TUTORIAL - MAGNETS AND MAGNETISM

NAME:-

Please note the following requirements in relation to tutorial work -

- All tutorial work is to be completed on ruled A4 pad paper, with multiple pages stapled together. Write on one side only of the answer sheets. Put your first 7 last names on each sheet.
- All work is to be completed in ink.
- In the case of multiple choice type questions, the question number and answerletter are to be written on the answer sheet.
- All relevant equations and working are to be shown in the case of calculation typequestions.
- All diagrams are to be drawn using appropriate drawing instruments. Drawings arenot to be freehand.

Section A

In the following statements one of the suggested answers is best. Place the identifying letter on your answer sheet.

Magnets are classified as either______magnets or_______magnets.

(a) temporary, electro-.

(b) electro-, induced

(c) permanent, temporary

(d) induced, temporary

Magnetic properties state that like magnetic poles______each other, whilst_______poles ______ each other.

(e) repel, unlike, attract.

(f) attract, unlike, repel.

(g) repel, equal, attract.

(h) repel, neutral, attract.

The north pole of a magnet is said to be:

(i) north repelling, repelling the earth's north magnetic pole.

(j) north seeking, seeking the earth's north magnetic pole.

(k) south seeking, seeking the earth's south magnetic pole.

(l) north repelling, seeking the earth's south magnetic pole.

A an example of a material which will have a magnetic field induced into it whilst under the influence of an adjacent magnet is:

(m) copper.

(n) wood.

(o) soft iron.

(p) aluminium.

The opposition of a material to becoming magnetised is known as:

(q) impedance.

(r) reluctance.

(s) resistance.

(t) inductance.

A piece of_______will have a lower amount of residual flux when compared to a piece of _____ when the magnetic influence is removed.

(u) hard steel, soft iron.

(v) soft iron, copper.

(w) hard steel, copper.

(x) soft iron, hard steel.

Magnetic flux is measured in:

(y) Webers.

(z) Teslas.

(aa)

Henries

.(bb) Ohm's.

Flux density is a measure of the amount of :

(cc) magnetic flux.

(dd) reluctance per unit area.

(ee) magnetic flux per unit area.

(ff) inductance flux per unit area.

Flux density is measured in:

(gg) Henries.

(hh) Ohm's.

(ii) Webers.

(jj) Teslas.

Retentivity is an indication of how much:

(kk) magnetism is required to magnetise a material.

(ll) residual magnetism a material will have.

(mm) magnetism is required to de-magnetise a material.

(nn) residual magnetism a material will lose.

Section B:

Blank spaces in the following statements represent omissions. Write the appropriate information.

The laws of magnetism state that magnetic lines of force never_______, they are _____ and unbroken, they can be_______indefinitely, and are said to flow externally from the ______ to the_______.

The greatest concentration of flux in a magnet will be at the ______

Laws of magnetism state the_______poles repel, and_______will_______each other.

List two materials that are:

(oo) ferromagnetic.

(pp) non-magnetic.

Reproduce the diagram of figure 28 on your answer sheet using drawing instruments to complete your drawing. Show the field pattern produced by the permanent magnet, and label all magnetic poles.

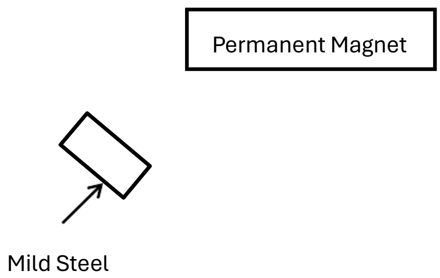

Figure 28

Many of the following equations will be encountered in work on magnetism. Transpose the equations as required.

(qq) MMF = I x N, I = ? (Note: mmf stands for "magneto-motive-force")

(b) $H = \frac{I \times N}{l}$ N = ?

(c) $\Phi = \frac{mmf}{S}$ S = ?

(d) $B = \frac{\Phi}{A}$ Φ = ?

(e) $L = \frac{\mu \times N^2 \times A}{l}$ N = ?

(f) $e = N \times \frac{\Delta\Phi}{\Delta t}$ N = ? (Note: Δ (delta) means a "change in" ie change in time)

(g) $L = N \times \frac{\Delta\Phi}{\Delta I}$ ΔI = ?

SECTION C

The following problems are to be solved with the aid of a calculator. All equations and working are to be shown.

