Single Phase Motor Test 1

Student Feedback **TOTAL MARKS AVAILABLE**

				SECTION	Possible Marks	Actual Marks
The results of my performance have been discussed and explained to me.				**A**	20	
Student:		**Date:**		**B**	20	
If you would like to request a review of your results or if you have any concerns about your results, contact your teacher or head teacher.				**C**	20	
				D	20	
Teacher:		**Date:**		**TOTAL**	80	

Aids to be supplied by College: None

Instructions to Students:

Electronic devices are to be turned off and removed from your person.
You cannot access an electronic device during this examination.

1. 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 MULTIPLE CHOICE (20 Marks)

In the following statements one of the suggested answers is the most correct. Place the letter corresponding to this answer in the space provided on the answer sheet.

1. The resistance of the insulation between windings and motor core should be:

   A. Greater than 1MΩ
   B. Less than 1MΩ
   C. Greater than 1Ω
   D. Less than 1Ω

2. The frequency produced by an alternator depends upon the :

   A. value of field current
   B. speed of rotation
   C. value of stator current
   D. value of terminal voltage

3. Alternators are designed to generate a sinusoidal voltage waveform because:

   A. it allows the use of cylindrical rotors
   B. it allows alternators to be paralleled
   C. this wave form can be transformed without distortion
   D. greater voltages can be generated

4. A common method of starting modern synchronous motors is by:

   A. providing a commutator
   B. induction motor principles
   C. the help of a compensator
   D. star/delta method

5. The operating power factor of a synchronous motor can be varied by changing the:

   A. rotor speed
   B. phase sequence
   C. field polarity
   D. field excitation

6. The terminal voltage of an alternator will rise due to an:

A. inductive load
B. resistive load
C. capacitive load
D. mechanical load

7. A three phase synchronous machine motor develops rotational torque by:

A. electromagnetic induction between the stator and the rotor
B. a magnetic coupling between the stator and the rotor
C. eddy current being induced in the rotor circuit
D. eddy currents being induced in the stator circuit

8. The armature current of a series universal motor is:

A. less than the stator current
B. the same as the stator current
C. greater than the stator current
D. independent of the stator current

9. If the following single phase motors had identical power ratings, which one would produce the lower value of starting torque?

A. split phase
B. shaded pole
C. capacitor start
D. Universal

10. The speed at which a synchronous motor rotates is governed by the:

A. pony motor
B. field winding
C. exciter
D. supply frequency

11. Normal excitation of a synchronous motor will result in:

A. maximum stator current, low power factor
B. minimum stator current, low power factor
C. maximum stator current, unity power factor
D. minimum stator current, unity power factor

12. A higher starting torque can be obtained with a split phase induction motor by:

A. placing extra induction in series with each motor winding
B. connecting a capacitor in parallel with the motor
C. disconnecting the centrifugal switch
D. connecting a capacitor in series with the start winding

13. A shaded pole induction motor would be the most suitable motor for use in a:

A. vacuum cleaner
B. desk fan
C. electric clock
D. washing machine

14. The single phase motor which is most suitable for driving a domestic vacuum cleaner would be a:

A. series universal motor
B. capacitor start/capacitor run motor
C. shaded pole motor
D. resistance start motor

15. The single phase motor that has two similar windings with a capacitor in series with one, is the:

A. split phase motor
B. capacitor start/capacitor run motor
C. permanently split capacitor motor
D. capacitor start motor

16. The advantages of a shaded pole motor are:

A. good power factor and reasonable starting torque
B. low cost and simple construction
C. good efficiency and good power factor
D. low cost and good power factor

17. The single phase motor that has two dissimilar windings displaced 90 electrical degrees is the:

A. series motor
B. permanently split capacitor motor
C. shaded pole motor
D. capacitor start motor

18. An under-excited three phase synchronous motor would operate with:

A. more than synchronous speed with leading power factor
B. synchronous speed with a leading power factor
C. synchronous speed and a lagging power factor
D. less than synchronous speed with a lagging power factor

19. The speed of a synchronous motor:

A. is constant from no-load to full load
B. is variable from no-load to full load
C. drops from no-load to full load
D. increases from no-load to full load

20. A changing load on a synchronous motor changes can cause:

A. increased excitation
B. hunting
C. varying supply frequency
D. loose wiring connection

SECTION B – SHORT ANSWER (Marks 20)

1. State the two reasons why ‘Amortisseur windings’ or ‘Damping bars’ are fitted to the rotor of a synchronous motor.

2. How is the output voltage of a 3ph alternator altered?

3. State the approximate angle of phase displacement between the start and run winding currents of a single phase split phase induction motor?

