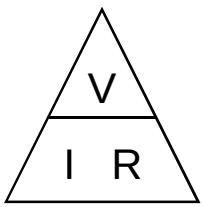
Formulas

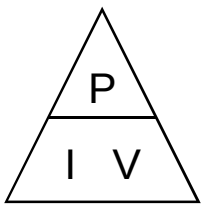
Transformer ratios

$$\frac{\text{Primary voltage}}{\text{Secondary voltage}} = \frac{\text{primary winding}}{\text{secondary winding}}$$

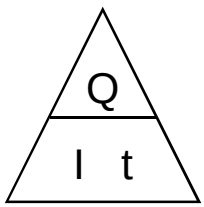
Ohms Law



Power Law



Charge



Frequency

$$t = \frac{1}{f}$$

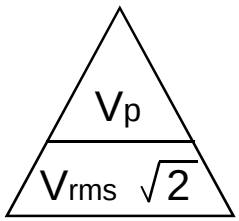
t = cycle time
f = frequency

Ripple Voltage

$$V_r = \frac{I\,t}{C}$$

t = cycle time
C = capacitance

AC voltage



Transistor current

$$I_e = I_b + I_c$$

Transistor gain

$$I_c = I_b \; hfe$$

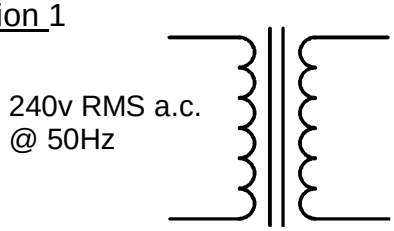
Transistor voltage

$$V_b = V_e + 0.7$$

ELECTRONICS A-LEVEL - POWER SUPPLY UNIT ASSESSMENT

Answer all questions.
Do not write on this paper. Provide your answers on a blank sheet of lined or plain paper.
When producing drawings and diagrams, use a sharp pencil and ruler where appropriate.

Question 1



Turns ratio 30:1

On the left is an a.c. transformer with a primary and secondary winding. They have a ratio of 30:1. The transformer primary is connected to a 240v a.c. supply whose frequency is 50 Hertz.

a) Calculate the RMS voltage in the secondary winding.

[1]

b) Calculate the peak voltage in the secondary winding.

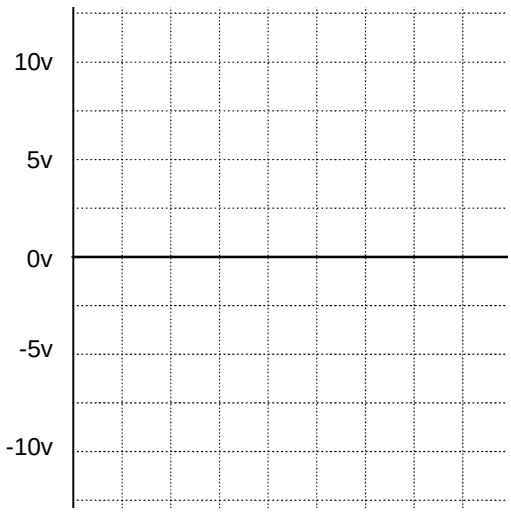
[1]

c) Calculate the cycle time of the secondary a.c. voltage

[1]

d) Copy out the grid below and draw the wave you expect to see on the secondary winding.

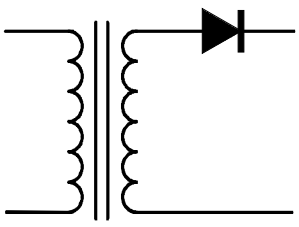
[2]



X axis: 5ms per division

Y axis: 2.5 volts per division

A diode is added as shown



e) What effect will the diode have on the peak voltage?

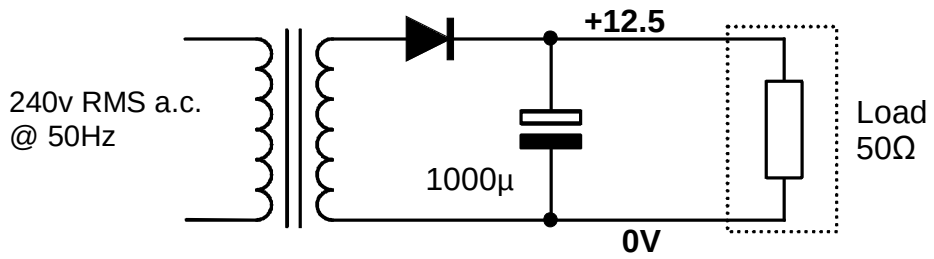
[1]

f) Draw on the same grid as d) the wave you would expect to see with the diode added.