The flux produced by a magnet is 10mWb. Determine the flux density if the area of the pole is 250 mm^2 (40T)

For the magnet in the previous question, determine the flux density away from the pole if the flux now spreads out to an area of 600 mm^2. (16.7T)

Determine the flux of a magnet if the flux density at the poles is 2T, and the area of the poles is $300mm^2$. (600μWb).

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TUTORIAL – ELECTROMAGNETISM

NAME:- ____

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Section A

In the following statements one of the suggested answers is best. Place the identifying letter on your answer sheet.

1. The magnetic field surrounding a single current carrying conductor is:

   (a) circular and independent of the direction of current flow.

   (b) circular and dependent of the direction of current flow.

   (c) axial and independent of the direction of current flow.

   (d) axial and dependent of the direction of current flow.

2. The direction of the magnetic field around a single current carrying conductor can bedetermined by:

   (a) Fleming's right hand rule.

   (b) Fleming's left hand rule.

   (c) the right hand conductor rule.

   (d) the right hand solenoid rule

3. In a single current carrying conductor, current flowing towards the viewer can be shown by a____, whilst current flowing away from the viewer can be shown by a
_______ .

   (a) cross, dot.

   (b) cross, asterisk.

   (c) dot, asterisk.

   (d) dot, cross.

4. If two single current carrying conductors adjacent to each other have currents flowingthrough them in opposite directions, then a/an_____force exists between the two coils.

   (a) attraction.

   (b) repulsion.

   (c) magneto motive

   (d) inductive.

5. The magnetic field around a copper conductor can be increased by:

   (a) winding the conductor into a coil.

   (b) increasing the current through the conductor.

   (c) inserting an iron bar into the wound.

   (d) all of the above

Section B:

Blank spaces in the following statements represent omissions. Write the appropriate information.

6. State the type of electromagnetic action employed in the following practicalapplications:

   (a) circuit breakers.

   (b) relays and contactors.

   (c) magnetic chucks and electric crane brakes.

7. State what type of electromagnetic device would be used in the following practicalapplications:

   (a) to break an arc on the opening of a circuit breaker.

   (b) measure both A.C. and D.C. currents.

   (c) anti shop lifting devices.

   (d) measure wheel speed.

8. Winding a conductor into a coil has the effect of ____

9. The two effects of current that are always present when current flows through aconductor are the________________effect and___effect

10. What is the force that exists between two adjacent conductors that have currentsflowing in:

(a) opposite directions ?

(b) the same direction ?

11. State the rule used to determine the magnetic field around a single conductor, andbriefly describe how you would apply that rule.

12. State the rule used to determine the magnetic field around a coil, and briefly describehow you would apply that rule.

13. Describe a method you would use to:

(a) magnetise a piece of magnetic material.

(b) de-magnetise a piece of magnetic material

14. State three advantages of using an electromagnet over a permanent bar magnet.

15. Draw a cross sectional view of a conductor. On your diagram, clearly mark howwould show current flowing towards the viewer through the conductor .

16. Draw a cross sectional view of a conductor. On your diagram, clearly mark howwould show current flowing away from the viewer through the conductor .

17. For the circuit of figure 27, use the right hand solenoid rule to determine which end ofthe electromagnet will be the north pole.

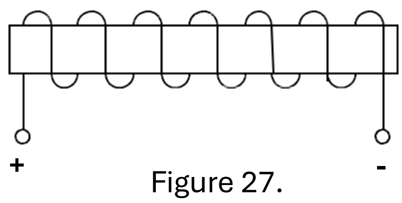

Figure 27.

18. For the circuit of figure 28, use the right hand solenoid rule to determine which end ofthe electromagnet will be the north pole.

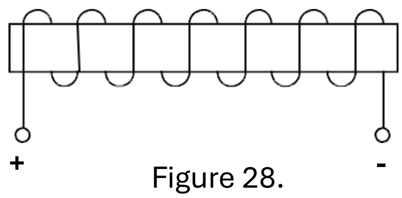

Figure 28.

19. For the circuit of figure 29, use the right hand solenoid rule to determine which end ofthe electromagnet will be the north pole.

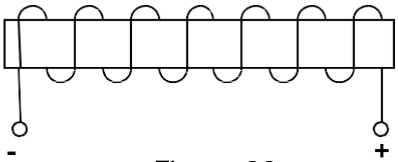

Figure 29.

