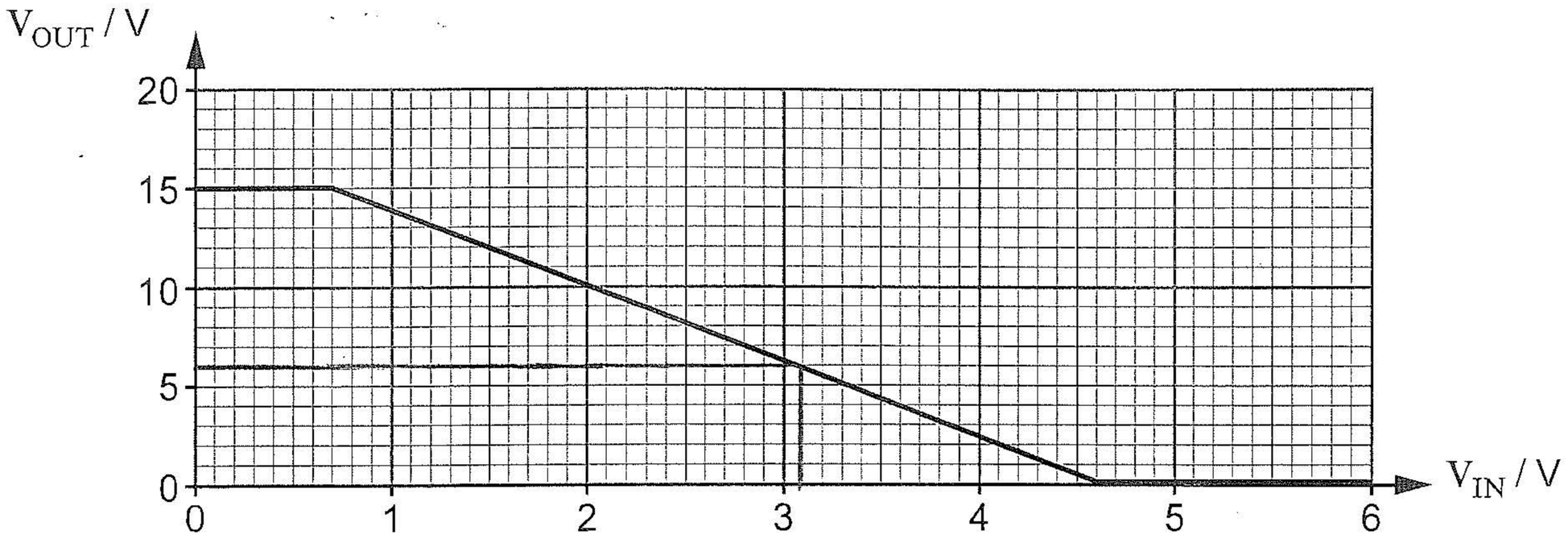


Examiner only

(ii) Determine the current gain ($h_{FE}$) of the transistor. [1]

$\frac{0.8}{0.2} = 4$

*(b)* A second graph was drawn to show how $V_{OUT}$ changed as $V_{IN}$ was increased from 0 to 6 V.




Use the graph to determine:

(i) the minimum value of $V_{IN}$ required to saturate the transistor;

4.6V [1]

(ii) the value of $V_{OUT}$, when $V_{IN}$ = 3.1 V.

6V [1]

*(c)* $V_{IN}$ = 3.1 V and the load resistor = 120 Ω.

Calculate the collector current and the power dissipated in the transistor. [3]

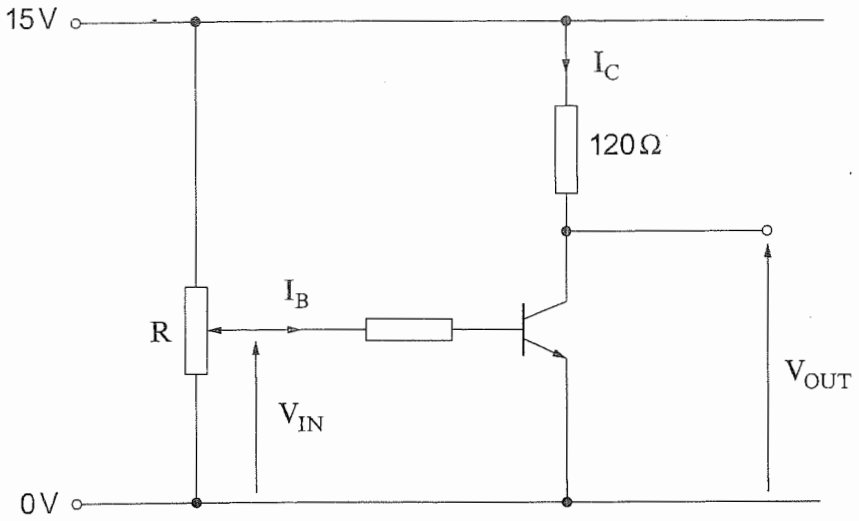
3.1 ~~x~~ 6 ÷ 120 = 0.05A

P = IV 0.05 x 6 = 0.3W

**TURN OVER FOR THE LAST QUESTION.**

Examiner only

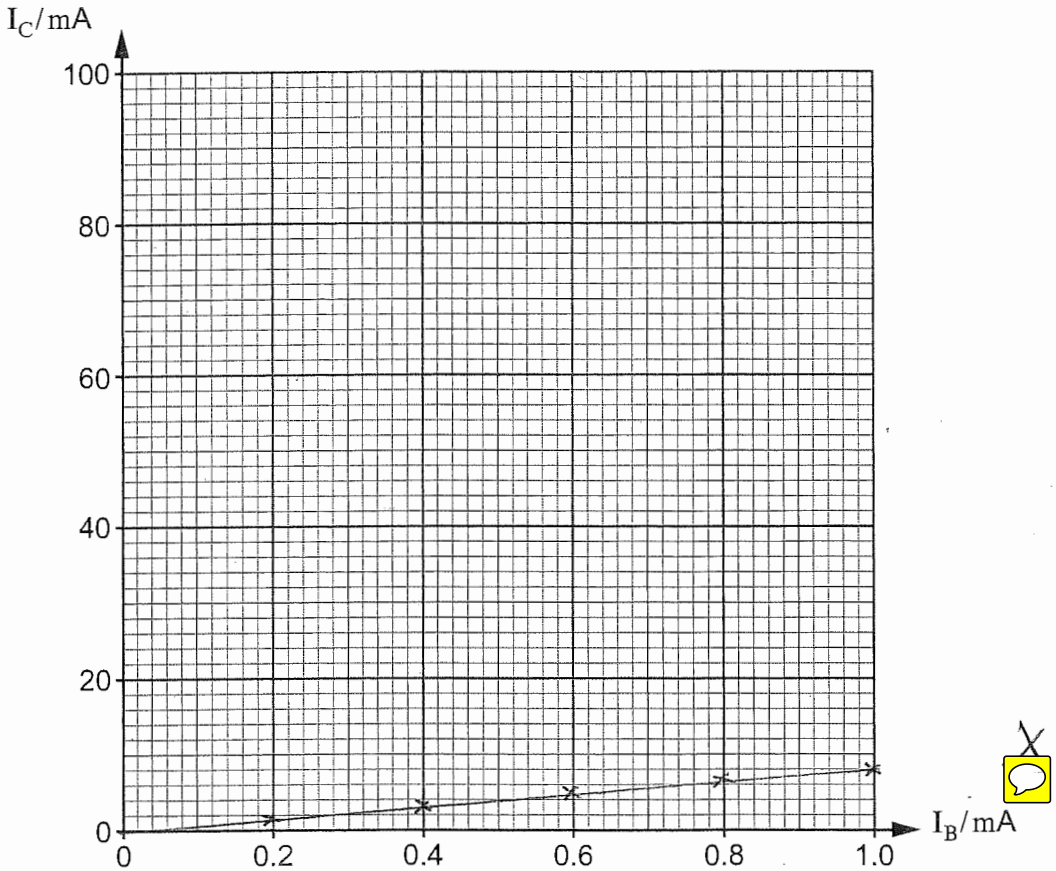
8. The following circuit is set up to investigate a transistor switching circuit.




Potentiometer R is varied and readings of $V_{IN}$, $V_{OUT}$, $I_B$ and $I_C$ are taken.

*(a)* As the base current is increased from 0.2 to 0.8 mA the collector current increases from 16 to 64 mA and the transistor does not saturate.

