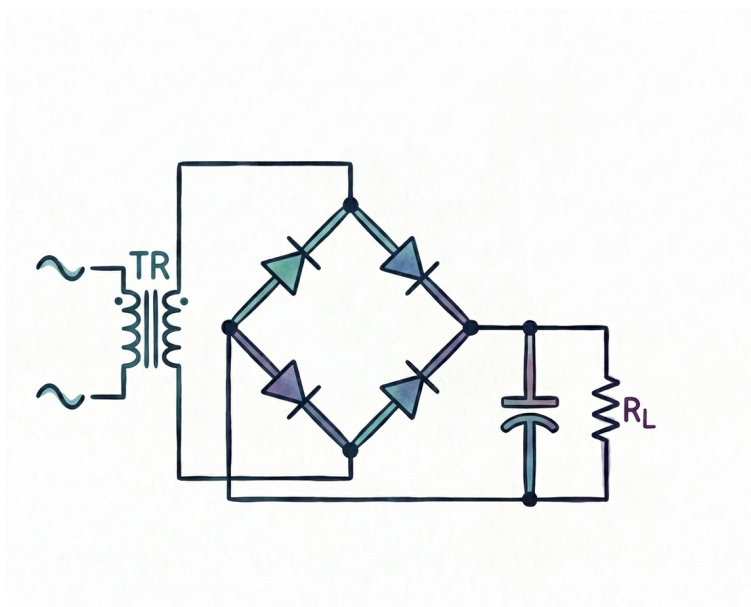


Topic 107 Mains Power Supplies Question Pack

for

Eduqas GCE A-Level Electronics



Student Name:

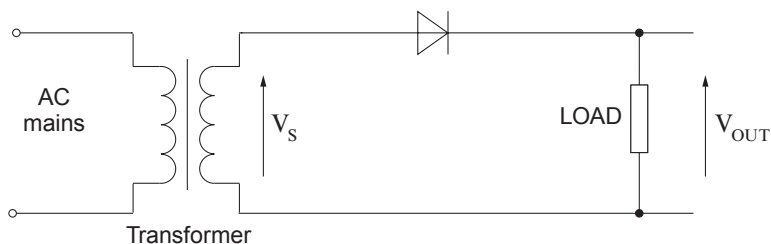
Class / Group:

Question 1

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4. The following diagram shows a half-wave rectified power supply without a smoothing capacitor. The power supply is connected to a load that draws a small current from it.



- (a) The **peak** value of the secondary voltage V_S is 12 V. Calculate:

(i) the **rms** value of the secondary voltage,

[1]

.....

(ii) the **peak** value of the voltage V_{OUT} .

[1]

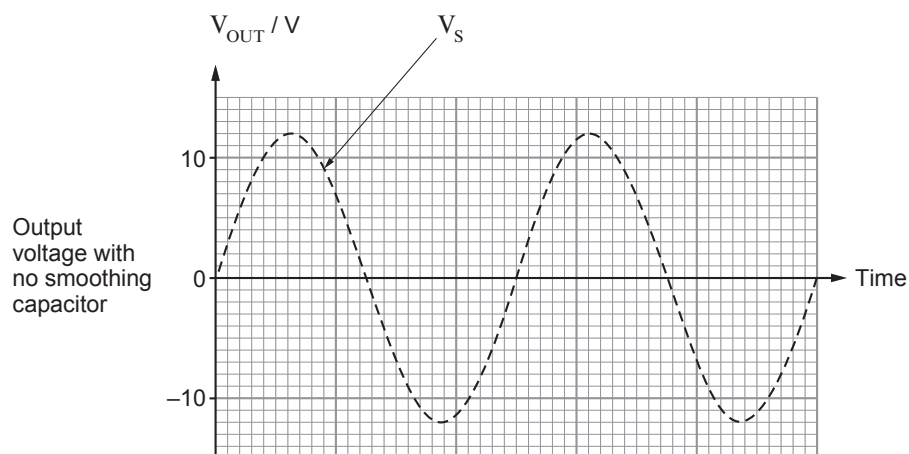
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- (b) A small current flows through the load without a smoothing capacitor in the circuit. On the axes provided below, sketch a graph to show the voltage V_{OUT} .