20. Two parallel conductors have currents flowing through them in opposite directions.Draw a sectional view of the two conductors, and show the following:

(a) the relative current directions in each conductor;

(b) the correct magnetic field around each conductor;

(c) the resultant magnetic field of the two conductors together;

(d) the direction of the force exerted between the conductors.

SECTION C

The following problems are to be solved with the aid of a calculator. All equations and working are to be shown.

21. A coil of 120 turns has a current of 250mA flowing through it. Determine themagneto motive force produced by the coil. (30At)

22. If the power supply for question 1 has a current limitation of 120mA, how many turnsmust the coil be varied by to maintain the same magneto motive force? (Add 130 turns)

23. How much current must flow in a coil of 1000 turns to produce a magneto motiveforce of 125At? (125mA)

24. The coil as shown in figure 30 has various *tapping's* to vary the magneto motive force produced by the coil. If the number of turns per tapped section is 35 turns, determine the magneto motive force produced by the various tapping's using position "**1**" as a reference. The current through all of the coil has been measured at 2.5 amperes . (1-2: 87.5At;1-3: 175At;1-4: 262.5At;1-5: 350At)

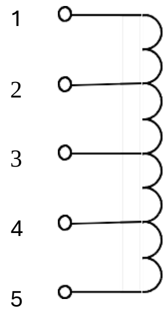

Figure 30.

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TUTORIAL - PART 1 - MAGNETIC CIRCUITS

NAME: ____________________

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Section A

In the following statements one of the suggested answers is best. Place the identifying letter on your answer sheet.

[1] The magneto motive force produced by a coil depends on:

a) the number of coil turns and the length of the magnetic circuit

b) the coil current and the C.S.A of the magnetic core

c) the length of the magnetic circuit and the core reluctance

d) the number of coil turns and the coil current

[2] The flux set up by a coil depends on the_____produced by the coil and ______ of the iron core:

a) mmf, reluctance.

b) magnetising force, C.S.A.

c) mmf, magnetising force.

d) mmf, flux density.

[3] The flux surrounding a coil is______to the coil current and______to the reluctanceof the core.

a) proportional, proportional

b) inversely proportional, inversely proportional

c) inversely proportional, proportional

d) proportional, inversely proportional

[4] A material with a high permeability will easily______magnetic flux.

a) concentrate
b) oppose
c) generate
d) produce

[5] A material with a high reluctance will______the establishment of magnetic flux.

a) concentrate
b) generate
c) control
d) oppose

[6] In a magnetic circuit, reluctance is____to the length of the core and______to the cross sectional area of the core.

a) proportional, proportional
b) inversely proportional, inversely proportional
c) inversely proportional, proportional
d) proportional, inversely proportional

Section B:

Blank spaces in the following statements represent omissions. Write the appropriate information.

Flux density is a measure of the_________of magnetic flux for a given_________, and is measured in_________.

To increase the flux produced by a coil, either increase the coil_________or the number of coil_________, or decrease the core_________.

Materials with a relative permeability of 1 are classified as____(a)___, whilst materials with a high to very high relative permeability are classified as____(b)___

μ_0 is the permeability of_________, μ_r is the_________of a material, whilst μ is the _________ of a material.

If a material has a high_________it is difficult to magnetise.

When comparing a magnetic circuit to an electrical circuit,_________is the equivalent of an emf,_________is the equivalent of circuit current and_________is the equivalent of circuit resistance.

The best size and shape for a magnetic core would be one with a________length and a large_________.

Neatly reproduce (or cut and paste) the diagram of figure 1 on your answer sheet, then label those parts identified with an arrow.

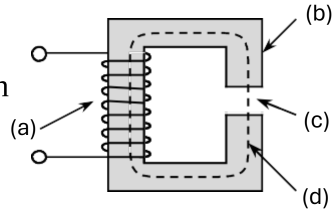


Figure 1.

SECTION C

The following problems are to be solved with the aid of a calculator. All equations and working are to be shown.

A coil of 150 turns has a current of 3.5A flowing through it. Determine the magneto motive force produced by the coil. (525At)

Determine the flux produced by a coil of 1000 turns when 1.5 amperes flows through it. The reluctance of the magnetic circuit is determined to be 45 000At/Wb.

(33.3mWb)

Determine the current that must flow through a coil of 1500 turns to produce a flux of 15mWb. The reluctance of the magnetic circuit is determined to be 5 000At/Wb.