(i) Complete the graph below to show how the ammeter readings change as $I_B$ is increased from 0 to 1 mA. The transistor does not saturate. [1]



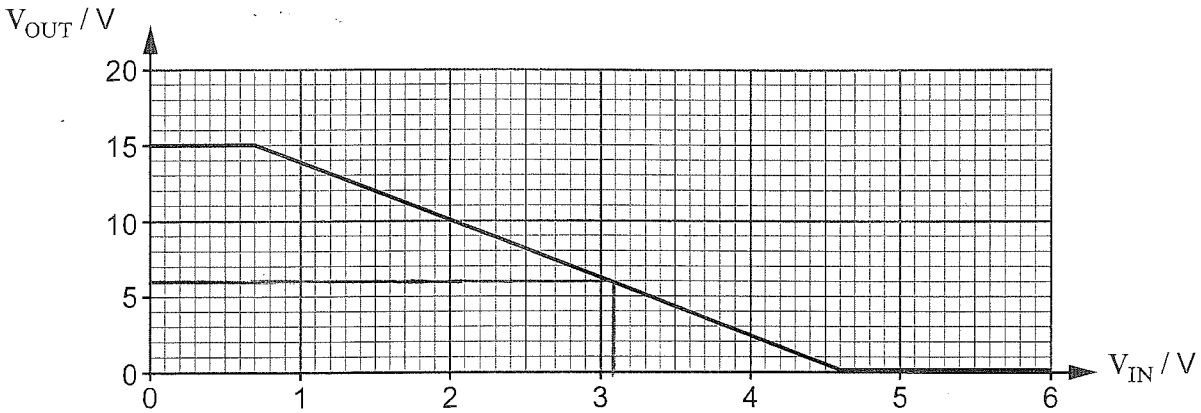
Examiner only

(ii) Determine the current gain ($h_{FE}$) of the transistor. [1]

$\frac{0.8}{0.2} = 4$ ✗

0

(b) A second graph was drawn to show how $V_{OUT}$ changed as $V_{IN}$ was increased from 0 to 6 V.




Use the graph to determine:

(i) the minimum value of $V_{IN}$ required to saturate the transistor;

4.6V ✓ [1] 1

(ii) the value of $V_{OUT}$, when $V_{IN}$ = 3.1 V.

6V ✓ [1] 1

(c) $V_{IN}$ = 3.1 V and the load resistor = 120 Ω.

Calculate the collector current and the power dissipated in the transistor. [3] 2

3.1 x (6) ÷ 120 ✓et = 0.05A

x

P = 1kV 0.05 x 6 = 0.3w ✓et.

4

**TURN OVER FOR THE LAST QUESTION.**

Examiner only

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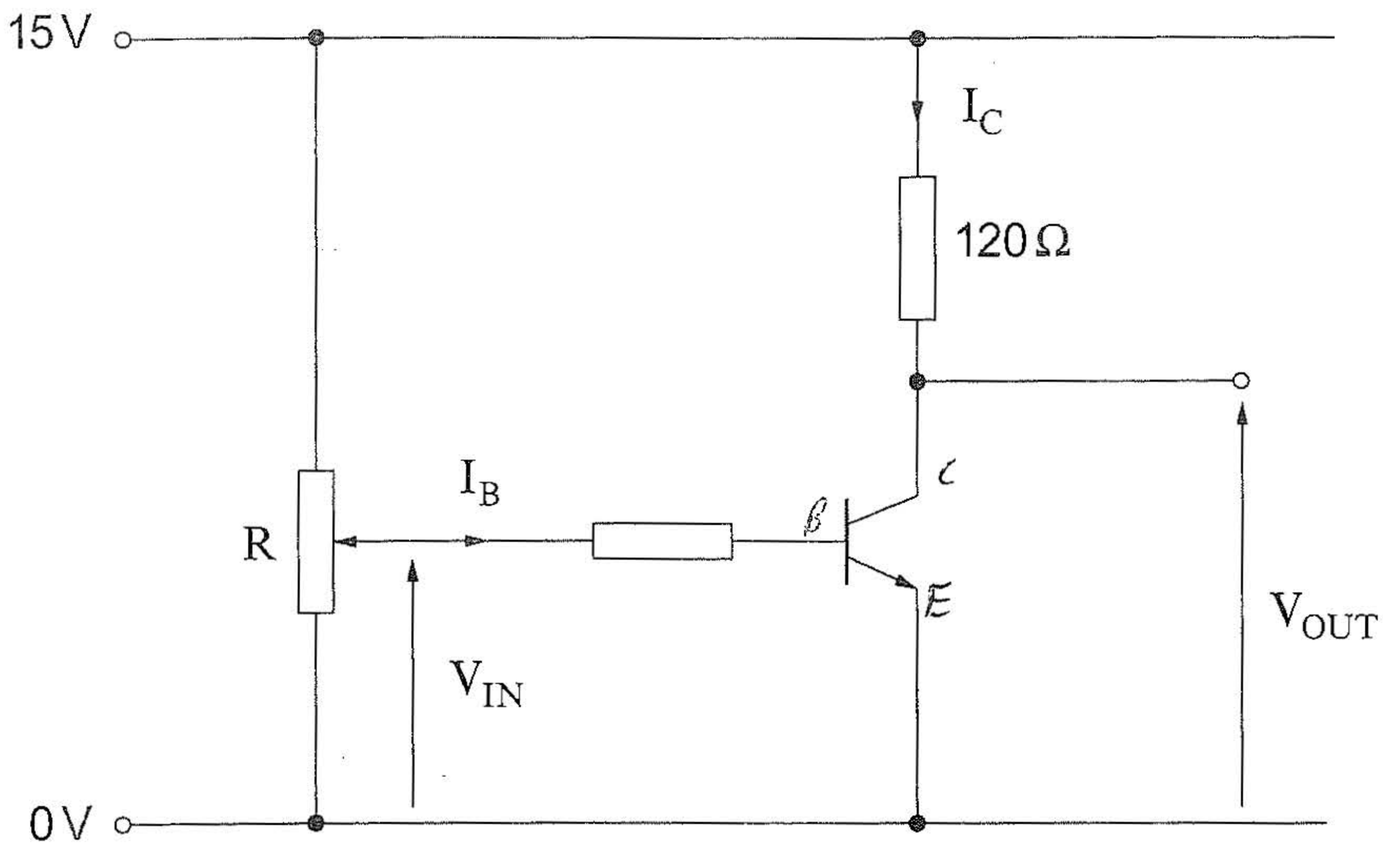


Potentiometer R is varied and readings of $V_{IN}$, $V_{OUT}$, $I_B$ and $I_C$ are taken.

*(a)* As the base current is increased from 0.2 to 0.8 mA the collector current increases from 16 to 64 mA and the transistor does not saturate.

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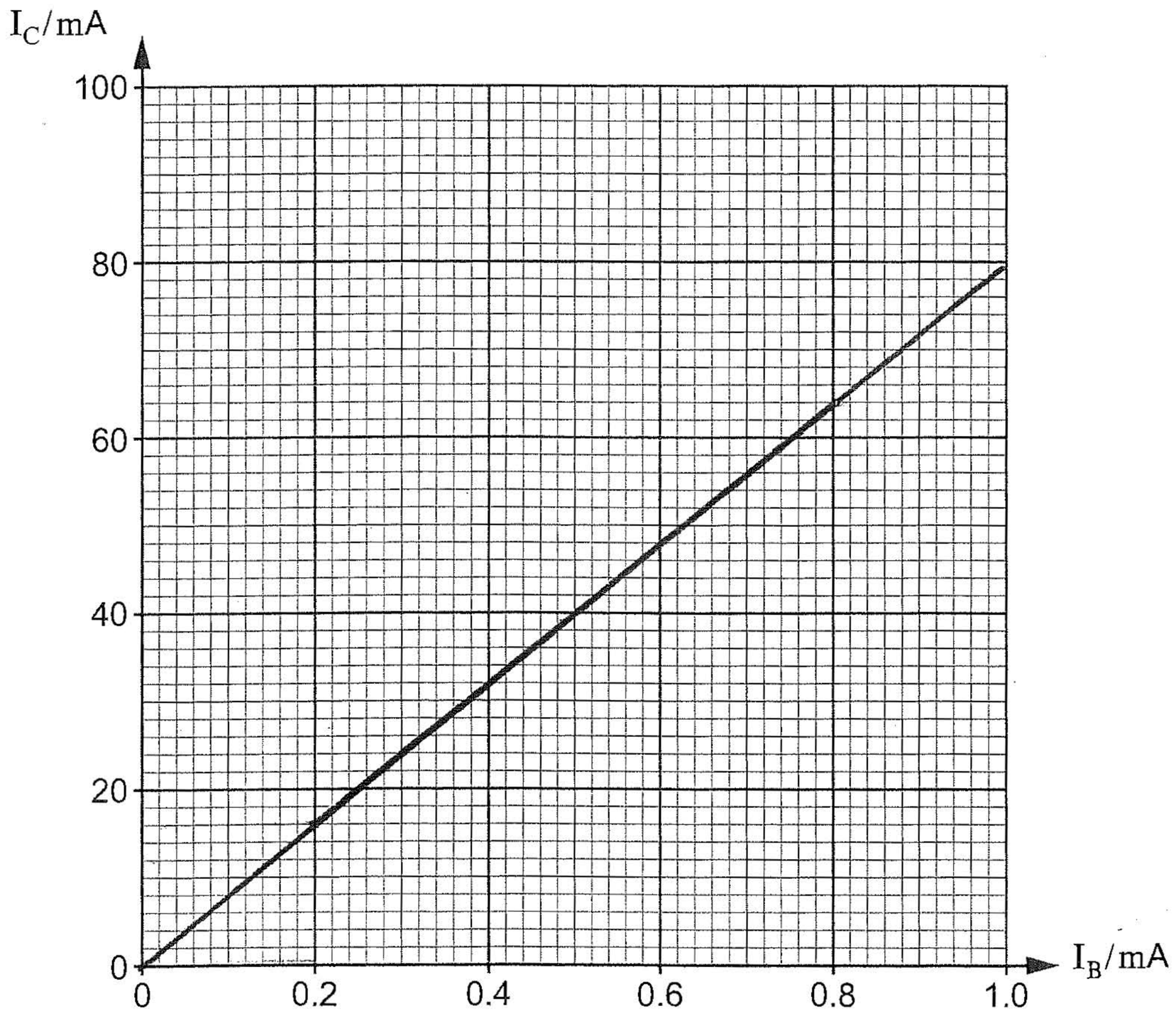
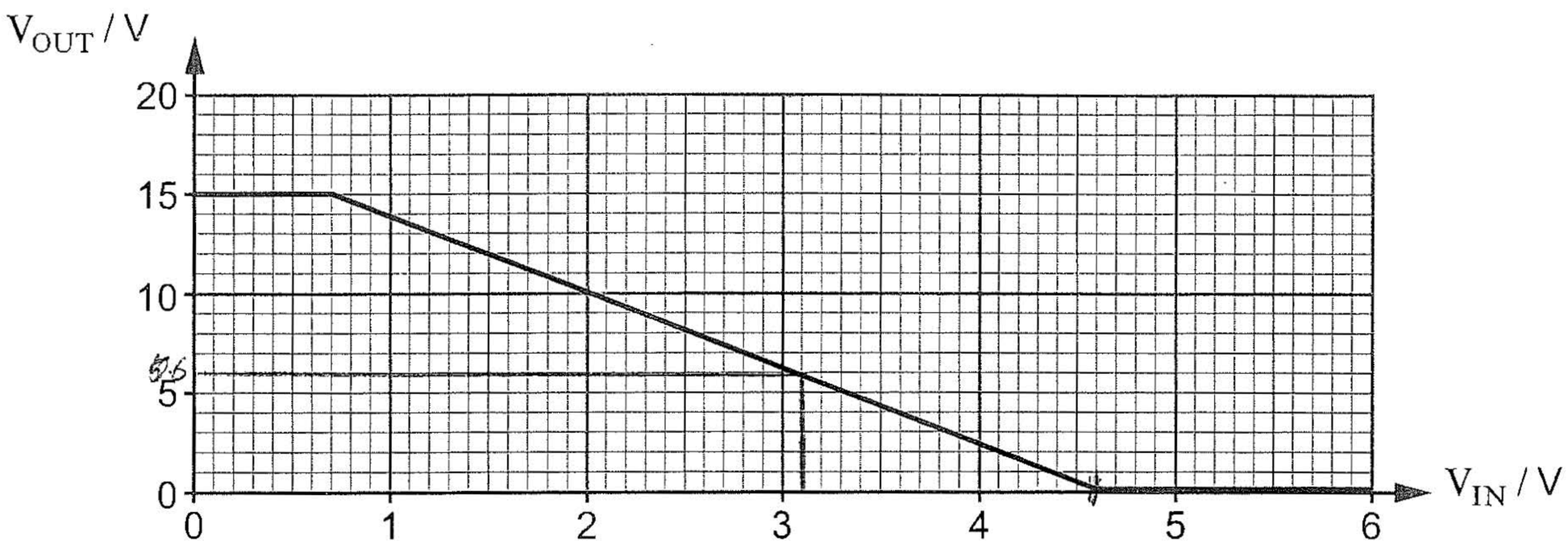