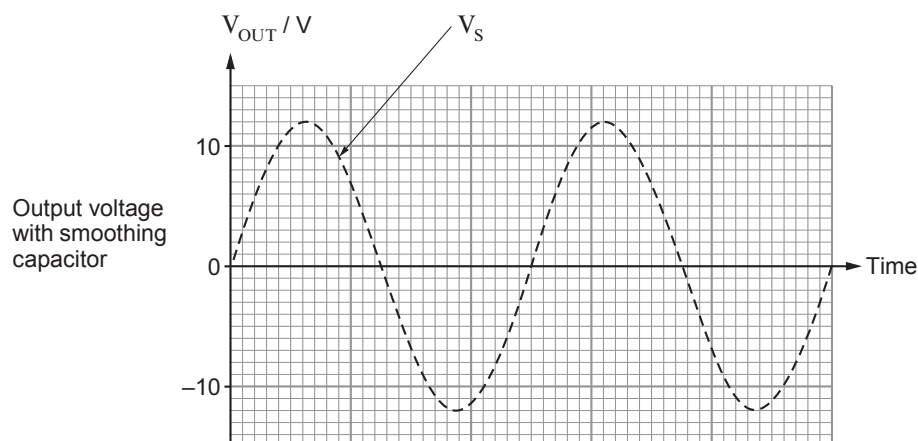
Label any relevant voltages.

[2]

The voltage across the secondary windings of the transformer is shown as a dotted waveform.



- (c) (i) Add a smoothing capacitor to the circuit diagram. [1]
- (ii) Show the effect of the smoothing capacitor on the output voltage. Use the next set of axes to sketch V_{OUT} for this modified circuit when a small current flows through the load. [2]

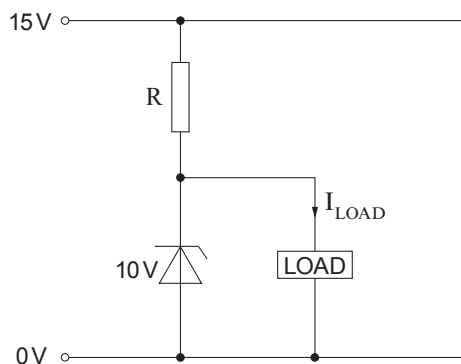


- (d) The half-wave rectifier is replaced with a full-wave rectifier. [2]
- (i) What is the new **peak** value of the voltage V_{OUT} ?
- (ii) What happens to the amplitude of the ripple voltage?

Question 2

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6. The following diagram shows a simple stabilised power supply delivering current I_{LOAD} to a load.

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- The power supply **must** be able to supply a load current, I_{LOAD} , of 120 mA.
- The 10 V zener diode requires a current of at least 5 mA to maintain the zener voltage.

- (a) Calculate the ideal value of resistor R. [3]

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- (b) The current through the load is 50 mA. [3]

- (i) What is the new value of the current through the zener diode?

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- (ii) Calculate the power dissipated in the zener diode.