(0.05A)

Determine the flux density at the poles of an electromagnet which produces a flux of 15mWb if the area of the poles is 200mm^2. (75T)

A magnetic circuit has a core area of 250mm^2 and a flux density of 2T. If the reluctance of the core is 60 000 At/Wb, determine the current flowing through the coil of 600 turns. (50mA)

An electromagnet has a core length of 400mm, is wound with 2000 turns and carries a coil current of 200mA. Determine the magnetising force of the magnetic circuit.

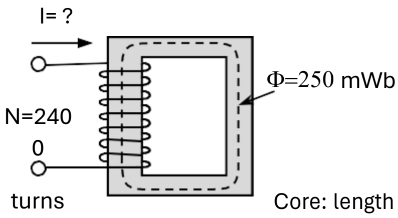
(1000At/m)

Determine the current flowing in a coil of 600 turns which produces a magnetising force of 2000 At/m in a core 150mm long. (500mA)

A magnetic core is 300mm long with a cross sectional area of 50mm^2 and has a permeability of 125.7x10^{-3} . Determine the reluctance of the core. (47,732 At/Wb)

For the circuit of figure 2, determine the coil current for the conditions shown.

(625mA)



Core: length = 150mm

C.S.A.= 250mm^2

Permeability = 100x10^{-3}

Figure 2.

Tutorial – Part 2 - Magnetisation Curves and Materials

NAME: ____

Section A

In the following statements one of the suggested answers is best. Place the identifying letter on your answer sheet.

2. Hysterisis loss is due to:

   a) high reluctance.
   b) low permeability.
   c) high flux density.
   d) residual magnetism.

3. A B-H curve shows how the______changes for changes in______.

   a) material reluctance; mmf
   b) flux density; magnetising force
   c) magnetising force; flux density
   d) flux; reluctance

4. The B-H curve which is shown as a straight line would be that for:

   a) air
   b) cast iron
   c) mild steel
   d) silicon steel

5. The lagging of changes in magnetic flux density behind changes in magnetising forceis known as:

   a) eddy current loss
   b) permitivity
   c) hysterisis
   d) reluctance

6. ______ occurs when the flux density of a material cannot be increased further forincreases in magnetising force.

   a) Residual magnetism
   b) Coercive force
   c) Retentivity
   d) Saturation

Section B:

Blank spaces in the following statements represent omissions. Write the appropriate information.

7. A magnetisation curve shows the relationship between______and_________for magnetic materials.

8. When the magnetisation___________is reduced to zero, any magnetic flux remaining in the material is known as__________, and the force required to reducethis______to zero is known as the_____________.

9. ______________ steel is commonly used in transformers and electric motors due to itslow_________.

10. This page may be removed from this workbook and handed in as part of thisassignment. On the diagram of figure 3:

    a) identify and name the characteristic curve;
    b) identify and fully label the horizontal and vertical axes;
    c) show and label on the diagram the following:

       - the saturation points.
       - the amounts of residual magnetism
       - the amounts of coercive force
       - from the text, draw the comparative hysterisis loop for silicon steel.

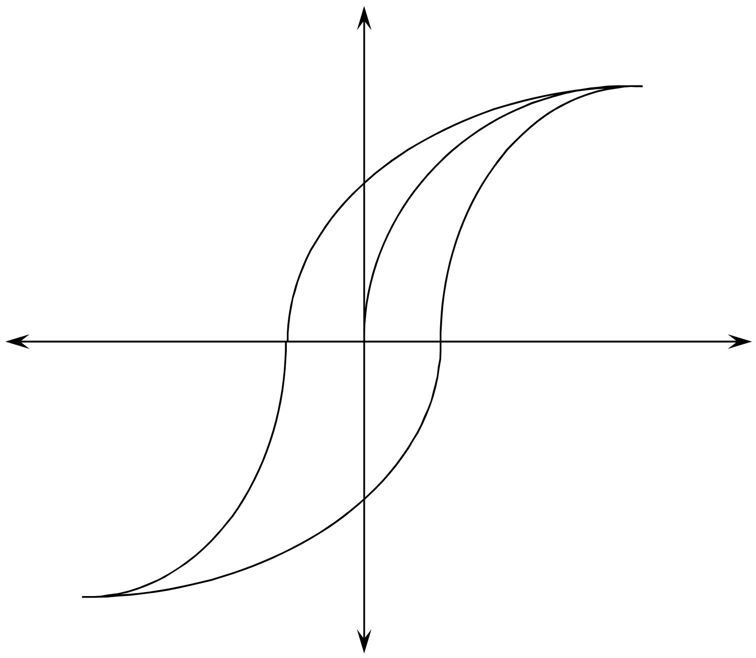


Figure 3

11. Table 2 represents the results of magnetising the field of a generator and the resultingfield flux.

Table 2								
Magneto motive Force (At)	0	500	1000	1500	2000	3000	4000	6000
Flux (mWb)	5	17.5	32	45	57.5	72	75	78

