(Electromagnetism)

Test 2

(Philips)

Time allowed – 2 Hours

15 Pages in this Question Booklet

TOTAL MARKS AVAILABLE

Aids to be supplied by College:

None

Aids to be supplied by Students:

Pen, pencil, eraser, rule, calculator

SECTION	Possible Marks	Actual Marks
A	20	
B	20	
C	20	
D	20	
TOTAL	80	

Instructions to Students:

- **Electronic devices are to be turned off and removed from your person.** You cannot access an electronic device during this examination.
- All questions are to be answered in the space provided in this Question Booklet. Answers to Section A – Multi-choice Questions, are to be recorded on the Answer Sheet attached to this Question Booklet.
- You are not to use any reference book in this examination.
- The whole of this Question Booklet is to be handed to the Supervisor upon completion.

Aids permitted where indicated:

Standard Dictionaries	Bilingual Dictionaries	Technical Dictionaries	Programmable Calculators	Non-programmable Calculators	Mobile Phones	MP3 Players
No	**Yes**	**No**	**No**	**Yes**	**No**	**No**

Section A - (20 Marks)

Select the best answer for the following statements and place an "X" in the appropriate box on the Answer Sheet attached to this examination paper.

1. The ability of a material to concentrate magnetic flux is known as:

   a. Inductance.
   b. Permeability.
   c. Remanence.
   d. Residual.

(1 Mark)

2. The unit of flux density is the:

   a. Henry.
   b. Siemen.
   c. Tesla.
   d. Weber.

(1 Mark)

3. Flux density is a measure of:

   a. inductive flux per unit area.
   b. magnetic flux per unit area.
   c. residual flux per unit area.
   d. resistive flux per unit area.

(1 Mark)

4. Retentivity is an indication of how much:

   a. magneto motive force is required to demagnetise a material.
   b. magneto motive force is required to magnetise a material.
   c. residual magnetism a material will have.
   d. residual magnetism a material will lose.

(1 Mark)

5. If two single current carrying conductors adjacent to each other have currents flowing in them in opposite directions then:

a. there will be a force of attraction between them.

b. there will be a force of repulsion between them.

c. there will be a magneto motive force between them.

d. there will be an inductive force between them.

(1 Mark)

6. The magnetic field around a wound coil can be increased by:

a. decreasing the cross sectional area (CSA) of the coil.

b. decreasing the current through the coil.

c. increasing the length of the coil.

d. increasing the number of turns of the coil.

(1 Mark)

7. A material with a high permeability will:

a. concentrate magnetic flux.

b. generate magnetic flux.

c. increase magnetic flux.

d. oppose magnetic flux.

(1 Mark)

8. Hysteresis loss is due to:

a. high flux density.

b. high reluctance.

c. high residual magnetism.

d. low permeability.

(1 Mark)

9. A B-H curve shows changes in:

a. flux density for changes in magnetising force.

b. flux density for changes in reluctance.

c. magnetising force for changes in flux.

d. reluctance for changes in magneto motive force (mmf).

(1 Mark)

10. When large increases in magnetising force only produce small increases in flux density a material is said to be:

a. coerced.
b. permeable.
c. reluctant.
d. saturated.

(1 Mark)

11. A material with high reluctance will:

a. assist magnetic flux.
b. concentrate magnetic flux.
c. control magnetic flux.
d. oppose magnetic flux.

(1 Mark)

12. If a mild steel core is inserted into an air cored coil the inductance will:

a. decrease.
b. disperse the magnetic flux.
c. increase.
d. remain the same.

(1 Mark)

13. The size and shape of an inductor which will give the greatest inductance will be:

a. long with a large CSA
b. long with a small CSA.
c. short with a large CSA
d. short with a small CSA.

(1 Mark)

14. To increase the time constant for a circuit containing inductance and resistance you could either:

a. decrease the inductance or decrease the resistance.
b. decrease the inductance or increase the resistance.
c. increase the inductance or decrease the resistance.
d. increase the inductance or increase the resistance.

(1 Mark)

15. Mutual inductance is defined as the magnetic linkage between:

a. a number of adjacent coils.

b. a single coil and its flux.

c. an inductor and a resistor.

d. the flux and the magnetic core.

(1 Mark)

16. The effect a changing magnetic field has on the current flowing in a conductor is known as:

a. Faraday's Law

b. Kirchhoff's Law

c. Lenz's Law

d. Ohm's Law

(1 Mark)

17. The EMF induced in a coil that opposes the applied EMF is commonly called:

a. back EMF.

b. black EMF.

c. mutually induced EMF.

d. self induced EMF.

