(Electromagnetism)

Test 1

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	25	
B	20	
C	20	
D	20	
TOTAL	85	

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 opposition of a material to becoming magnetised is known as:

   a) inductance
   b) impedance
   c) resistance
   d) reluctance

(1 Mark)

2. Magnetic Flux is measured in:

   a) teslas
   b) webers
   c) henries
   d) ohms

(1 Mark)

3. Flux Density is a measure of:

   a) magnetic flux
   b) reluctance per unit area
   c) magnetic flux per unit area
   d) inductance per unit area

(1 Mark)

4. The Magneto Motive Force produced by a coil depends on the:

   a) reluctance of the core and the length of the magnetic circuit
   b) number of turns in the coil and the C.S.A. of the core
   c) number of turns in the coil and the length of the magnetic circuit
   e) number of turns in the coil and the current in the circuit

(1 Mark)

5. When two single current carrying conductors run in parallel, have a current flowing through them in the same direction, there is:

   a) a magneto motive force between them
   b) an inductive force between them
   c) a force of repulsion between them
   d) a force of attraction between them

(1 Mark)

6. A B-H curve shows the relationship between:

   a) reluctance and flux.
   b) reluctance and magneto motive force
   c) flux density and magnetising force
   d) flux density and magneto motive force

(1 Mark)

7. A suitable application for a permanent magnet would be:

a) loud speakers
b) transformers
c) relays
d) lasers

(1 Mark)

8. When a material's flux density only has a small gain for large increase in magnetising force, the material is said to be:

a) permeable
b) saturated
c) retentive
d) reluctant

(1 Mark)

9. When using the Right Hand Rule for Solenoids, the thumb points :

a) in the direction of current flow
b) to the active terminal
c) to the south pole of the solenoid
d) to the north pole of the solenoid

(1 Mark)

10. To reduce eddy currents, the core materials should be:

a) solid steel
b) laminated steel
c) rolled steel
d) high quality silicon steel

(1 Mark)

11. If an air gap is introduced into a magnetic circuit the magnetomotive force required to maintain the flux would:

a) need to be decreased
b) not need to be changed
c) need to be shut down and re energised
d) have to be increased

(1 Mark)

12. The magnetic field surrounding a conductor can be increased by increasing the:

a) current flowing in the conductor
b) temperature of the conductor
c) number of turns of the magnet
d) diameter of the conductor of the magnet

(1 Mark)

13. The term given for the current or voltage of an LR circuit to reach 63.2% of its final value is:

a) time period
b) time constant
c) lenz's law
d) self inductance

(1 Mark)

14. The polarity of the induced voltage in a conductor can be changed by:

a) reversing the direction of the magnetic field
b) increasing the field strength
c) decreasing the size of the conductor
d) reversing the voltmeter connections

(1 Mark)

15. The magnetic field surrounding a straight conductor can be decreased by:

a) decreasing the current in the conductor
b) decreasing the number of turns of the conductor
c) using a conductor with a larger diameter
d) decreasing the temperature of the conductor

(1 Mark)

16. The law that states that the polarity of an induced voltage will be such that it opposes the voltage which initially caused the induced voltage is called:

a) Kirchhoff's Law
b) Lenz's Law
c) Ohm's Law
d) Faraday's Law

(1 Mark)

17. Magnetising force is the:

a) force between the north and south poles of the magnet
b) reluctance per unit length
c) product of the turns and current per metre
d) product of the current and the reluctance per metre

(1 Mark)

18. 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)

19. A material of low reluctance has a:

a) high permeability
b) low permeability
c) high retentivity
d) low reactance

(1 Mark)

20. Saturation of a magnetic material means that a further increase in the magnetomotive force will:

a) cause a small increase in magnetic flux in the material
b) cause the material to start to act as a magnetic screen
c) actually reduce the magnetic flux within the material
d) cause the material to overheat increasing the resistance

(1 Mark)

21. The magnetic lines of flux associated with a bar magnet:

a) are strongest at the south pole
b) flow from the north pole to the south pole
c) are weakest inside the bar magnet
d) enter at the north pole and leave at the south pole

(1 Mark)

22. The main components within an LR circuit are:

a) lamp and straight conductor
b) resistor and capacitor
c) inductor and a resistor
d) inductor and a magnet

(1 Mark)

23. The scientist who discovered that a moving magnetic field causes a current to flow in a conductor was:

a) Henry
b) Faraday
c) Oersted
d) Watt

(1 Mark)

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

a) remain unchanged
b) decrease to zero
c) increase
d) decrease

(1 Mark)

25. The induced emf in a conductor moving in a magnetic field can be increased by:

a) moving the conductor more slowly
b) reducing the diameter of the conductor
c) increase the length of the conductor
d) using a magnetic field with less flux density

(1 Mark)

Section B – (20 Marks)

1. Name a type of material that can be used to screen instruments from stray magnetic fields.

_____

(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 either ferromagnetic, diamagnetic or paramagnetic. Place the correct classification next to each of the materials in the below table.