12. On the 5mm grid on page 34, draw vertical and horizontal axes, and clearly label eachaxis and title the graph,

    a) Using a scale of 10mm = 500At and 10mm = 5mWb, plot and neatly drawthe curve from the results of table 1, using a curve of best fit,

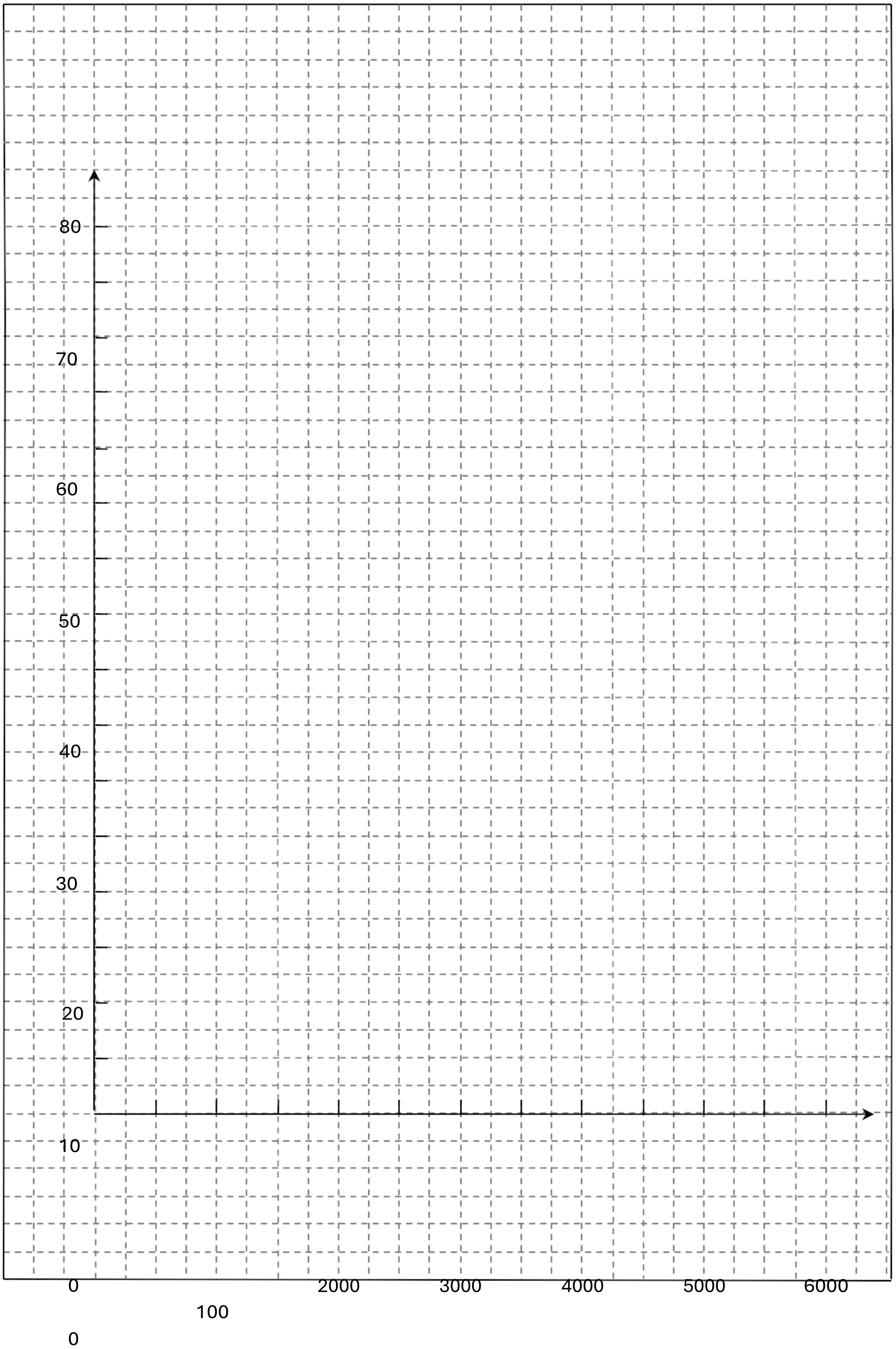
    b) On the graph, show the useful region of the curve, the knee of the curveand the point of saturation.

    c) From the graph determine

- the flux required for mmf's of 2500 At and 5000 At;
- the mmf's required for a flux of 40mWb and 65mWb.