Examiner only

(ii) Determine the current gain ($h_{FE}$) of the transistor. [1]

$h_{FE} = \frac{I_c}{I_B}$ $\frac{64}{0.8 \times 10^{-3}} = 80 \times 10^3$

*(b)* A second graph was drawn to show how $V_{OUT}$ changed as $V_{IN}$ was increased from 0 to 6 V.




Use the graph to determine:

(i) the minimum value of $V_{IN}$ required to saturate the transistor;

4.6 V [1]

(ii) the value of $V_{OUT}$, when $V_{IN}$ = 3.1 V.

6V [1]

*(c)* $V_{IN}$ = 3.1 V and the load resistor = 120 Ω.

Calculate the collector current and the power dissipated in the transistor. [3]

$15/120 = 0.125 = I_c$

$P = V \times I$ $3.1 \times 0.125 = 0.3875$

$\simeq 0.39$ W

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Examiner only

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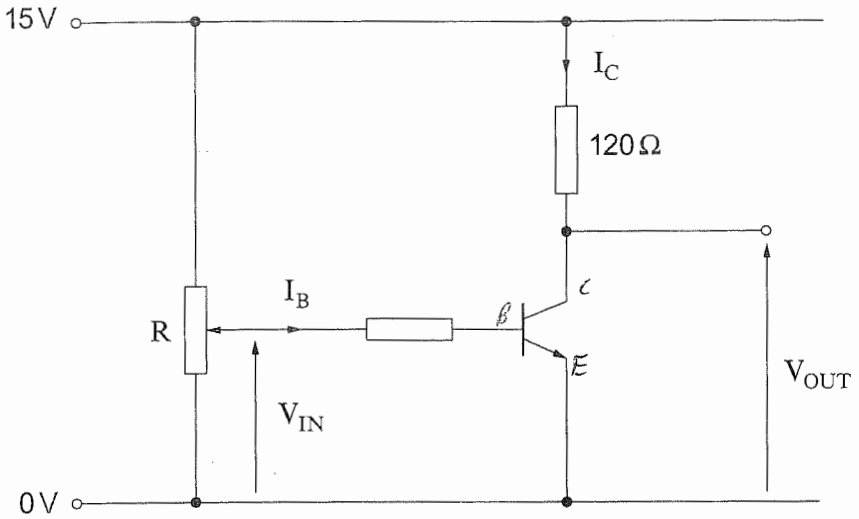


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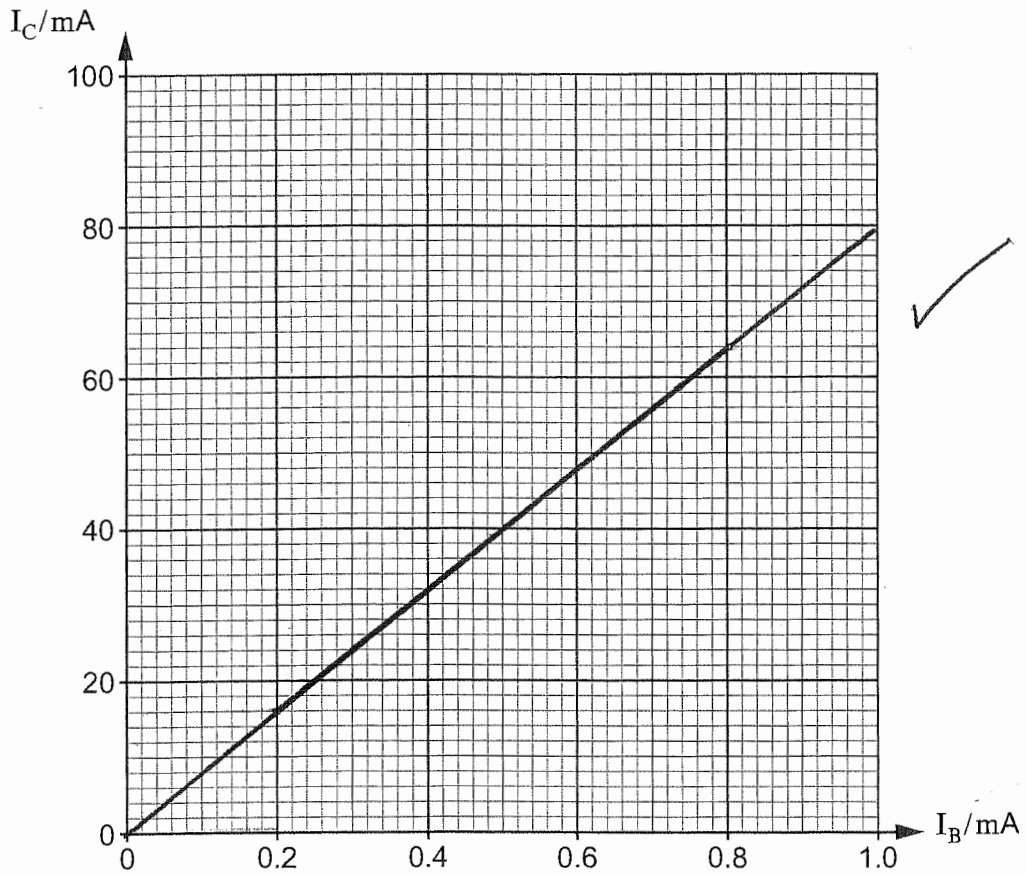
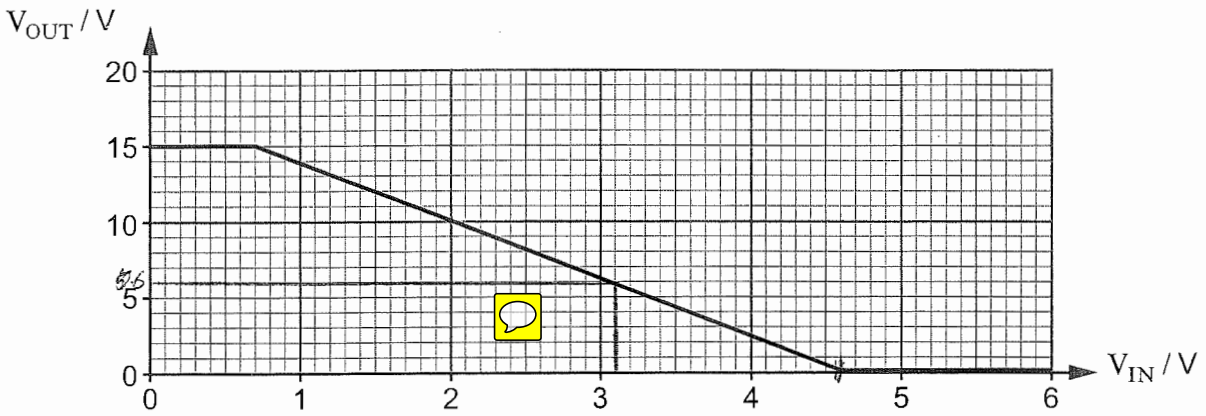


Examiner only

(ii) Determine the current gain ($h_{FE}$) of the transistor. [1]

$h_{FE} = \frac{I_c}{I_b}$ $\frac{64}{0.8 \times 10^{-3}} = 80 \times 10^3$ ✓

(b) A second graph was drawn to show how $V_{OUT}$ changed as $V_{IN}$ was increased from 0 to 6 V.