4. Describe the differences in resistance between the start and run winding of a split phase motor.

5. State the **2** methods used to isolate the start winding from the supply when a split phase motor reaches approx, 75% of running speed.

6. Describe how to reverse the rotation of a series universal motor.

7. What type of single phase motor is best suited to drive a reversible ceiling fan?

_____

_____

8. What type of single phase motor uses a commutator?

_____

_____

9. What will be the likely outcome if the centrifugal switch fails to open as a split phase motor accelerates?

_____

_____

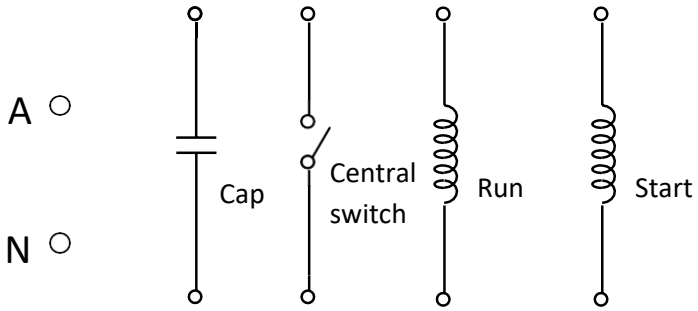
10. What machine can be used to improve power factor?

_____

_____

SECTION C- DRAWINGS & DIAGRAMS (20 Marks)

1. Parts A, B, and C relate to the following diagram which represents the components of a single phase 'capacitor start' induction motor.



(A) **On the diagram**, connect the components to the single phase terminals to give correct motor operation. (3marks)

(B) What characteristic of this motor make it suitable for use in a refrigerator? (2mark)

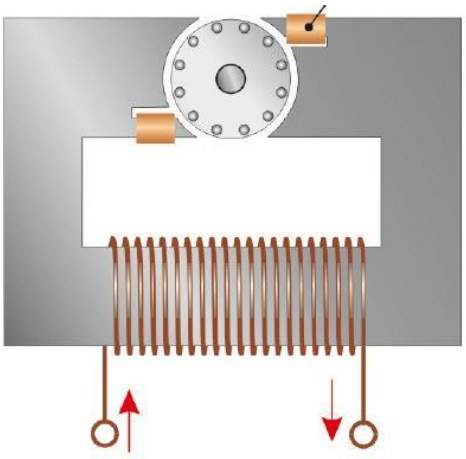
_____

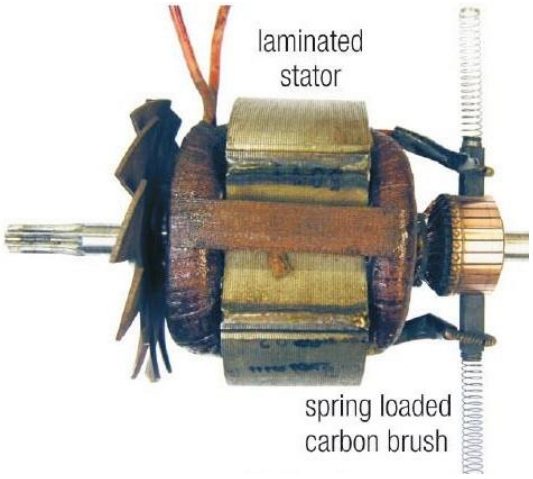
_____

(C) How could the direction of rotation of this motor be reversed? (2mark)