NOTE:

Include the 5mm grid on page 34 as part of your submitted assignment.



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TUTORIAL - ELECTROMAGNETIC INDUCTION

NAME: ____

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Section A

In the following statements one of the suggested answers is best. Place the identifying letter on your answer sheet.

1. If a conductor in a magnetic field moves parallel to the magnetic field , the inducedvoltage will be__volts.

   (a) a maximum

   (b) alternating

   (c) an average

   (d) zero

2. Fleming's Right Hand rule is used to determine the direction of the:

   (a) magnetic field around a solenoid

   (b) induced currents in a conductor

   (c) magnetic field around a single conductor

   (d) force exerted on a current carrying conductor

3. The value of emf induced into a conductor is dependent upon the___density,

______ of conductor and______of the conductor.

(a) conductor; length; velocity

(b) flux; type; velocity

(c) flux; length; velocity

(d) flux; length; material

4. Maximum emf is induced in a conductor when it moves through a magnetic field atan angle of intersection of:

   (a) 0^{o}

   (b) 45^{o}

   (c) 90^{o}

   (d) 180^{o}

5. If the rate at which a conductor moves through a magnetic field is increased, theinduced emf will:

   (a) decrease.

   (b) remain the same.

   (c) alternate.

   (d) increase.

Section B:

Blank spaces in the following statements represent omissions. Write the appropriate information.

6. In Flemings Right Hand Rule, the thumb indicates________; the first finger indicates _________ and the middle finger indicates__________.

7. A cross shown in a cross sectional view of a conductor shows______, whilst a dotshows______.

8. The polarity of an emf induced into a conductor depends on the______of the magnetic field and the________of the conductor.

9. To find the emf induced into a conductor, the equation to use is______, where “e” is the_________, measured in________, “B” is the_________measured in_________, “ l ”is the_________measured in_________and “ v ” is the__________measured in _________.

10. If the rate at which a conductor cuts across a magnetic field is increased, the value ofthe__will__________.

11. **Neatly** reproduce (or cut and paste) the diagram of figure 21 on your answer sheet.For the diagram of figure 21;

   (a) draw the magnetic field pattern for the bar magnet;

   (b) determine the polarity for the terminals **"A"** and **"B"** if the bar magnet ismoved into the coil in the direction as shown; and

   (c) describe the method you used to determine the polarity of the terminals.

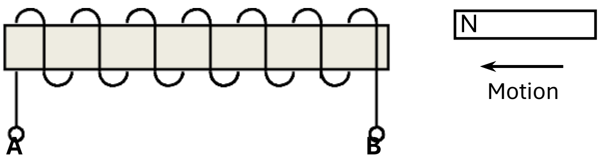

Figure 21.

Section C:

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12. A conductor 250mm long moves at right angles with a velocity of 20m/s through a magnetic field with a flux density of 1.5 Tesla. Determine the emf induced in the conductor. (7.5V)

13. For the conductor in question 1, what would need to be increase in flux density to increase the voltage to 12V? (0.9T)

14. Determine the velocity of a conductor of 200mm length which is moving at a uniform speed through a magnetic field of 1.25 Tesla flux density at right angles to produce a voltage of:

    (a) 1.5V (6m/s)

    (b) 10V (40m/s)

    (c) 500mV (1m/s)

15. Determine the flux density of a magnetic field if a conductor 25mm long cuts throughthe flux at right angles with a velocity of 15m/s to produce a voltage of 6V.

(20T)

16. A coil of 150 turns is lined by a flux of 300mWb. If the flux is reduced to 100mWb in100mS, determine the voltage induced in the coil. (300V)

17. The diagram of figure 22 represents atransformer with input (primary) and output (secondary) turns as shown. The coils are linked by a common core flux of 25mWb, which is reduced to zero in 5mS. Determine the voltage induced in both coils. (V_1= 3kV,V_2=250V)

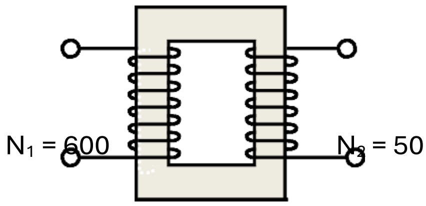

Figure 22.