Use the graph to determine:

(i) the minimum value of $V_{IN}$ required to saturate the transistor;

4.6 V ✓ [1] 1

(ii) the value of $V_{OUT}$, when $V_{IN}$ = 3.1 V.

6V ✓ [1] 1

(c) $V_{IN}$ = 3.1 V and the load resistor = 120 Ω.

Calculate the collector current and the power dissipated in the transistor. [3] 0

$15/120$ ✗ $= 0.125 = I_c$

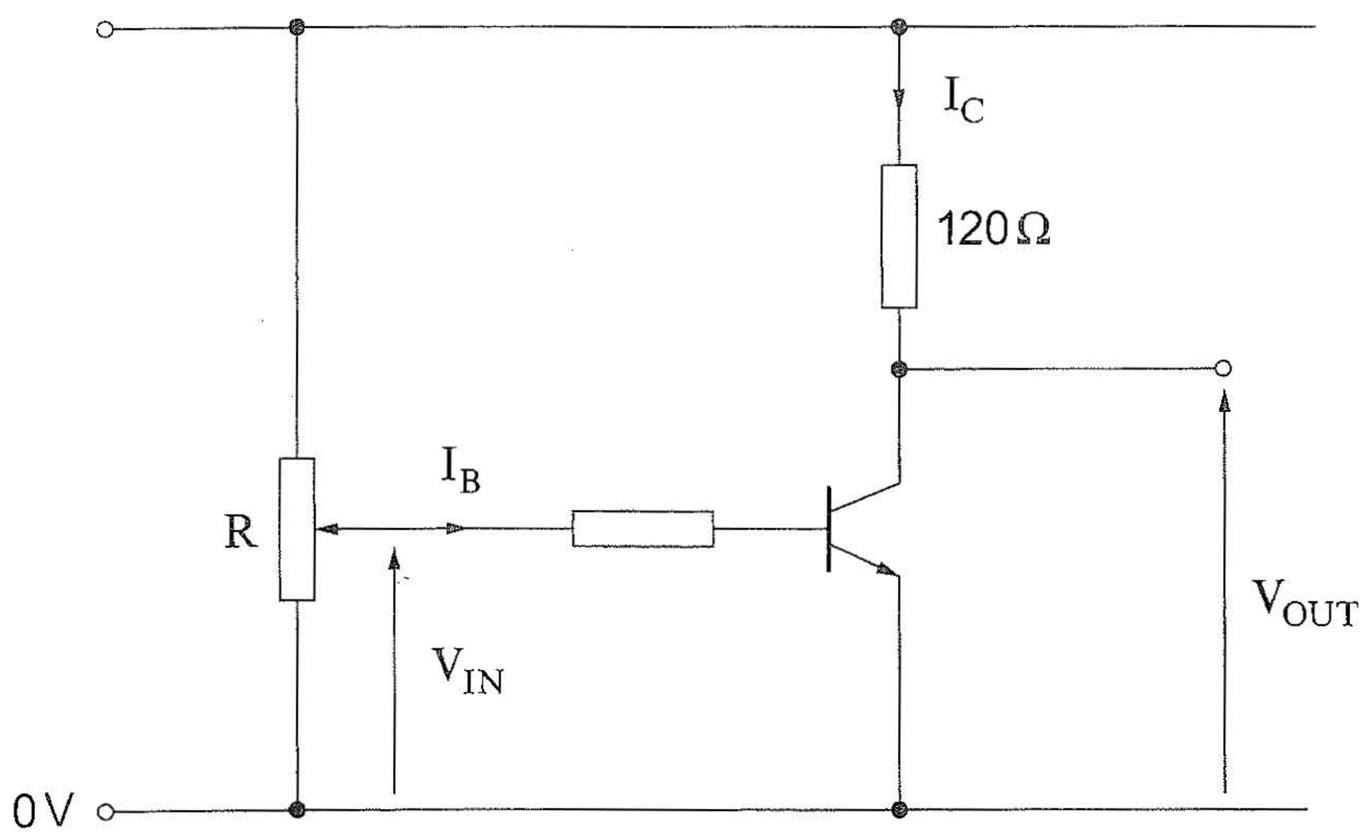
$P = V \times I$ $3.1 \times 0.125 = 0.3875$

✗ $\approx 0.39$ W ✗ 1

4

**TURN OVER FOR THE LAST QUESTION.**

Examiner only

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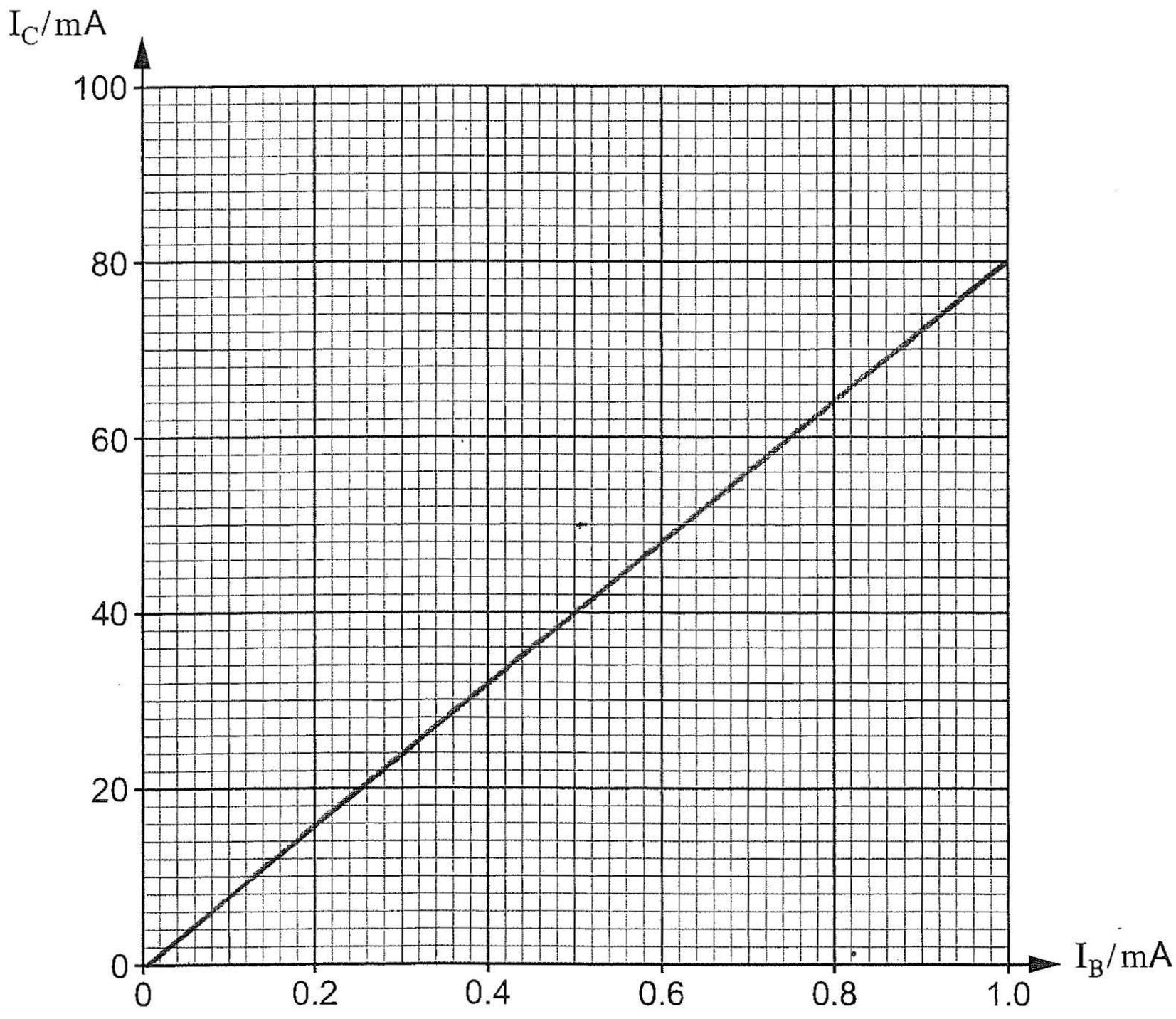
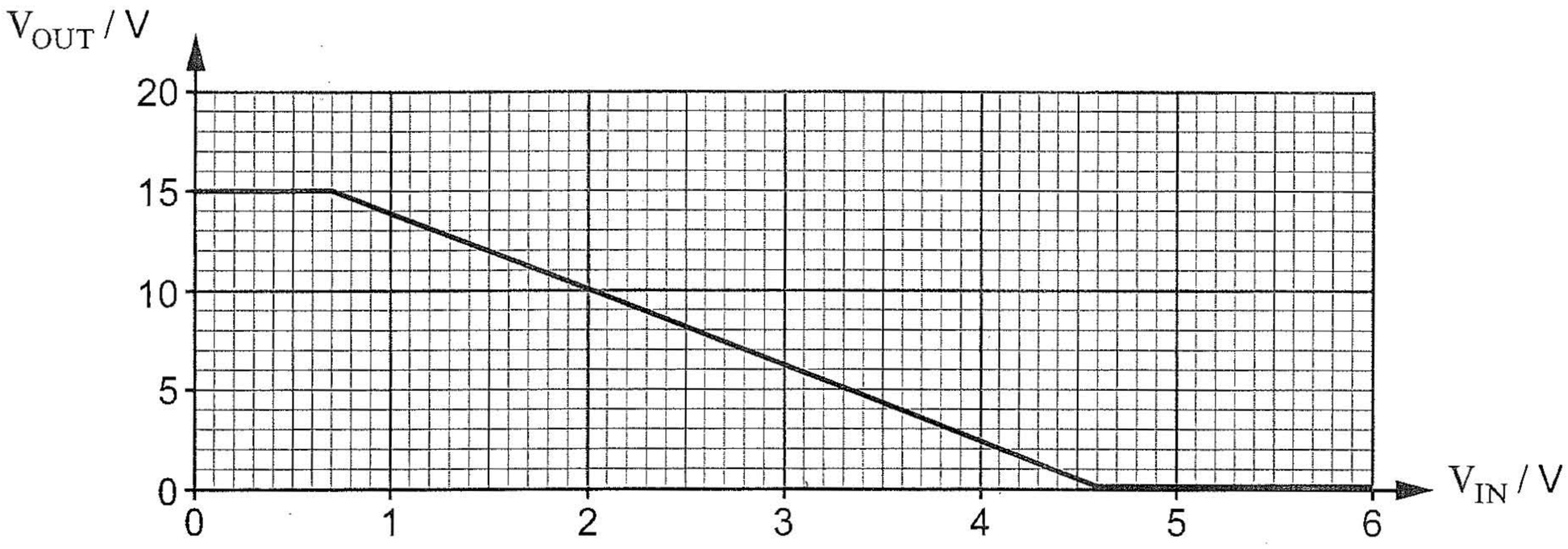