Aluminium	Copper	Iron

(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. State two factors that can determine the polarity of the magnetic poles in a coil?

_____

_____

(2 Marks)

7. Explain why the back EMF of a coil exceeds the supply voltage when it is suddenly de-energised? *(Hint: Consider what happens to the magnetic field)*

_____

_____

(2 Marks)

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 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.

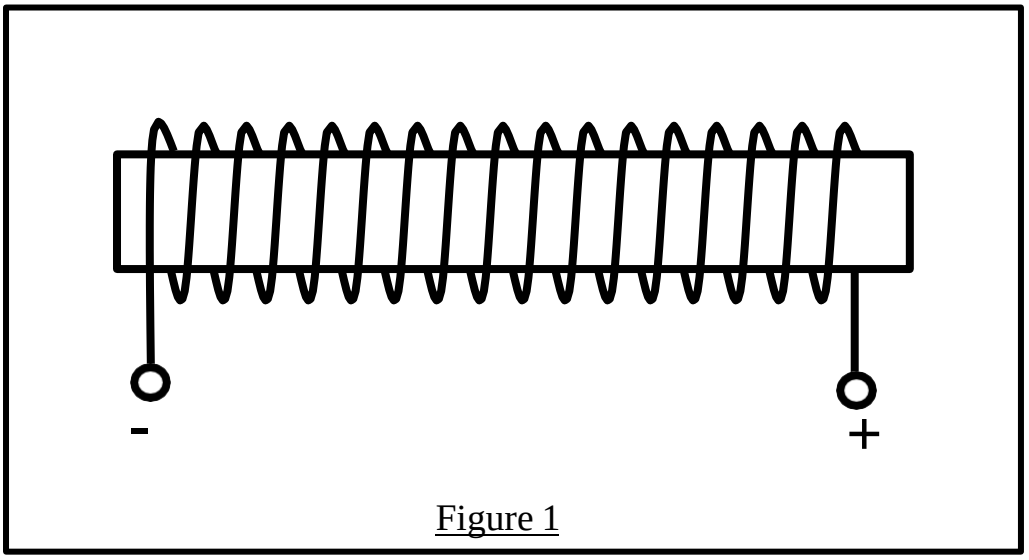


Figure 1

(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.

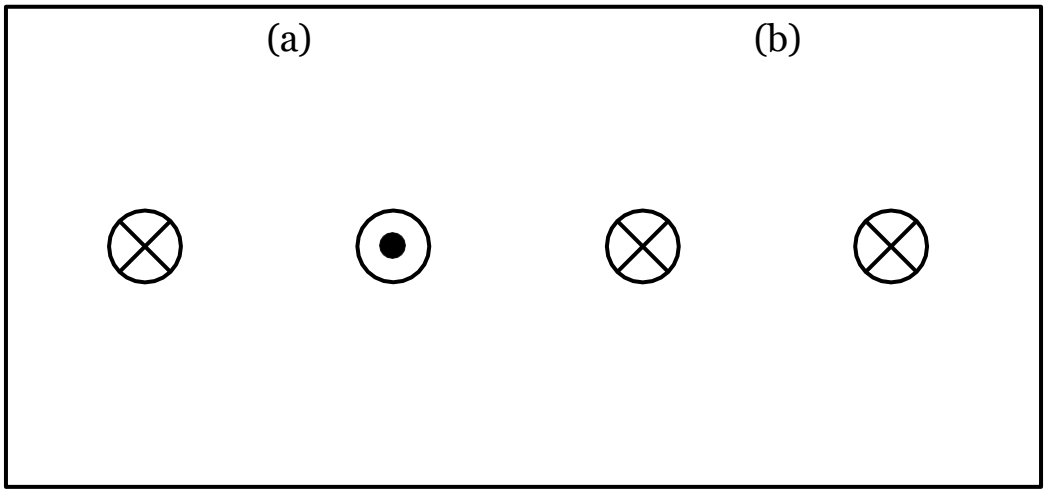


Figure 2

(2 Marks)