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

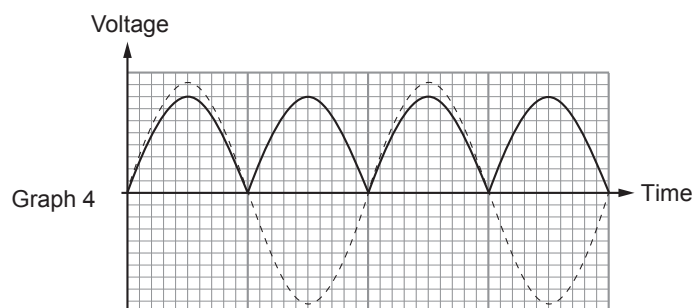
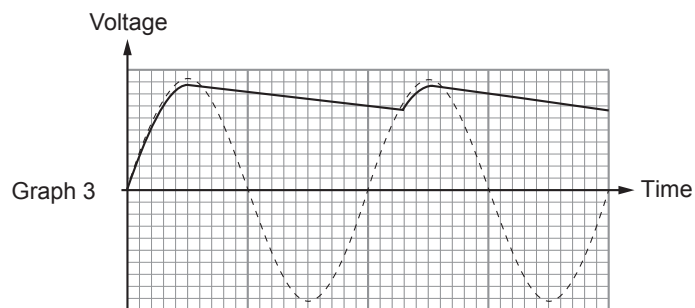
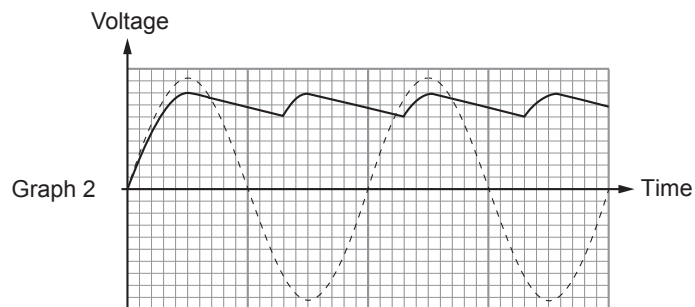
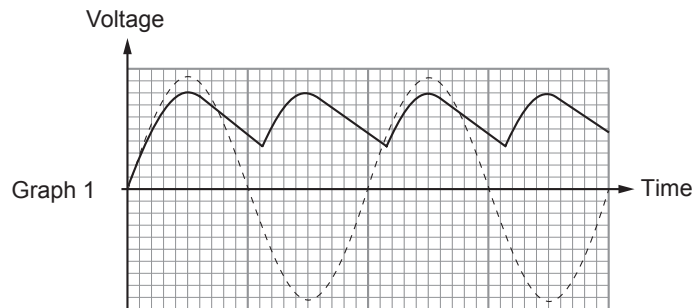
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Question 3

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4. (a) Here are four waveforms produced by various diode rectifiers. All graphs use identical voltage scales and identical time scales. The AC voltage supplied to the diode rectifier is shown as a dotted waveform.



Which graph shows:

(i) The unsmoothed output of a full wave rectifier. [1]

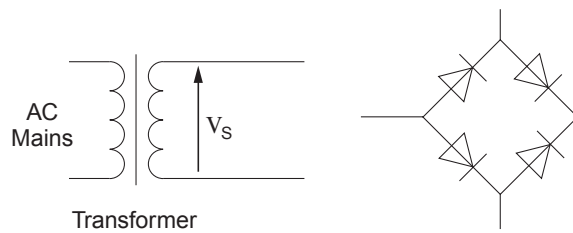
(ii) The smoothed output of a half-wave rectifier with a small ripple voltage. [1]

.....

(iii) The smoothed output of a full-wave rectifier with a large ripple voltage. [1]

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(b) The following diagram shows an incomplete circuit for a full-wave rectified power supply.



(i) Complete the circuit by adding: [3]

- a smoothing capacitor
- a load resistor
- any missing connections

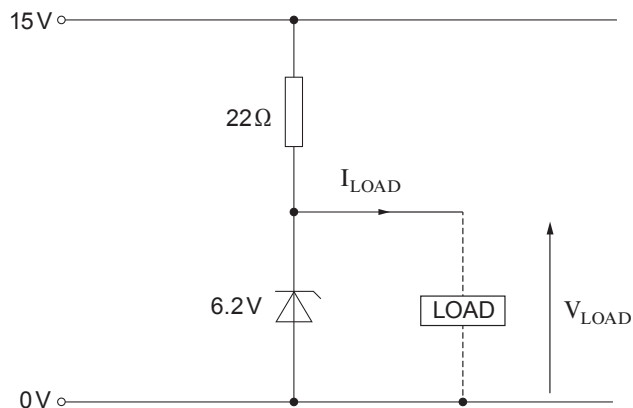
(ii) The **peak** value of the secondary voltage of the transformer (V_s) is 15 V. Calculate the **peak** value of the full-wave rectified voltage. [1]

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Question 4

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7. The diagram below shows a simple regulated power supply providing an output voltage V_{LOAD} . The zener diode requires a **minimum** current of 10 mA to maintain the zener voltage.