Examiner only

(ii) Determine the current gain ($h_{FE}$) of the transistor. [1]

$h_{fe} = \frac{I_c}{I_b} \quad \frac{0.8\,mA}{64\,mA} = 0.0125$

*(b)* A second graph was drawn to show how $V_{OUT}$ changed as $V_{IN}$ was increased from 0 to 6 V.




Use the graph to determine:

(i) the minimum value of $V_{IN}$ required to saturate the transistor;

4.6 V [1]

(ii) the value of $V_{OUT}$, when $V_{IN}$ = 3.1 V.

6 V [1]

*(c)* $V_{IN}$ = 3.1 V and the load resistor = 120 Ω.

Calculate the collector current and the power dissipated in the transistor. [3]

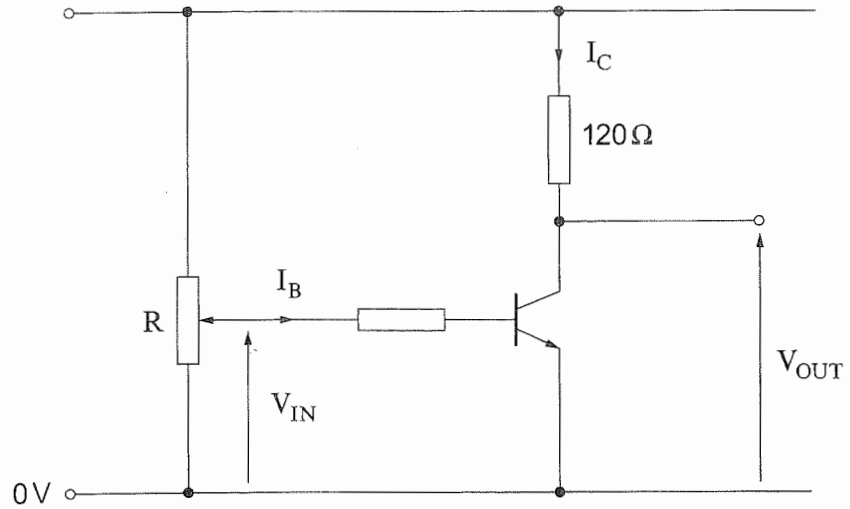
$P = VI$ $I = \frac{V}{R} = \frac{3.1}{120} = 0.02583$ A

$0.08\,W = 3.1 \times 0.02583$

$I_c = \frac{15}{120} = 0.125$

**TURN OVER FOR THE LAST QUESTION.**

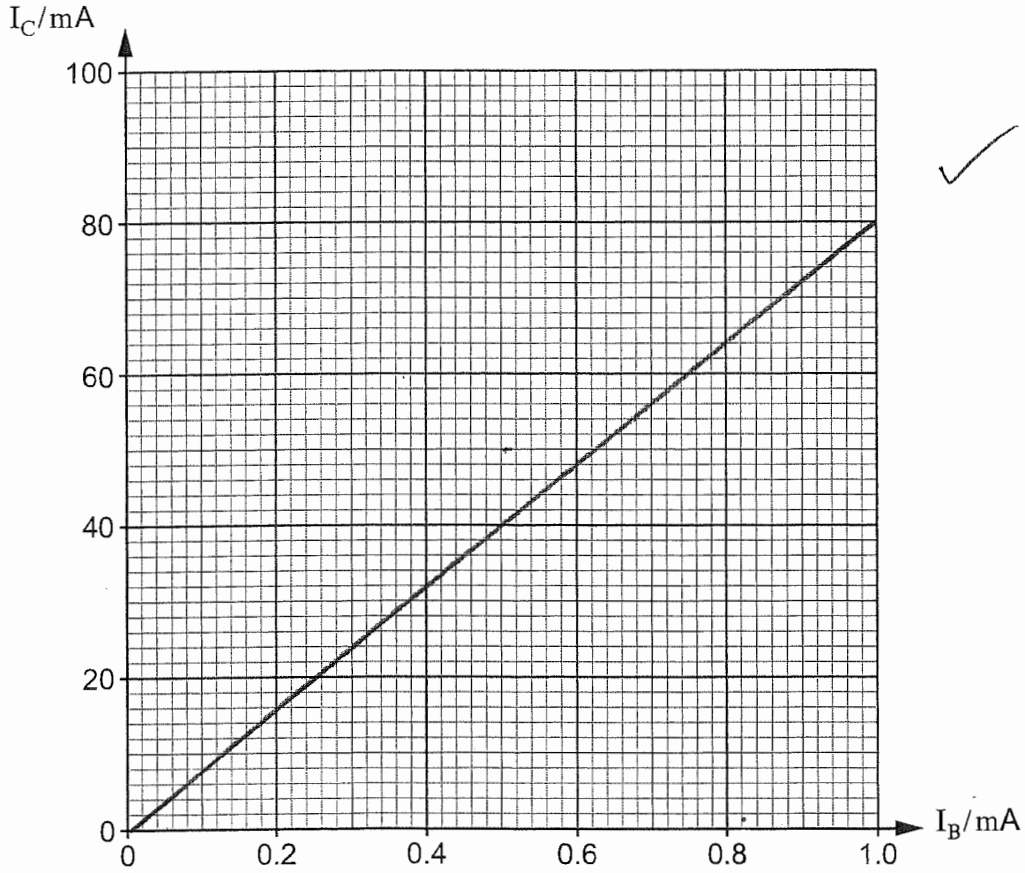
Examiner only




Potentiometer R is varied and readings of $V_{IN}$, $V_{OUT}$, $I_B$ and $I_C$ are taken.

*(a)* As the base current is increased from 0.2 to 0.8 mA the collector current increases from 16 to 64 mA and the transistor does not saturate.