_____

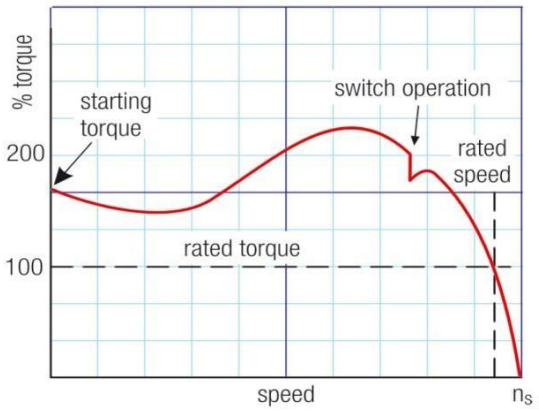
2. Name the two motors represented below (4 Marks)

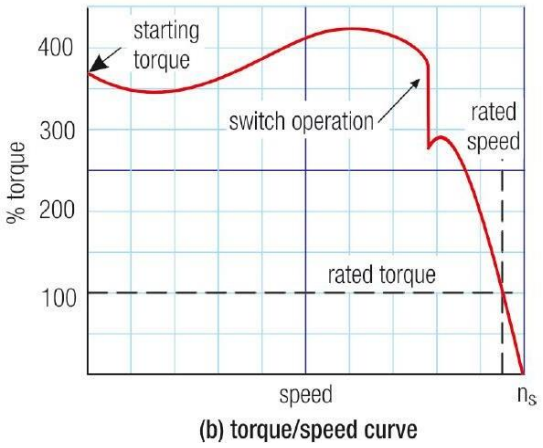




(A) _____ B_____

3. Study the torque curves below and answer the following questions





(b) torque/speed curve

Graph A ***Graph B***

a. Which graph represents a single phase motor which can be reversed while running

_____(1 Mark)

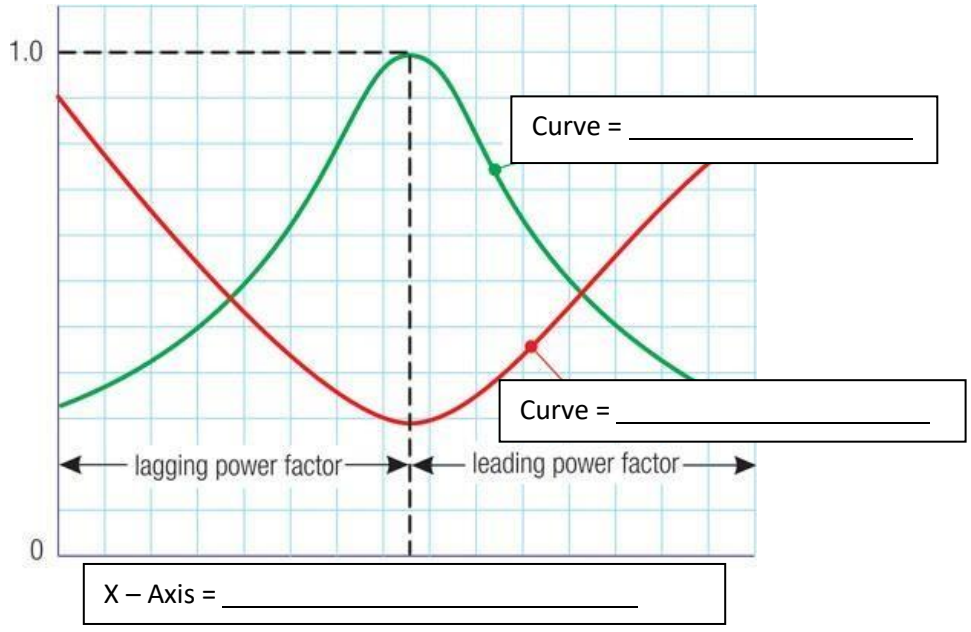
b. What motor design characteristics produces the torque curve represented by **graph B**

_____

_____(2 Marks)

4. Select the appropriate term and label the synchronous motor 'V Curve' below (6 Marks)

Power factor	Torque Curve	Field excitation
Impedance	Phase angle	Motor Current



SECTION D- CALCULATIONS (20 Marks)

All working must be shown as marks are allocated for correct working.

1. Determine the number of poles required by a three phase 50Hz alternator that is driven by a prime mover with a speed of 120rpm.