3. On the axes in Figure 3:

a) Fully label the vertical and horizontal axes. (2 Marks)
b) Draw a Hysteresis Curve for hard steel. (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)

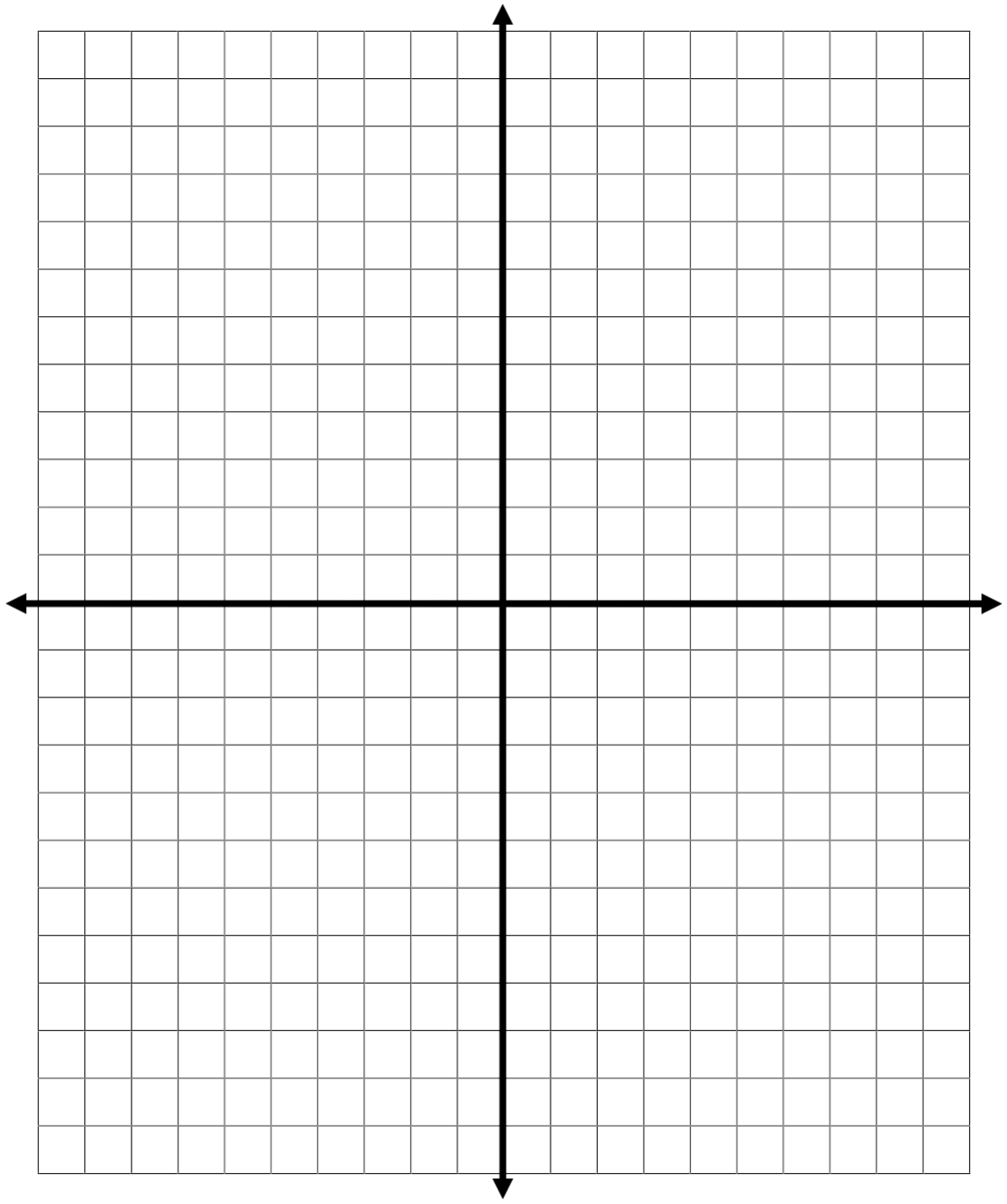


Figure 3

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

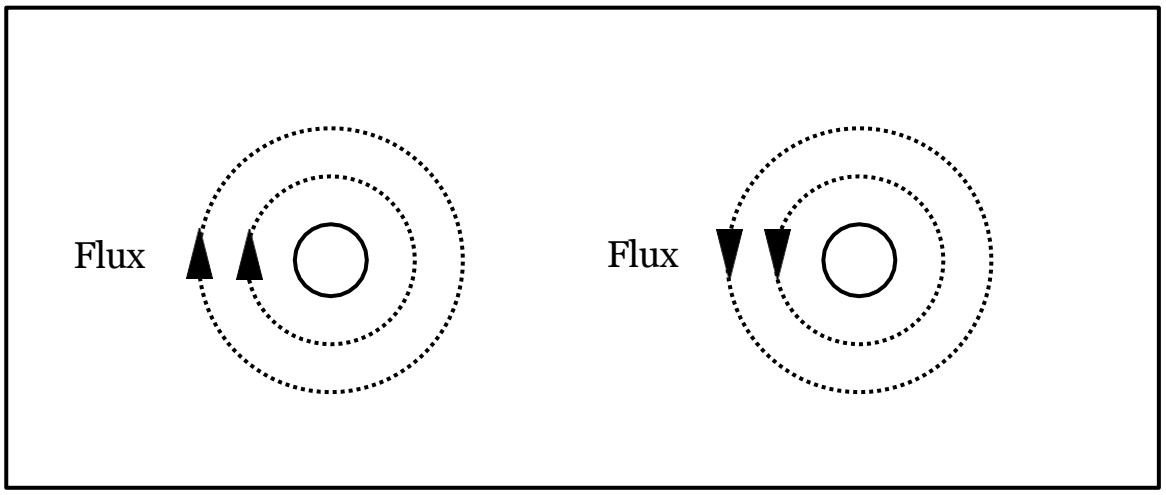


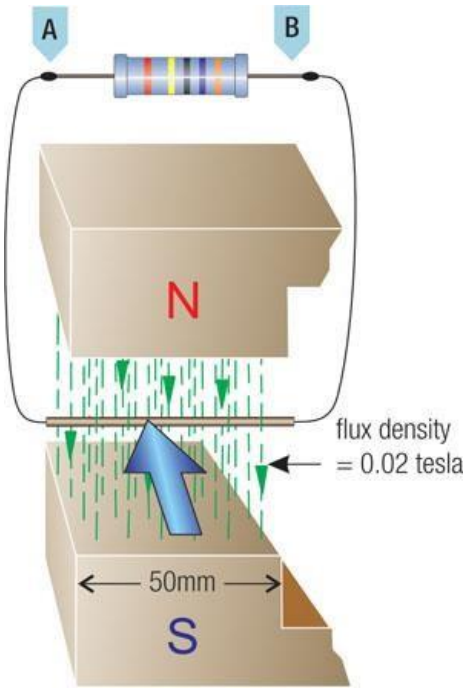
Figure 4

(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

6. A conductor 350mm long moves at a velocity of 25m/s at right angles to a magnetic field with a flux density of 2.3Tesla. Calculate the value of the emf generated in the conductor.

(2 Marks)

7. Determine the flux produced by a coil when the flux density on an area of 300mm^2 is 50T

(2 Marks)

8. A coil of 25 Turns has a flux linking it of 0.4Wb. If the flux is reduced to 0.1Wb in 200 milliseconds, calculate the induced emf in the coil.

(2 Marks)

9. A coil is required to produce an ***Fm*** of 2500 At. Determine the coil current if the coil has 3200 turns.