(i) Complete the graph below to show how the ammeter readings change as $I_B$ is increased from 0 to 1 mA. The transistor does not saturate. [1]

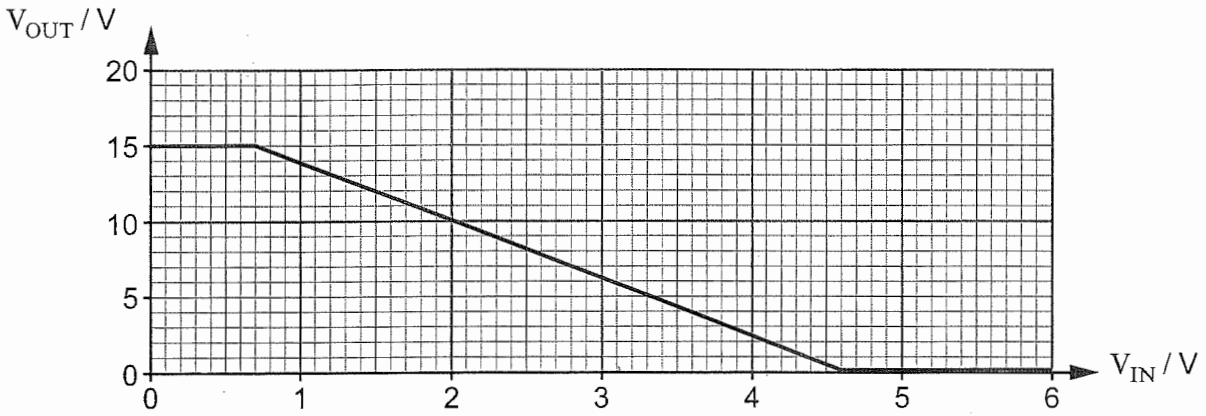


Examiner only

(ii) Determine the current gain ($h_{FE}$) of the transistor. [1]

$h_{fe} = \frac{I_c}{I_b}$ $\frac{0.8\,mA}{64\,mA} = 0.0125$ X

(b) A second graph was drawn to show how $V_{OUT}$ changed as $V_{IN}$ was increased from 0 to 6 V.




Use the graph to determine:

(i) the minimum value of $V_{IN}$ required to saturate the transistor; [1]

4.6 V ✓

(ii) the value of $V_{OUT}$, when $V_{IN}$ = 3.1 V. [1]

6 V ✓

(c) $V_{IN}$ = 3.1 V and the load resistor = 120 Ω.

Calculate the collector current and the power dissipated in the transistor. [3]

$P = VI$ $I = \frac{V}{R} = \frac{3.1}{120} = 0.02583\,A$

$0.08\,W = 3.1 \times 0.02583$ X

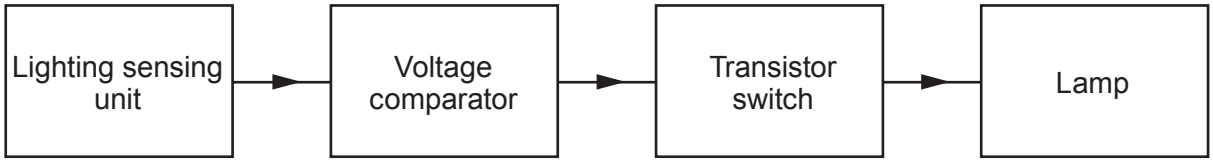
$I_c = \frac{15}{120} = 0.125$ X

(3)

**TURN OVER FOR THE LAST QUESTION.**

Examiner only

**9.** A system is required to turn on a 12 V, 2 A lamp automatically at night.

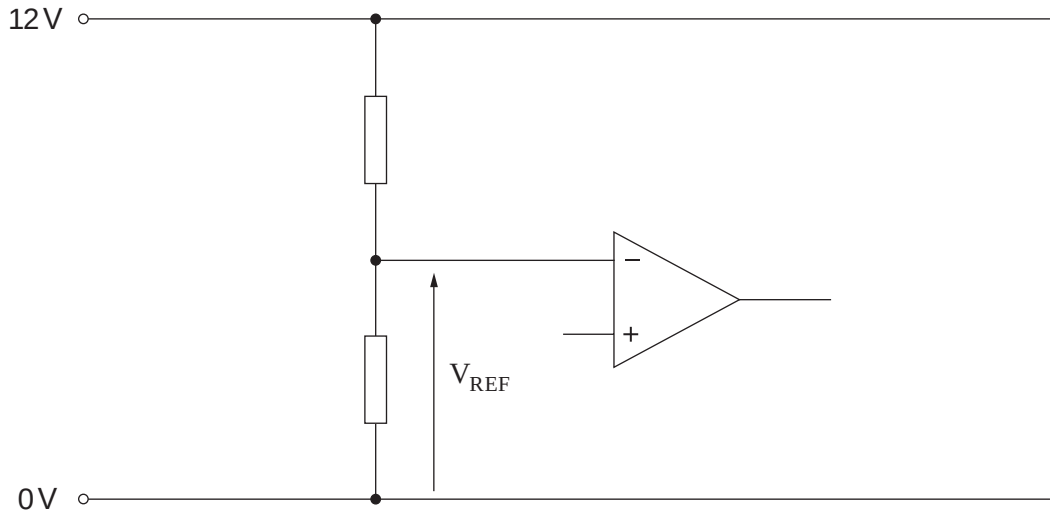



The specification for the system is:

- the system requires a 12 V power supply;
- the light level at which the lamp comes on should be adjustable;
- the lamp is capable of being driven directly from the transistor switch output;
- the voltage comparator reference voltage is 3 V.

Complete the circuit diagram for the system by adding:

- the component values required to provide a reference voltage, $V_{REF}$ = 3 V;
- the light sensing sub-system;
- a facility for adjusting the light level at which the lamp comes on;
- the transistor switch;
- the output sub-system. [7]

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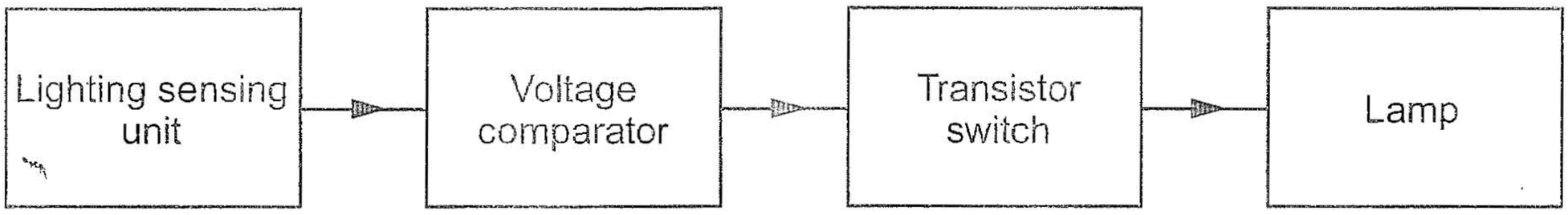


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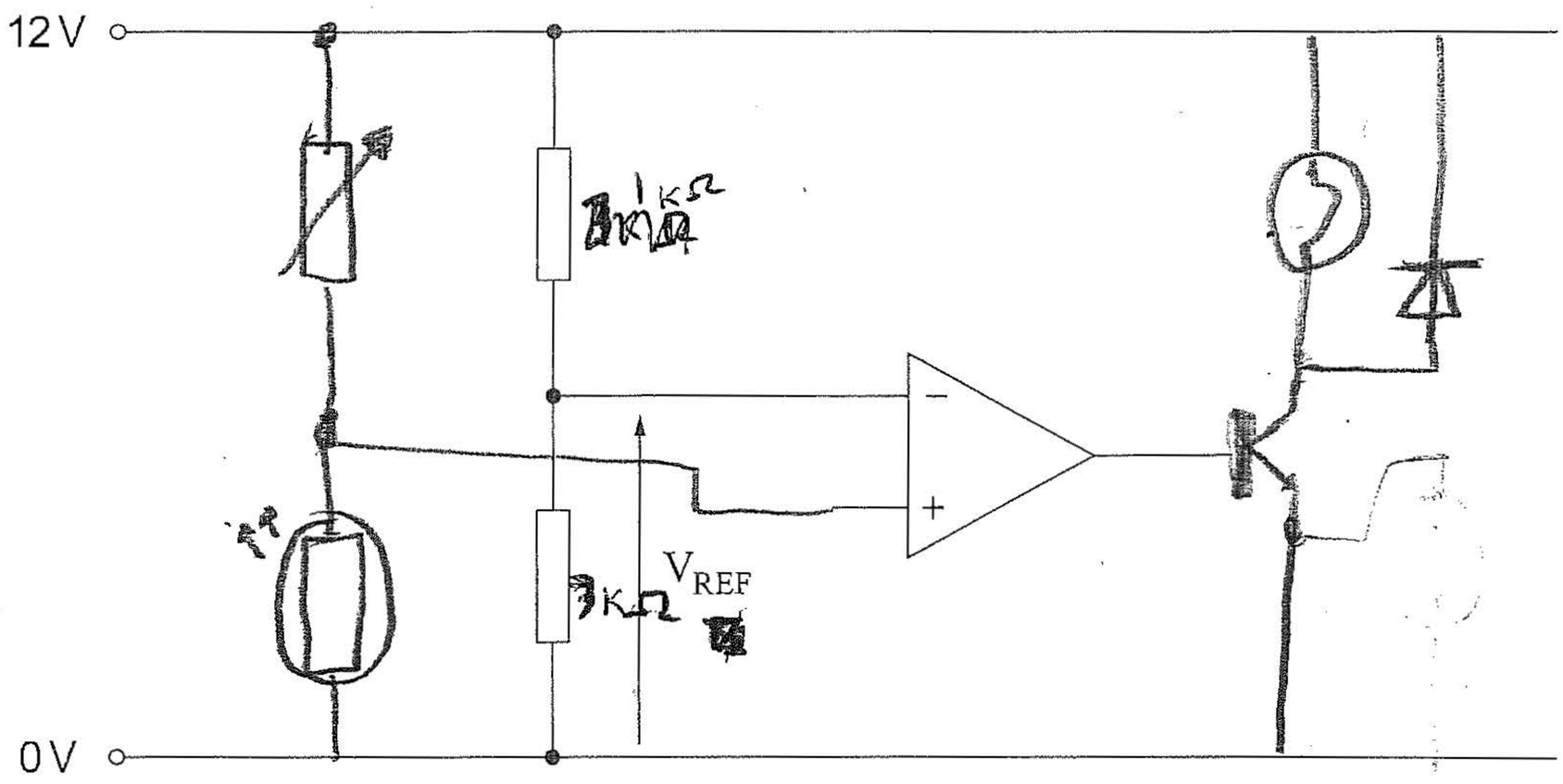