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- (a) Calculate the current through the 22Ω resistor when there is no load connected. [2]

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- (b) What is the maximum load current that the power supply can provide whilst still maintaining the zener voltage? [1]

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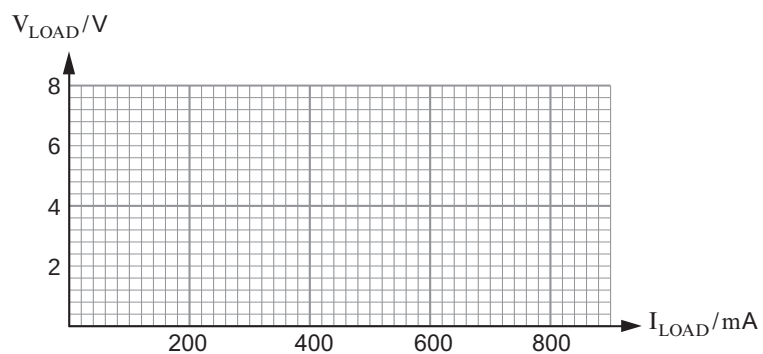
- (c) A low resistance load is connected to the power supply. The zener diode ceases to conduct and the load current increases to 500 mA. Calculate the new value of V_{LOAD} . [2]

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- (d) Sketch a graph to show how V_{LOAD} changes as I_{LOAD} is increased gradually from 0 to approximately 700 mA. [3]

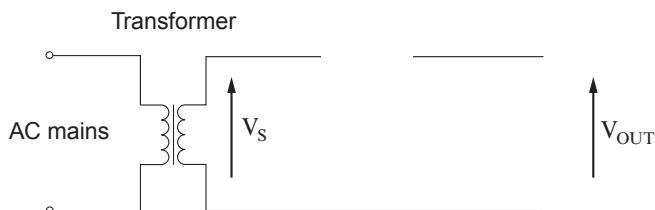
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Question 5

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4. The following diagram shows part of the circuit of a half-wave rectified power supply.



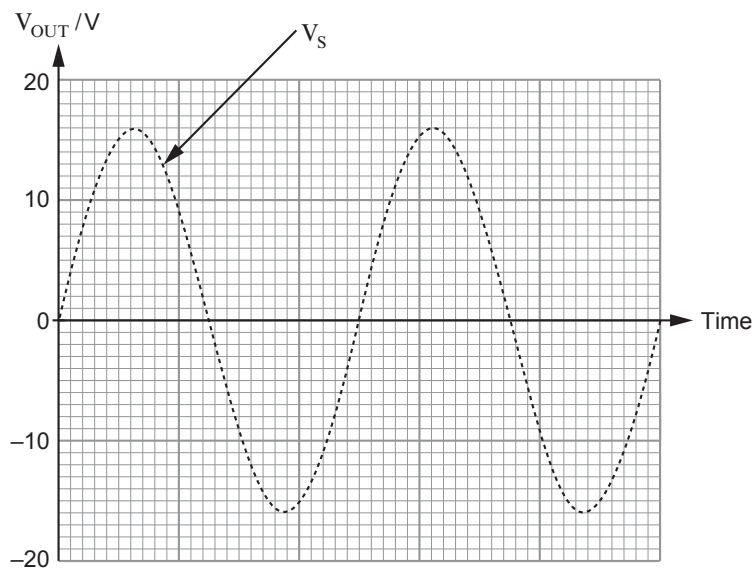
- (a) Complete the circuit by adding: [3]

- a diode to produce the half-wave rectification;
- a capacitor to smooth the output;
- a load resistor.