[2]

Question 2

A supply is connected as shown. It has a secondary voltage rated at 12.5 volts and is smoothed using a 1000µF capacitor. This can be measured at +V.
Connected to the supply is a load of 50 Ω.



With the load connected,

a) calculate the current flowing through the load resistance.

[1]

b) calculate the ripple voltage.

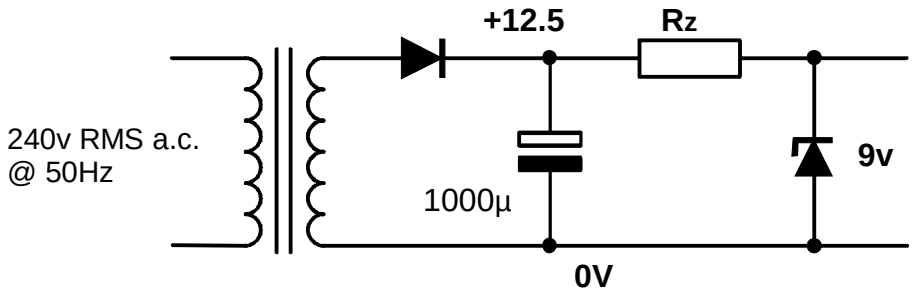
[1]

c) How could you reduce the ripple voltage?

[1]

Question 3

The load is removed and a 9 volt zener diode regulator is added as shown below.



a) What does the zener diode do?

[1]

b) This supply must be capable of producing a maximum of 20mA at 9v. What value must resistor Rz have?

[1]

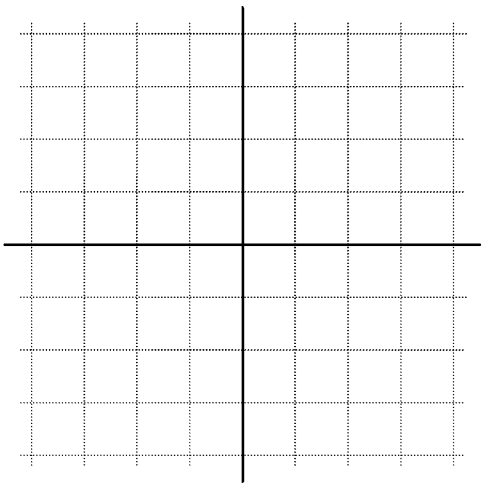
c) Calculate the power dissipated in the zener diode when there is no load connected

[1]

d) Redraw the circuit diagram of the supply using an NPN transistor to improve the current capability of the supply.

[2]

Question 4



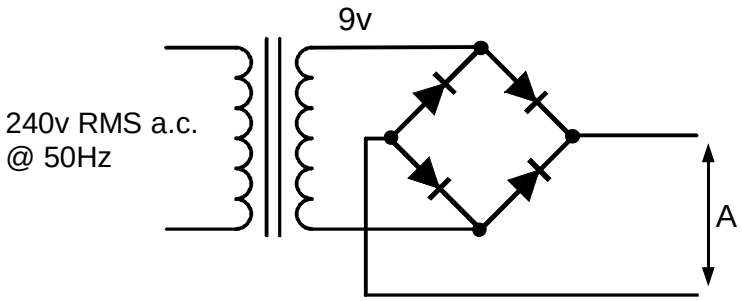
a) Copy out the graph to the right. Draw out the current-voltage characteristics of a zener diode.
[2]

b) On your diagram, indicate where the breakdown point is.
[1]

C) What is meant by 'reverse bias'?
[1]

Question 5

Below is a transformer with a bridge rectifier connected. The secondary voltage is 9 volts RMS.



a) What is the peak voltage you would expect to see across point A?
[1]

b) Why are bridge rectifiers a more efficient way of rectifying a.c. waves rather than using just one diode?
[1]

c) Draw the approximate shape of the wave you would expect to see at point A.
[1]

d) What is meant by the term – split power supply?
[1]

e) Draw a circuit diagram of a split power supply. The output must be rectified and smoothed.
[3]

End of test.