Answer:_____ (3 Marks)

2. An eight pole synchronous motor is connected to a 60Hz three phase supply.
   a) Calculate the synchronous speed. (2)
   b) Determine the rotor speed. (1)

Answer:_____ (3 Marks)

3. At full load a *three phase* 11kV alternator supplies a current of 1,335 amperes. Determine the rated output of the alternator.

Answer:_____ (3 Marks)

4. Determine the output current of *three phase* 250KVA, 415V alternator which is supplying a load with a power factor of 0.75 lagging.

Answer:_____ (3 Marks)

5. A three phase 50Hz star connected 8 pole alternator has 400 turns per phase and a flux of 40mWb and a machine constant (K) of 6. Determine the phase and line voltages.

Answer: _____

(3 marks)

6. What is the percentage voltage regulation of an alternator rated at 800 Volts if its terminal voltage is 775 Volts under load?:

(3 marks)

7. A three phase four-pole 400V, 50Hz, synchronous motor delivering 35kW to a load and draws a current of 62A with normal excitation (resistive) applied to the motor. Determine the :

   a) The input power to the motor

(2 marks)

Answer: _____

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\cos\phi = \frac{P}{S} \qquad \cos\phi = \frac{R}{Z} \qquad S = \sqrt{P^2 + Q^2}$$

$$S = VI \qquad P = VI\cos\phi \qquad Q = VI\sin\phi$$

$$f_o = \frac{1}{2\pi\sqrt{LC}} \qquad V_L = \sqrt{3}V_P \qquad I_L = \sqrt{3}I_P$$

$$S = \sqrt{3}V_L I_L \qquad P = \sqrt{3}V_L I_L \cos\phi \qquad Q = \sqrt{3}V_L I_L \sin\phi$$

$$\tan\phi = \sqrt{3}\left(\frac{W_2 - W_1}{W_2 + W_1}\right) \qquad Q = mC\Delta t$$

$$V' = 4.44\Phi f N \qquad \frac{V_1}{V_2} = \frac{N_1}{N_2} \qquad \frac{I_2}{I_1} = \frac{N_1}{N_2}$$

$$N_{syn} = \frac{120f}{p} \qquad s\% = \frac{(n_{syn} - n)}{n_{syn}} \times \frac{100}{1} \qquad f_r = \frac{s\% \times f}{100}$$

$$V_{reg}\% = \frac{(V_{NL} - V_{FL})}{V_{FL}} \times \frac{100}{1} \qquad V_{reg}\% = \frac{(V_{NL} - V_{FL})}{V_{NL}} \times \frac{100}{1} \qquad T = \frac{\Phi ZIP}{2\pi a}$$

$$I_{ST} = \frac{1}{3} \times I_{DOL} \qquad T_{ST} = \frac{1}{3} \times T_{DOL} \qquad I_{ST} = \frac{V_{ST}}{V} \times I_{DOL}$$

$$T_{ST} = \left(\frac{V_{ST}}{V}\right)^2 \times T_{DOL} \qquad I_{motor\,st} = \frac{\%TAP}{100} \times I_{DOL} \qquad I_{line\,st} = \left(\frac{\%TAP}{100}\right)^2 \times I_{DOL}$$

$$E = \frac{\Phi_v}{A} \qquad E = \frac{I}{d^2} \qquad \eta_v = \frac{\Phi_v}{P}$$

$$V_L = 0.45V_{ac} \qquad V_L = 0.9V_{ac} \qquad V_L = 1.17V_{phase}$$

$$V_L = 1.35V_{line} \qquad PRV = \sqrt{2}V_{ac} \qquad PRV = 2\sqrt{2}V_{ac}$$

$$PRV = 2.45V_{ac} \qquad V_{ripple} = \sqrt{2}V_{ac} \qquad V_{ripple} = 0.707V_{phase}$$

$$V_{ripple} = 0.1895V_{line}$$

Student Name:_____

Class : _____

Date : _____

ANSWER SHEET

Section A (Multi-choice Questions)

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				
Totals				

Question	A.	B.	C.	D.
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
Totals				