- (b) In the graph below the voltage across the secondary windings of the transformer (V_S) is shown as a dashed waveform.

- (i) What is the peak value of the voltage V_S ? [1]

- (ii) Use the graph to show the voltage V_{OUT} when the load draws a large current. [3]

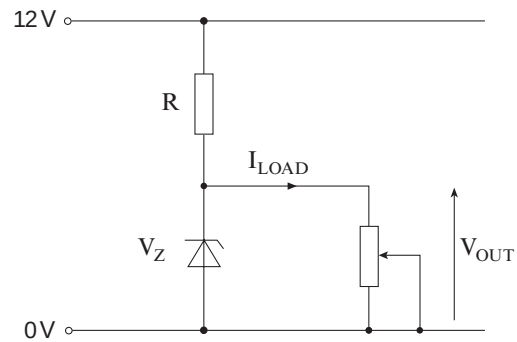


- (c) The amplitude and frequency of V_S remain unchanged.
State **one** way in which the amplitude of the ripple voltage can be reduced in this half-wave rectified power supply. [1]

Question 6

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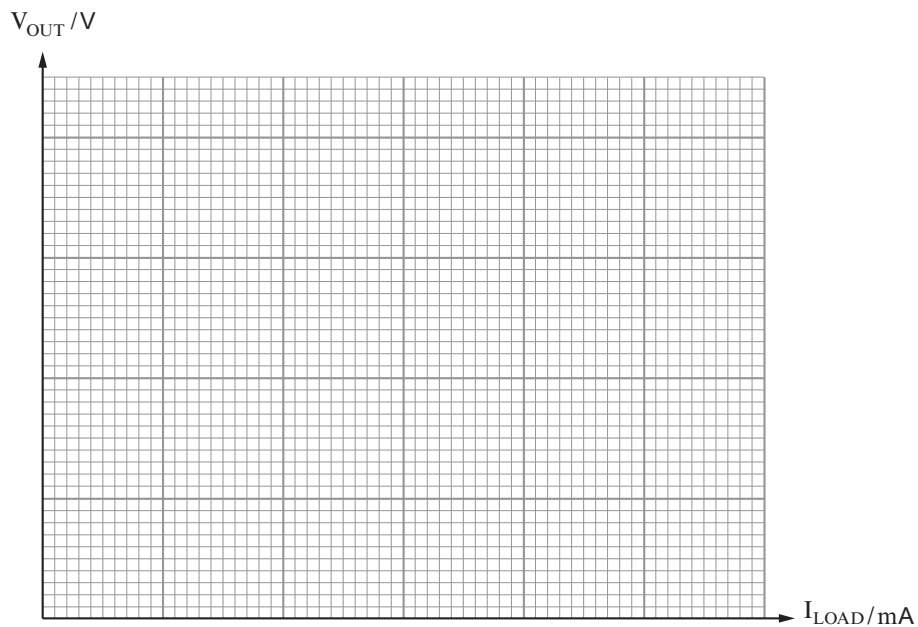
7. A simple regulated power supply is shown below.



The table below shows the results obtained when the output voltage of the power supply is measured at different values of load current:

Load current (mA)	Output voltage (V)
0	3.95
50	3.94
100	3.93
150	3.92
200	3.91
250	3.91
300	3.04
350	1.44
400	0.00

- (a) Plot a graph of V_{OUT} against I_{LOAD} on the axes below. Label both axes with your chosen scale. [2]



- (b) Use the graph to determine:
- (i) the zener reference voltage V_Z [1]
 - (ii) the maximum load current that the power supply can provide whilst still maintaining the zener voltage. [1]

- (c) Calculate the resistance of resistor R. [2]