(1 Mark)

18. If the velocity of an magnet moving through a coil is decreased, the induced voltage will:

a. decrease

b. decrease to zero

c. increase

d. remain unchanged

(1 Mark)

19. Magnetising force is the:

a. force between the north and south poles of the magnet.

b. product of the turns and current per metre.

c. product of the current and the reluctance per metre.

d. reluctance per unit length.

(1 Mark)

20. The laws of magnetism state that magnetic lines of force:

a. Cross inside the magnet.

b. Always travel from south to north.

c. Travel from north to south inside the magnet.

d. Are continuous and can be distorted.

(1 Mark)

Section B – (20 Marks)

1. State the direction that the magnetic lines of force are said to travel external to a magnet.

_____

(1 Mark)

2. What type of magnet retains practically all of its magnetism when the magnetising force is removed?

_____

(1 Mark)

3. Describe what is meant by the following terms:

Residual Magnetism: _____

_____

_____

(1 Mark)

Retentivity: _____

_____

_____

(1 Mark)

4. Magnetic materials are generally classified as Ferromagnetic, Paramagnetic, or Diamagnetic. State one example for each in the below table.

Ferromagnetic	Paramagnetic	Diamagnetic

(3 Marks)

5. What do the following fingers indicate when using Fleming's right hand rule?

Thumb: _____

(1 Mark)

First Finger: _____

(1 Mark)

Second Finger: _____

(1 Mark)

6. List three characteristics of magnetic lines of force.

_____

_____

_____

(3 Marks)

7. What does the thumb point towards in the Right Hand Rule for Solenoids?

_____

_____

(1 Mark)

8. How many time constants does it take for an LR circuit to reach its final value?

_____

(1 Mark)

9. Explain the term ‘mutual inductance’:

_____

_____

(2 Marks)

10. What action does an inductor oppose in a circuit?

_____

(1 Mark)

11. What is the unit of inductance?

_____

(1 Mark)

12. What would happen to the inductance of a coil if its air core is replaced with a mild steel core?

_____

(1 Mark)

Section C - (20 Marks)

The questions in this section require some simple drawing and calculations. Show all working. Answers are to be provided to two (2) decimal places.

1. On the magnetic circuit in Figure 1 indicate the direction of the current flow in the coil, and the Polarity of the Magnetic Field.

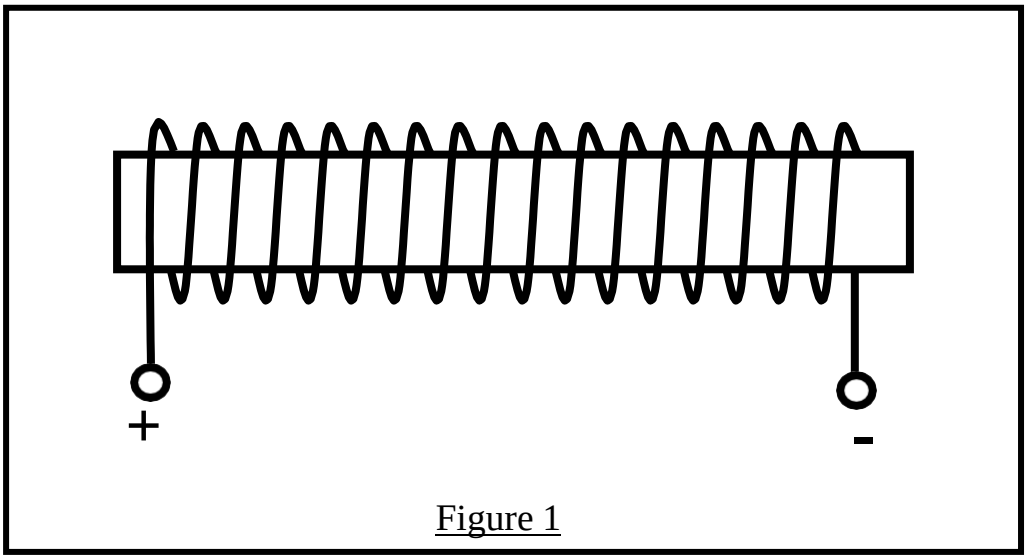


Figure 1

(2 Marks)

2. In Figure 2 below, sketch the relevant magnetic fields showing the direction in which the resulting force will act when two conductors carrying an electric current are placed next to each other.

