



**Complete, fold and seal**  
(see note 2 below)

FORENAME(S): Nathan

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over the label provided and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

38.75%

38.75%

1.

$$P = 270 \text{ kW}$$

$$V = 25 \text{ kV}$$

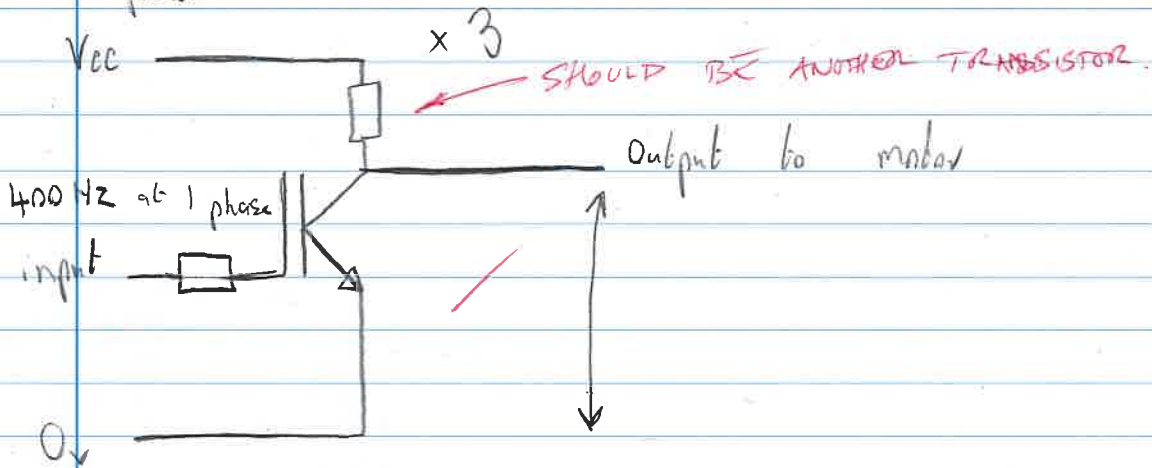
$$400 \text{ Hz}$$

$$\text{Switch } f = 15 \text{ kHz}$$

$$I = 10.8 \text{ A}$$

~~A Mosfet could be used within this circuit as a mosfet~~

An IGBT transistor should be used within this circuit as it allows for high voltage. Along with medium switching speed.



I WOULD HAVE EXPECTED MORE DETAIL ON REASONS FOR TRANSISTOR CHOICE AND CIRCUIT OPERATION.

Agree completely

1

2

Maximum power point tracking (MPPT) is a process in which specific parameters such as voltage and current of a solar array are observed. Depending on the value of these parameters the resistance of the array is then changed. MPPT comes in three types which each observe different parameters about an array, these will be listed below with explanations about them.

### Perturb and observe

This method changes the voltage of the array incrementally to calculate power. If when this value is increased and the power changes the voltage continues to be increased incrementally until the power ceases to change. This method also produces oscillating outputs. This method is the most commonly used of the three because of its ease of implementation.

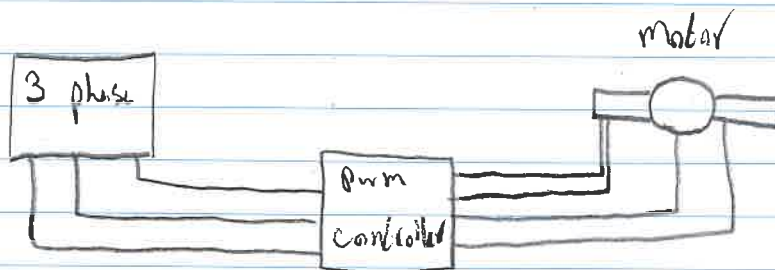
### Incremental Conductance

Like perturb and observe (P&O), this method changes the voltage in small increments but also changes the current. This method can also produce oscillating outputs. As this method changes two parameters about the array it's more accurate compared to the P&O method. This method also does not need to oscillate its output to calculate MPP unlike the P&O method.

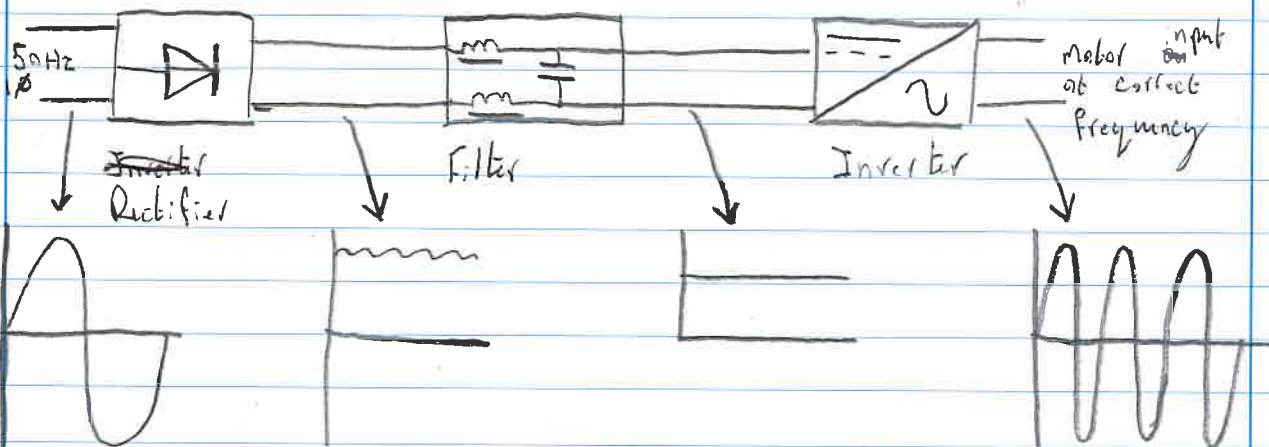
### Current Sweep

Different to the last two methods this method uses a wave sweep to calculate the power created.

a)



PWM controller



(4)

4

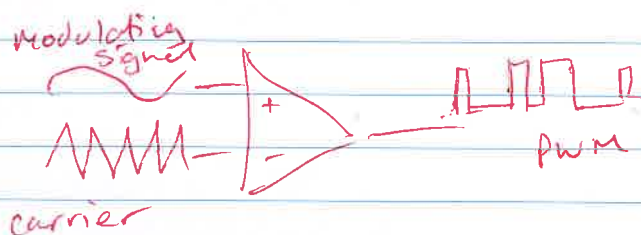
b)

To control the speed within an AC motor using a variable frequency drive the frequency needs to be altered. Increasing the frequency allows for an increase in speed which decreasing the frequency decreases the speed. As for the torque the voltage and current input into the VFD will need to be altered.

(6)

6

was looking for detail on how the PWM signal is generated similar to this



Agree

Full step - In full step mode ~~two~~ pairs of coils are excited at the same time, these normally being opposite coils. As each pair are excited they attract the rotor in a direction creating rotation within the motor. This means the motor is at full torque.

Half step - Half step is a mode in which only one coil is excited at any one time. As each individual coil is excited either clockwise or anti-clockwise, the coils attract the rotor in that direction creating rotation within the motor. As this method only uses one coil at a time the rotor only has half the torque the motor can produce.

REQD. TIMING DIAGRAM + ~~NOTE~~

Agree

1/2 STEP = ALL COILS ACTIVATED TOGETHER.

4