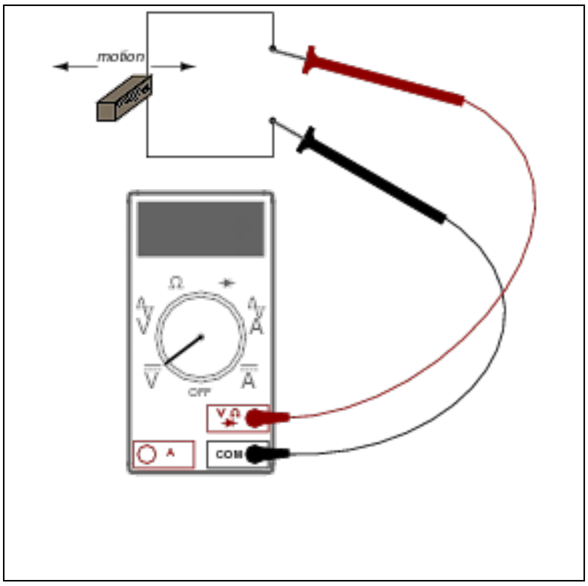
CORPUS CHRISTI COLLEGE SEQUERE DOMINUM	**Year 12** ***ATAR* Physics Unit 3** **2017** ***TEST 5*** ***Electromagnetism 2*** ***5.0%*** **NAME: ……………………………………………………** Data: See Data Sheet Approx. marks shown. ***(55 marks)***

When calculating numerical answers, show your working or reasoning clearly. Give final answers to **three** significant figures and include appropriate units where applicable.

When estimating numerical answers, show your working or reasoning clearly. Give final answers to a maximum of **two** significant figures and include appropriate units where applicable.

1. By moving a permanent magnet sideways perpendicularly past a wire, a voltage will be generated between the ends of that wire.



(a) Describe what factors determine the polarity and magnitude of this voltage. [4]

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(b) In the diagram given, when moving the permanent magnet sideways to the ***left***, the red probe attached to the positive jack of the voltmeter produces a positive reading.
Which pole of the magnet is closest to the wire? [1]

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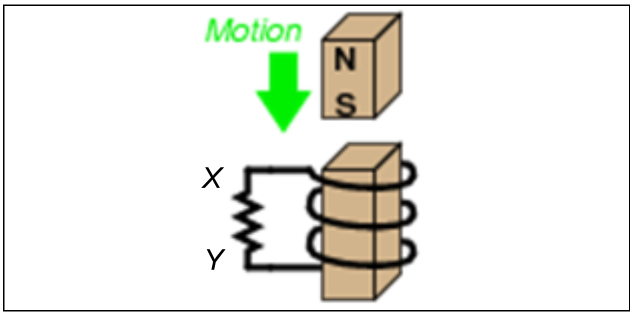
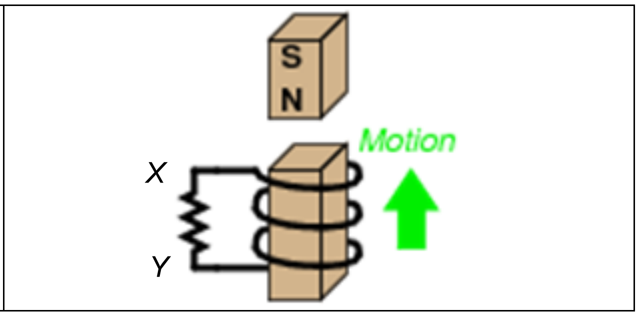
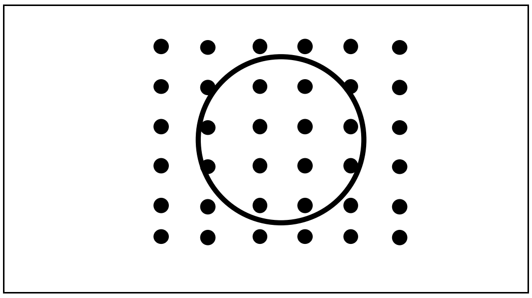
2. In each of the diagrams below clearly show the direction of the induced current through the resistor XY when the magnet moves relative to the coil as shown. [2]