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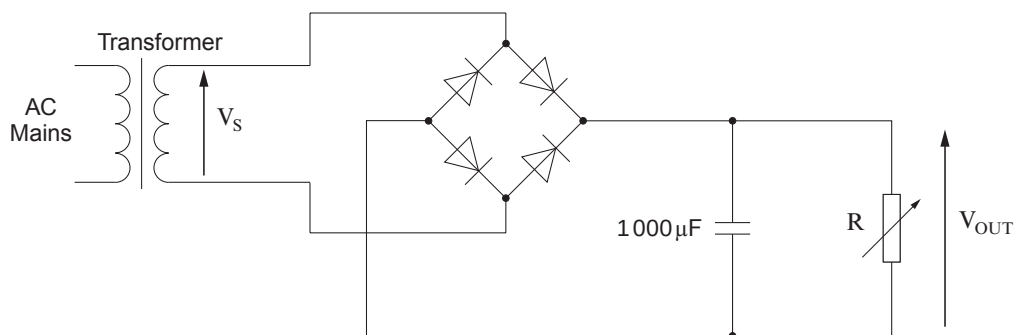
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Question 7

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4. The following diagram shows the circuit of a full-wave rectified power supply connected to the 240 V, 50 Hz AC mains.



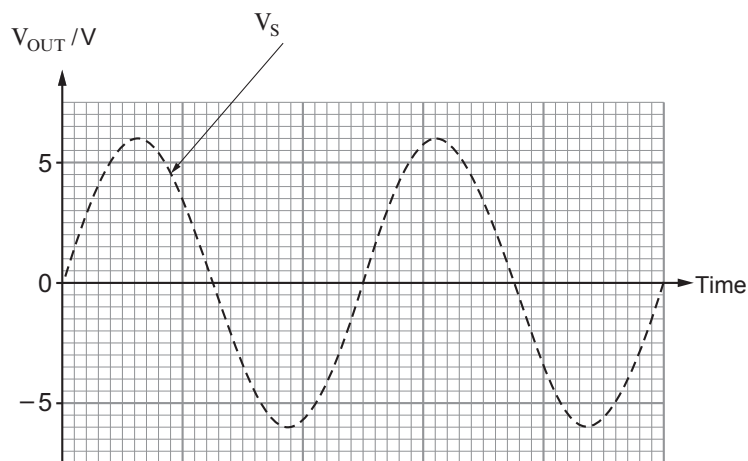
- (a) In the graph below the voltage across the secondary windings of the transformer (V_S) is shown as a dotted waveform and has a peak voltage of 6 V.

(i) What is the **peak** value of the voltage V_{OUT} ?

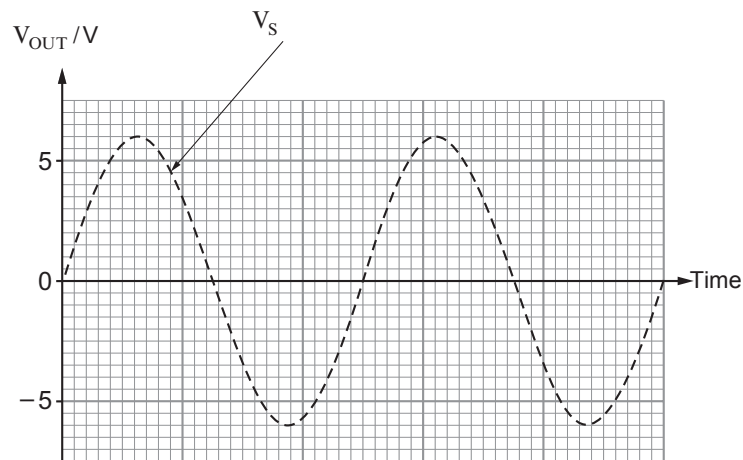
[1]

- (ii) On the axes provided below sketch the graph to show the output voltage V_{OUT} when a small current flows through the load resistor, R.

[2]



- (b) R is adjusted to allow a large load current to flow. Use the axes below to sketch the resulting voltage V_{OUT} . [1]



- (c) The $1000\mu\text{F}$ capacitor is replaced with a $2200\mu\text{F}$ capacitor. [2]

(i) What happens to the amplitude of the ripple voltage?

(ii) What is the frequency of the ripple voltage?

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