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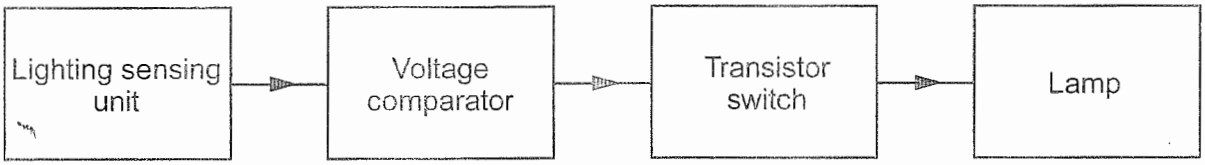


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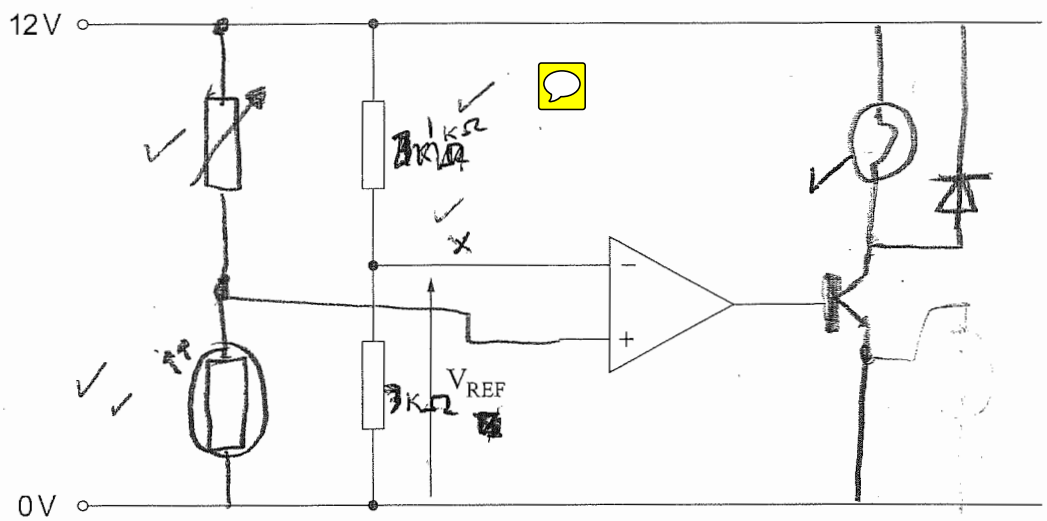
[7] 6

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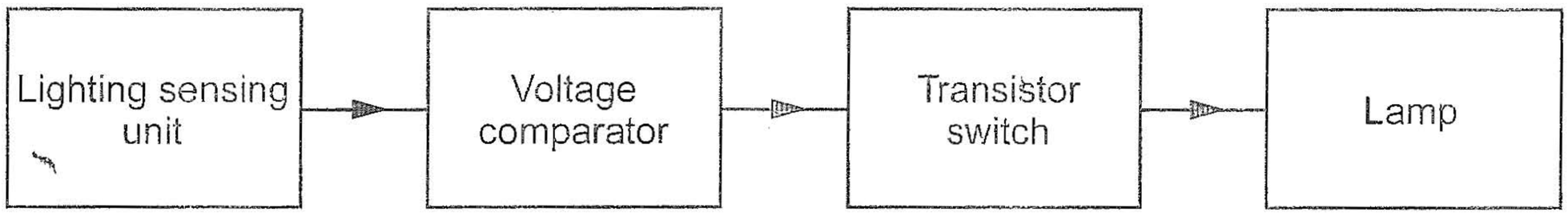


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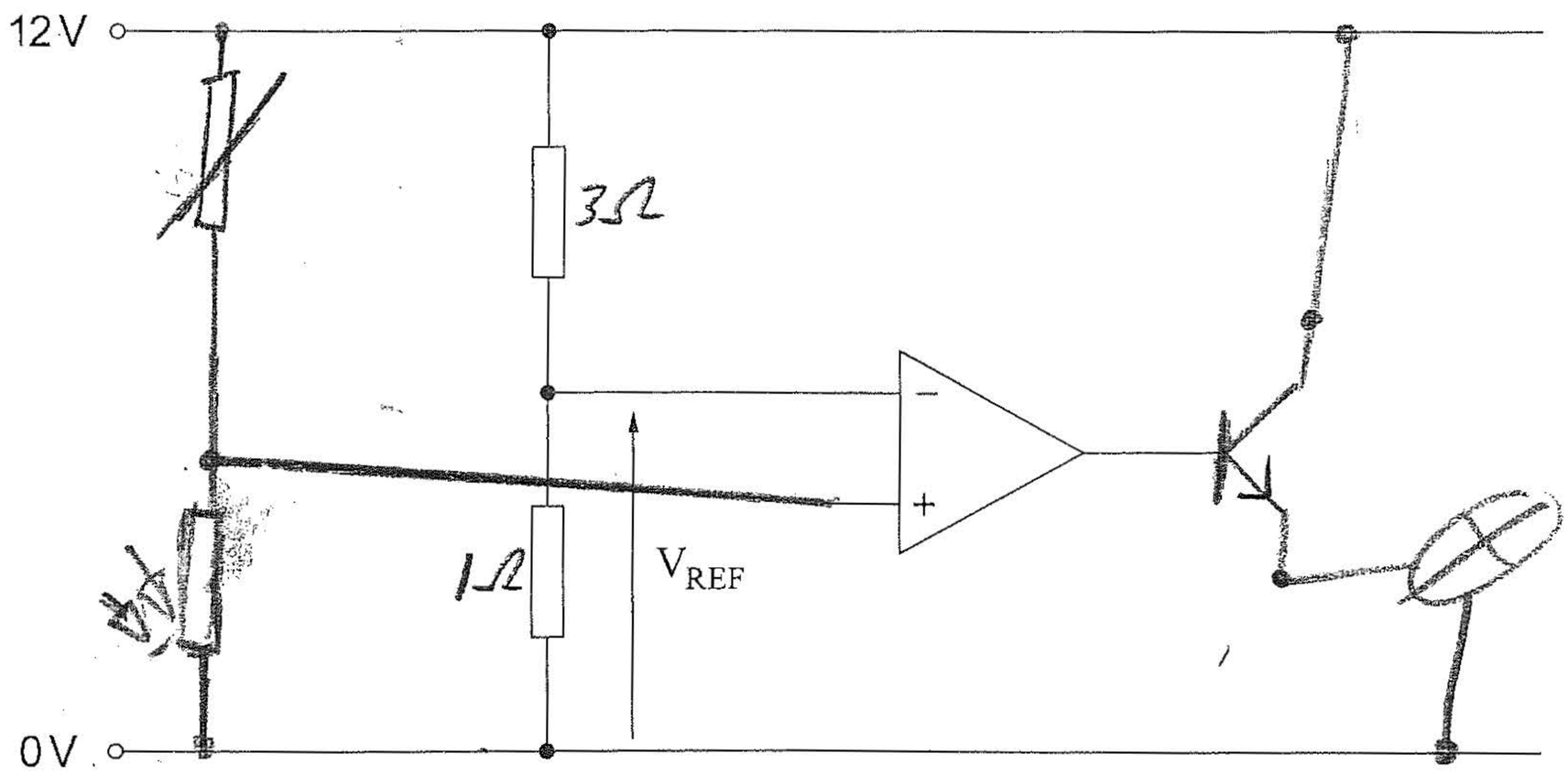


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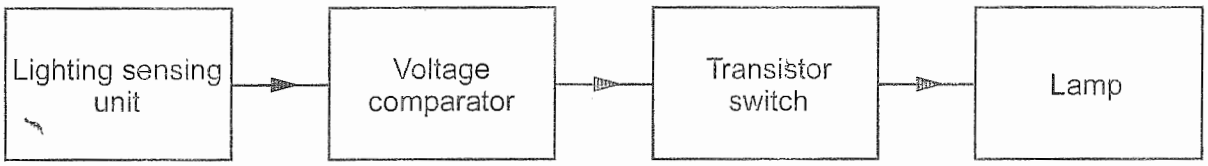