(3 Marks)

10. If a magnetic circuit of a relay has a reluctance of 25,000At/Wb and a relay coil has 1000 turns, determine the relay coils current required to produce a flux of 60mWb.

(2 Marks)

11. The length of an iron core is 200 mm and has a rectangular core C.S.A of 150 mm^2. If the core has an absolute permeability of $\mu = 10.68 \times 10^{-4}$ at a particular flux density, calculate the reluctance of the core.

(3 Marks)

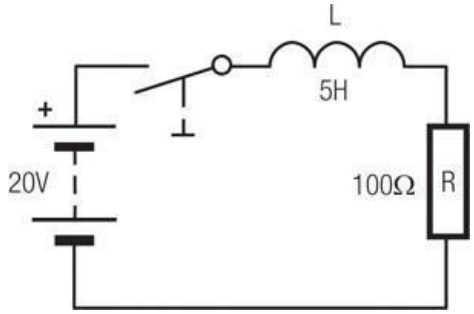
12. Calculate the absolute permeability of a soft iron magnetic circuit if the permeability of free space is $\mu_o = 12.57 \times 10^{-7}$ and the relative permeability of soft iron is $\mu_r = 55000$.

(2 Marks)

13. For the following circuit determine:

    a. LR time constant, and

    b. Final current value



(4 Marks)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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				
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Totals				

Total Marks Section A: _____