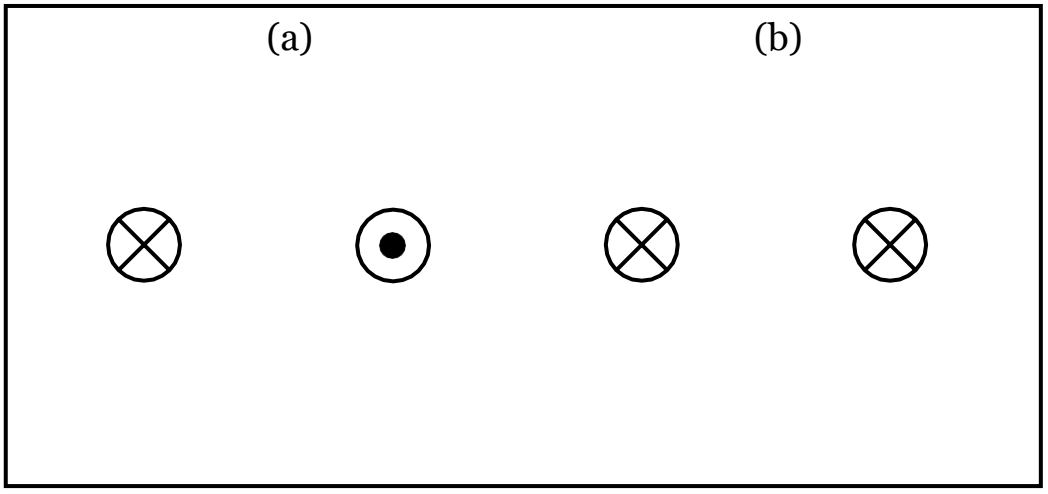


Figure 2

(2 Marks)

3. On the axes in Figure 3:

a) Fully label the vertical and horizontal axes. (2 Marks)
b) Draw a standard Hysteresis Curve. (5 Marks)
c) Show and label: (3 Marks)
   i. The Saturation Points,
   ii. The Residual Magnetism areas, and
   iii. The Coercive Forces.

(All work must be neat and legible or marks will be deducted)