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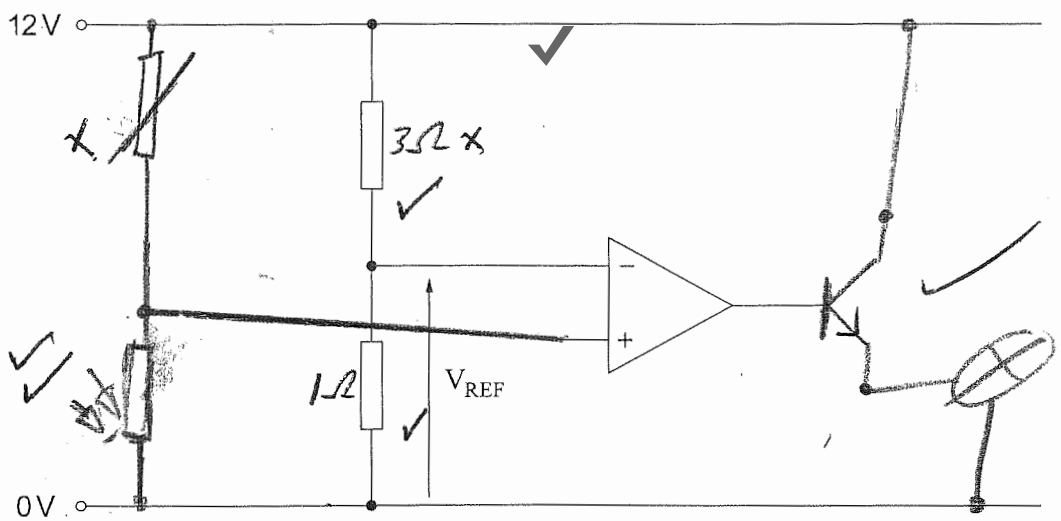
[7] 5

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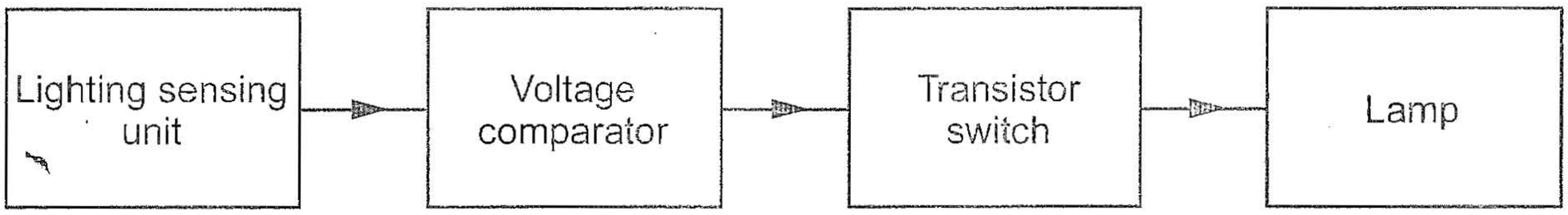


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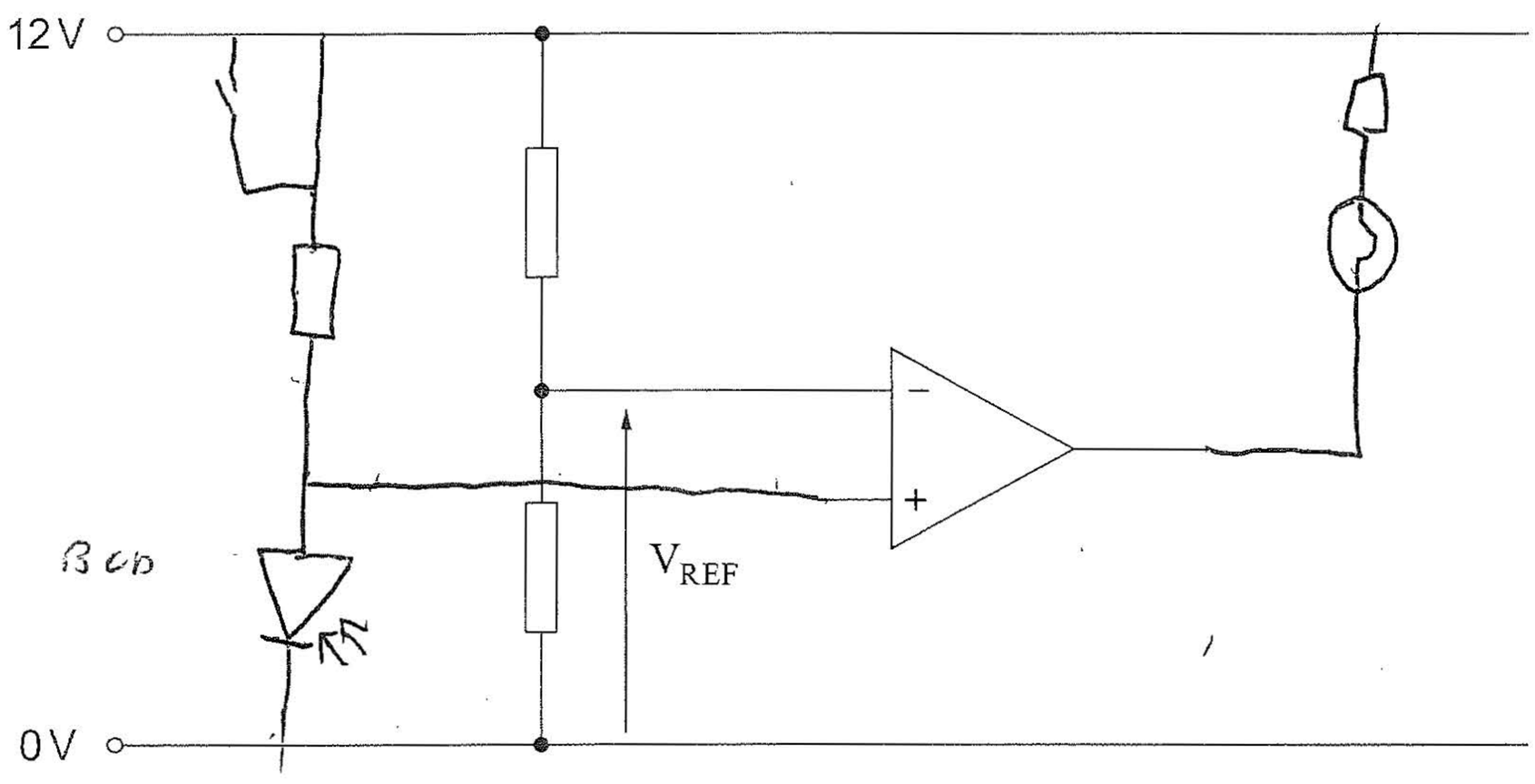


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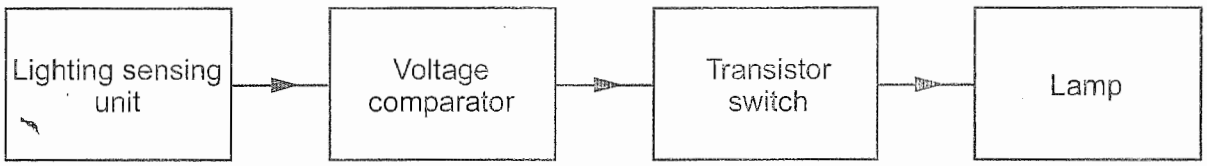


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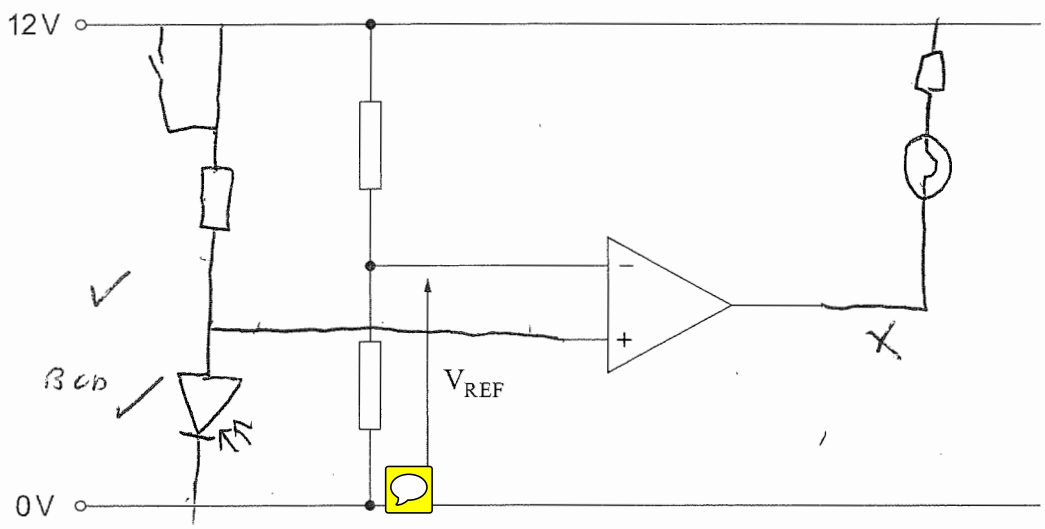


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