Tutorial - Measuring Instruments

NAME: ____

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Section A

In the following statements one of the suggested answers is best. Place the identifying letter on your answer sheet.

1. An ammeter has a_______resistance and is connected in_____with the load.

   (a) high, series

   (b) low, series

   (c) high, parallel

   (d) low, parallel

2. A voltmeter has a_______resistance and is connected in_____with the load.:

   (a) high, series

   (b) low, series

(c) high, parallel

(d) low, parallel

3. The moving coil meter is_______and measures_______:

(a) polarised, A.C. only.

(b) non polarised, D.C. only.

(c) non polarised, D.C. or A.C.

(d) polarised, D.C. only.

4. The moving iron meter is_______and measures_______:

   (a) polarised, A.C. only.
   (b) non polarised, D.C. only.
   (c) non polarised, D.C. or A.C.
   (d) polarised, D.C. only.

5. The deflecting torque in an analogue meter is produced by.

   (a) springs
   (b) Lenz's law
   (c) the coil current
   (d) an air dashpot

6. In the permanent magnet meter the current coil_____and the scale is________.

   (a) is stationary, linear
   (b) moves, linear
   (c) is stationary, non-linear
   (d) moves, non-linear

7. In the moving iron meter the current coil______and the scale is________.

   (a) is stationary, linear
   (b) moves, linear
   (c) is stationary, non-linear
   (d) moves, non-linear

Section B:

Blank spaces in the following statements represent omissions. Write the appropriate information.

8. The three torques in analogue meters are the_________torque, which moves theneedle upscale from zero, the_______torque, which moves the needle back to zero, and the_________torque, which only has an effect when the needle is ____________.

9. In the electrodynamometer, which measures_________, the____________coil is stationary, while the moving coil measures the_____________in the circuit.

10. The range of the moving____________meter, which is used on currentcircuits, may be extended using an instrument transformer.

11. The sensitivity of a voltmeter is measured in___________per_____________.

12. A higher resistance____________meter would have a larger____________effect on acircuit when inserted into the circuit than a lower resistance meter.

13. A clip on DC ammeter uses the___________effect device to measure the ____________ produced by the current in the conductor.

Section C:

The following problems are to be solved with the aid of a calculator. Any working for a problem is to be fully shown. Where a problem involves calculating for circuit conditions, a neat and fully labelled circuit diagram (if not provided) is to accompany the question. Answers are to be expressed in the appropriate multiple or sub-multiple.

14. A galvanometer with a resistance of 17.5 ohms has a full scale deflection current of 2.4 milli amperes. Determine:
    (a) the full scale deflection voltage. (42mV)
    (b) the resistance of the shunt required to use the meter as a 100mA ammeter.(0.2126Ω)
    (c) the resistance of the multiplier if the meter is used as a 100V voltmeter.(41.65kΩ)
    (d) the sensitivity of the voltmeter. (416.7Ω/V)

15. A moving iron meter movement requires 3200 ampere turns to indicate full scale deflection. If the meter is to be used as a 5 ampere AC ammeter how many turns arerequired on the current coil? (640 turns)

16. An ammeter scaled 0 to 150mA is used with the appropriate shunt to measure a full scale current of 25 amperes. If the scale reading is 96 milliamperes what is the currentflowing in the circuit?(16A)

17. A galvanometer with a full scale deflection current of 2 milliamperes has a full scaledeflection voltage of 6 millivolts. Determine:
    (a) the resistance of the coil in the galvanometer. (3Ω)
    (b) the total current in the circuit when connected with a 0.125Ω shunt (thegalvanometer shows full scale deflection). (50mA)
    (c) the total current in the circuit when the meter indicates a deflection equivalentto 1.8 milliamperes going through the meter movement. (45mA)

(d) the current in the shunt from (c) above (43.2mA)

18. Calculate the sensitivity in ohms per volt for moving-coil instruments having thefollowing full scale deflection values.

(a) 50 μA. (20kΩ/V)

(b) 500 μA (2kΩ/V)

(c) l

mA.

(1kΩ/V)

(d) 10

mA.

(100Ω/V)

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