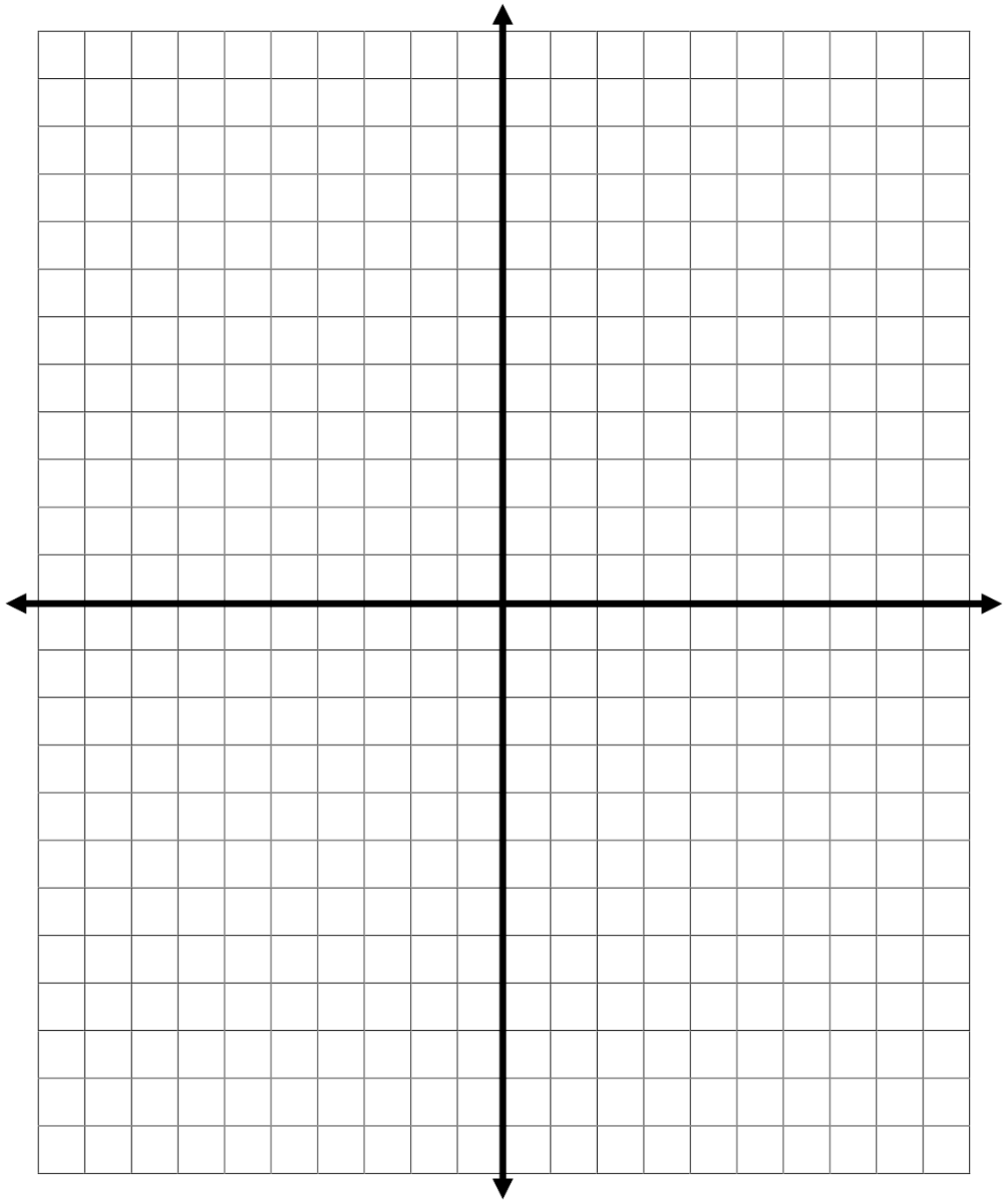


Figure 3

4. In Figure 4 below, draw the symbol to represent the direction of conventional current flow to establish the magnetic fields as shown.

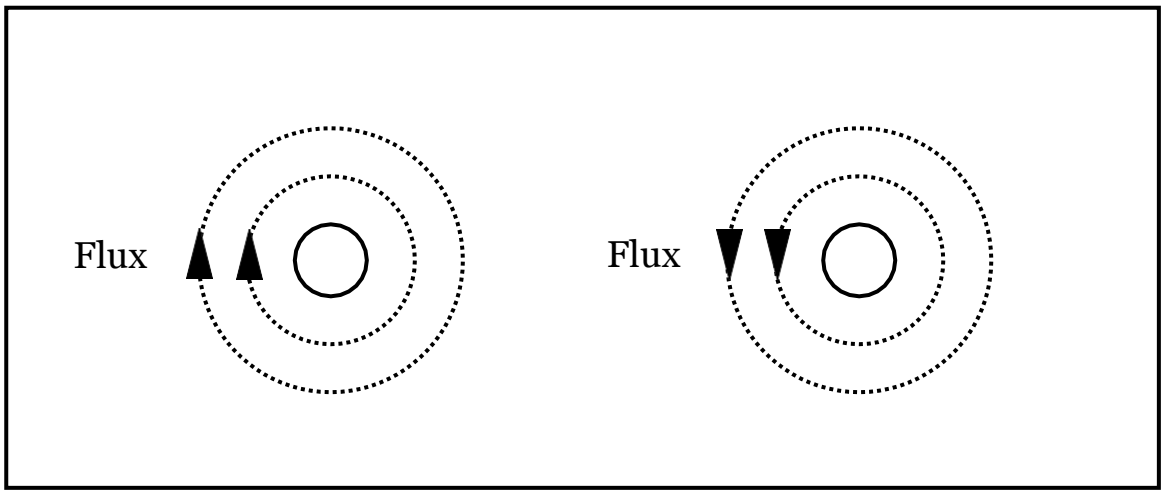


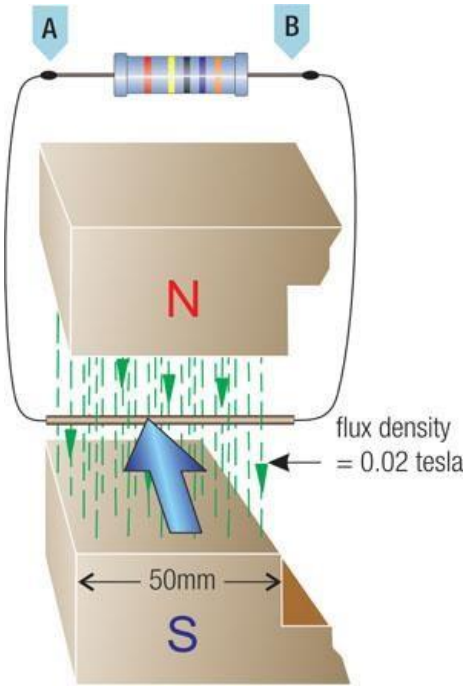
Figure 4

(2 Marks)

5. On the diagram below:

a. Mark the direction of the current through the conductor, and

b. State the rule was used to determine your answer.