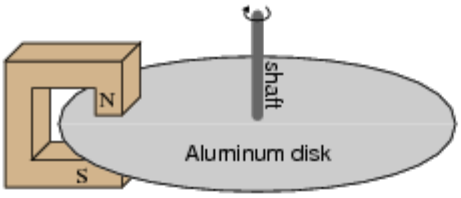
3. Consider the coil of wire located the magnetic field shown.



(a) How many turns of wire must the coil have in order to induce a voltage of 10.5 volts when exposed to a magnetic flux decreasing at a rate of 0.0075 Wb s^{-1}? [3]

(b) On the diagram above clearly show the direction of the induced current in the loop. [1]

4. Electromechanical watt-hour meters use an aluminium disk that is spun by an electric motor. To generate a constant "drag" on the disk necessary to limit its rotational speed, a strong magnet is placed in such a way that its lines of magnetic flux pass perpendicularly through the disk's thickness:



(a) Using the laws of induction explain the phenomenon behind this magnetic "drag" mechanism. [5]

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(b) Explain how the permanent magnet assembly should be re-positioned so that it provides *less* drag on the disk for the same rotational speed. The poles of the magnet remain completely over the disk. [2]

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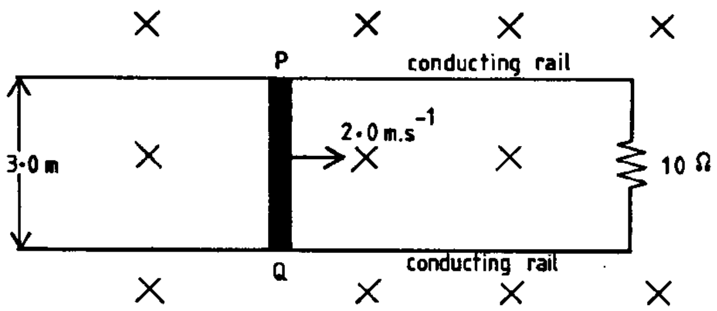
5. The diagram below shows a conducting bar PQ moving with constant speed, 2.00 m s^{-1}, along two parallel conducting rails 3.00 m apart. The ends of the bar touch the rails. The rails are connected by a 10.0 Ω resistor, as shown. The resistance of the bar and rails is negligible.

There is a uniform magnetic field of magnitude 0.50 T perpendicular to the bar and the rails. This field is directed into the page.



(a) What is the magnitude of the EMF induced in the bar? Show your working. [2]

(b) What is the magnitude of the force required to keep the bar moving? Show your working. [2]

(c) The rails are frictionless and there is good electrical contact between the bar and the rails. Why is it necessary to apply a force to keep the bar moving at a constant speed? [2]

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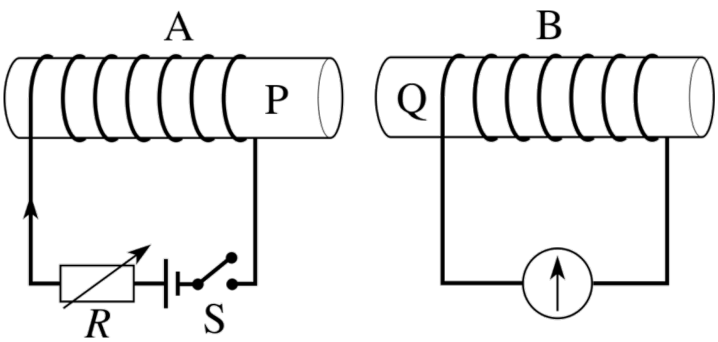
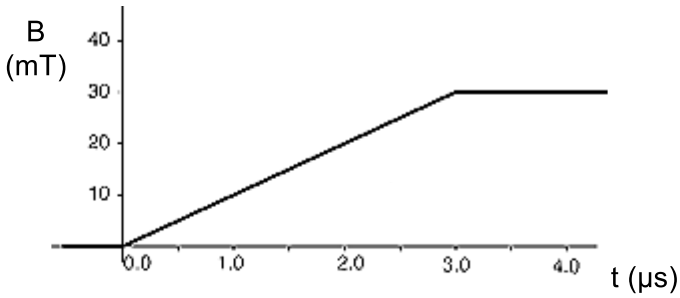
6. Two coils A and B are placed closed together, as shown below. P and Q are soft iron cores.



(a) Show the direction of the current induced in coil B when the switch in coil A is closed. [1]

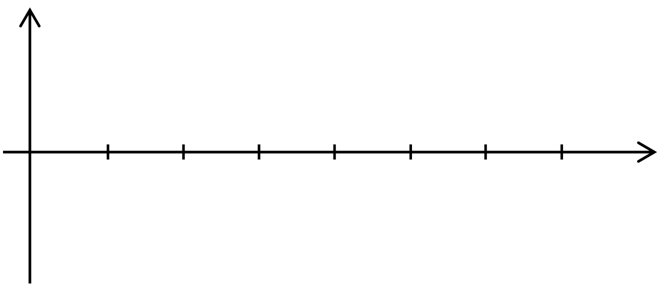
(b) The graph below shows how the magnet field strength changes in coil A when the switch closes.



Assume that all of the magnetic flux from coil A passes through coil B which has an area of 5.0 cm^2.

(i) Calculate the emf induced in coil B. [5]

(ii) On the axes below draw the graph of the emf calculated in (i). [3]
[t = 0 s when the switch is closed.]



7. (a) A generator has a rectangular coil of side 15 cm by 12 cm that lies perpendicular to a magnetic field of flux density 4.0 T. What is the magnetic flux passing though the coil? [2]

(b) The coil, consisting of 20 turns of wire, is rotated and generates a peak emf of 63.5 V. Calculate the frequency with which it is being rotated. [2]

(c) The coil of the above generator is shown below. In Figure 7A the coil is connected to slip rings. In Figure 7B the coil is connected to a split commutator.

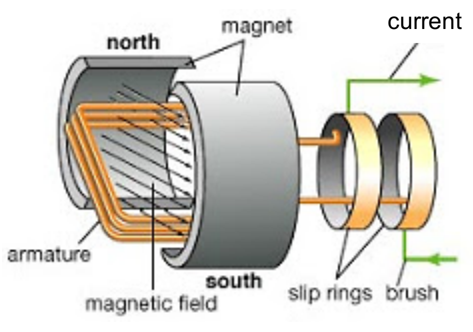


Fig 7A

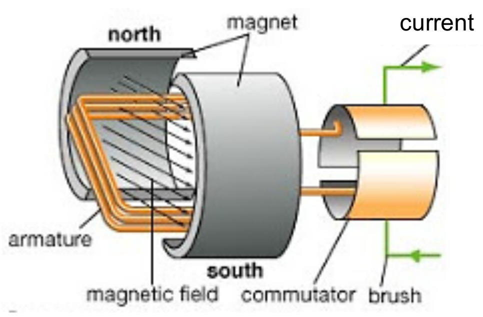


Fig 7B

(i) On Figure 7A ***clearly*** show the direction of rotation of the coil that induces the direction of the current shown on the diagram. [1]

(ii) On the axes below draw the graph of the emf induced by during one rotation of each of the generators above. Assume that time t = 0 s when the coil is located in the position shown in Figure 7A and in Figure 7B.