(4 Marks)

Section D - (20 marks)

Use correct engineering notation and units

1. Calculate the length of a conductor which moves at a velocity of 20 m/s at right angles to a magnetic field with a flux density of 2.5 Tesla to produce an EMF of 100 Volts.

(2 Marks)

2. Determine the strength of the magnetic field which produces a flux density of 50 T when it passes through a circular core with a diameter of 19.5 mm.

(2 Marks)

3. Calculate the EMF induced in a coil of 400 Turns which has a flux of 0.4 Wb which is reduced to 0.1 Wb in 20 milliseconds,.

(2 Marks)

4. Determine the current required to flow in a coil of 4000 turns required to produce a Magneto Motive Force (mmf) of 2500 At.

(2 Marks)

5. Determine the current required in a relay's coil to produce a flux of 60 mWb if the coil has 1000 turns and a reluctance of 25,000 At/Wb.

(2 Marks)

6. Calculate the current flowing in a coil of 600 turns if it produces a flux density of 2 T has a C.S.A. of 250 mm^2, and a reluctance of 60,000 At/Wb.

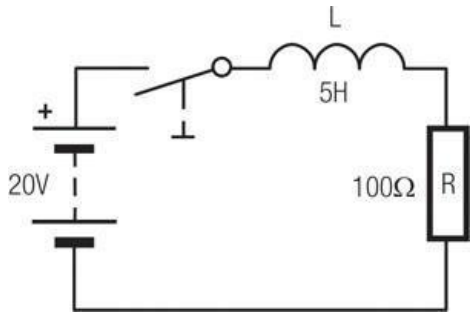
(4 Marks)