Also indicate ***clearly*** on the graph the time when the plane of the coil is parallel with the magnetic field. [5]

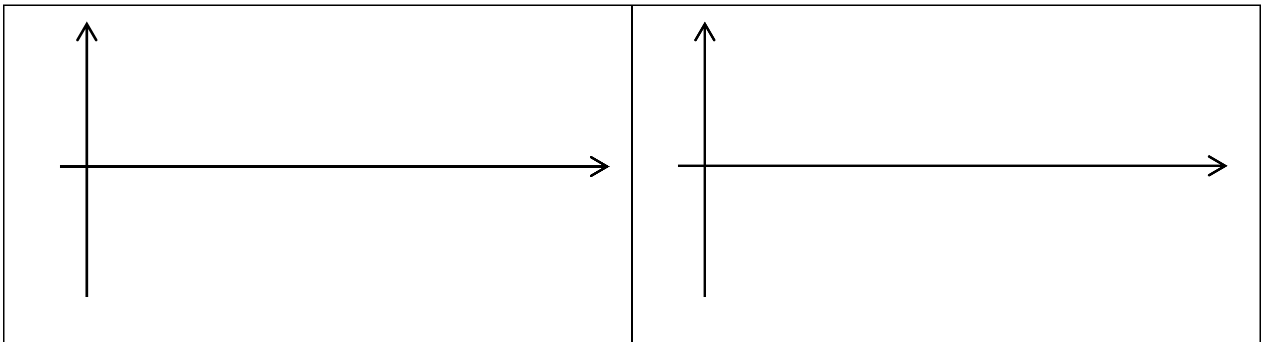
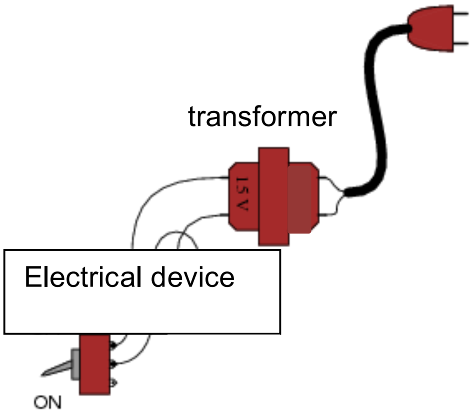


Fig 7A **Fig 7B**

8. The following transformer is required to operate a 15 V AC device, as shown, in WA.



(a) Determine the turns ratio: $N_s : N_p$ for the transformer. [2]

(b) Some transformers can be up to 98% efficient. Describe 2 methods used in the construction of transformers to produce this efficiency. [2]

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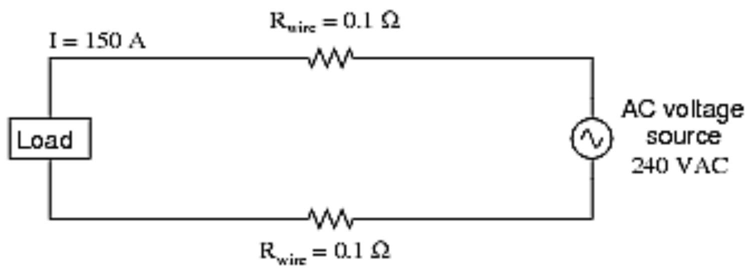
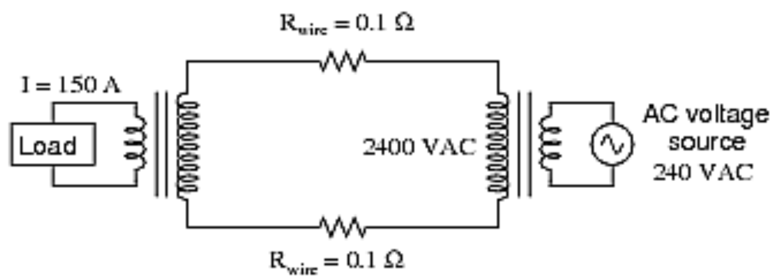
9. Suppose a power system were delivering AC power to a resistive load drawing 150 amps:



(a) Calculate the load voltage and the load power dissipation. [3]

(b) Now, suppose we were to use a pair of perfectly efficient 10:1 transformers to step the voltage up for transmission, and back down again for use at the load.



Calculate the load voltage, load power and the wasted power of this system. [5]