7. For the following circuit determine:

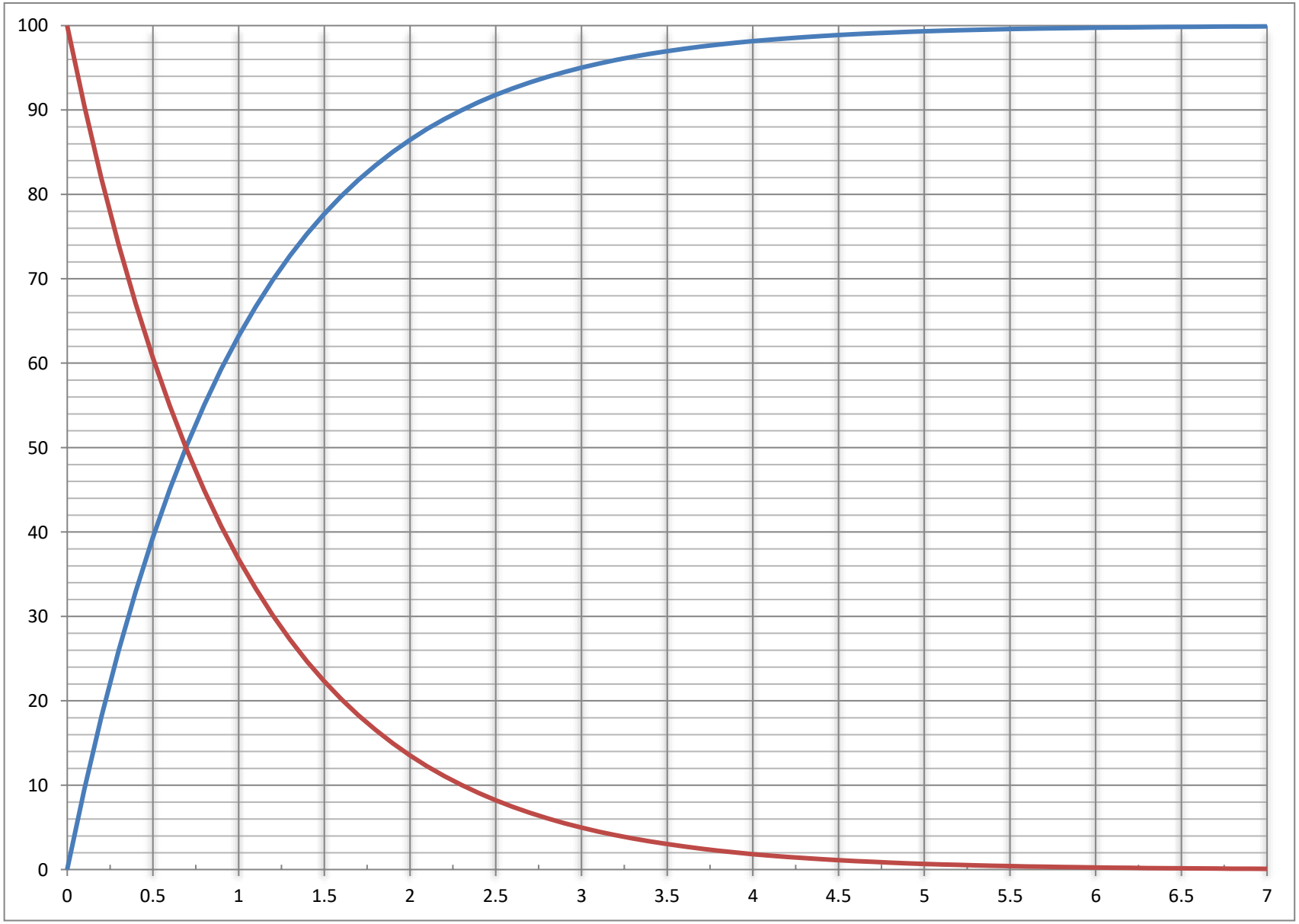
   a. The LR time constant,

   b. The final current flowing in the circuit, and

   c. The current flowing in the circuit 2.5 time constants after the switch is closed.



(6 Marks)


100
90
80
70
60
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7

Note: The symbols used on this sheet follow AS1046 pt 1. There are alternate recognised symbols in use. The list does not contain every equation used in the course. Transposition of equations will be necessary to solve problems

$$Q = It \qquad v = \frac{s}{t} \qquad a = \frac{\Delta v}{t}$$

$$F = ma \qquad W = Fs \qquad W = mgh$$

$$W = Pt \qquad \eta\% = \frac{output}{input} \times \frac{100}{1} \qquad I = \frac{V}{R}$$

$$P = VI \qquad P = I^2R \qquad P = \frac{V^2}{R}$$

$$R_2 = \frac{R_1 A_1 l_2}{A_2 l_1} \qquad R_h = R_c(1 + \alpha\Delta t) \qquad R = \frac{\rho l}{A}$$

$$R_T = R_1 + R_2 + R_3 \qquad V_T = V_1 + V_2 + V_3 \qquad \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$I_T = I_1 + I_2 + I_3 \qquad V_2 = V_T \frac{R_2}{R_1 + R_2} \qquad I_2 = I_T \frac{R_1}{R_1 + R_2}$$

$$R_x = \frac{R_A R}{R_B} \qquad C = \frac{Q}{V} \qquad \tau = RC$$

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \qquad C_T = C_1 + C_2 + C_3 \qquad C = \frac{A\varepsilon_o\varepsilon_r}{d}$$

$$F_m = IN \qquad H = \frac{F_m}{l} \qquad B = \frac{\Phi}{A}$$

$$\Phi = \frac{F_m}{S} \qquad S = \frac{l}{\mu_o\mu_r A} \qquad V = N\frac{\Delta\Phi}{\Delta t}$$

$$e = Blv \qquad L = \frac{\mu_o\mu_r AN^2}{l} \qquad L = N\frac{\Delta\Phi}{\Delta I}$$

$$V = L\frac{\Delta I}{\Delta t} \qquad \tau = \frac{L}{R} \qquad F = Bil$$

$$T = Fr \qquad E_g = \frac{\Phi ZnP}{60a} \qquad P = \frac{2\pi nT}{60}$$

$$t = \frac{1}{f} \qquad f = \frac{np}{120} \qquad V = 0.707V_{\max}$$

$$I = 0.707I_{\max} \qquad V_{ave} = 0.637V_{\max} \qquad I_{ave} = 0.637I_{\max}$$

$$v = V_{\max}\sin\phi \qquad i = I_{\max}\sin\phi \qquad I = \frac{V}{Z}$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} \qquad X_L = 2\pi fL \qquad X_C = \frac{1}{2\pi fC}$$

Student Name: _____

Class: _____

Date: _____

Section A (Multiple Choice Questions)

ANSWER SHEET

Instructions:

Enter your personal details in the top right hand corner of this sheet.
Place an **X** in box of your choice. If you make a mistake, circle your answer ⊗ and choose again.

Question	A	B	C	D
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
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16				
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Totals				

Total Marks Section A: _____