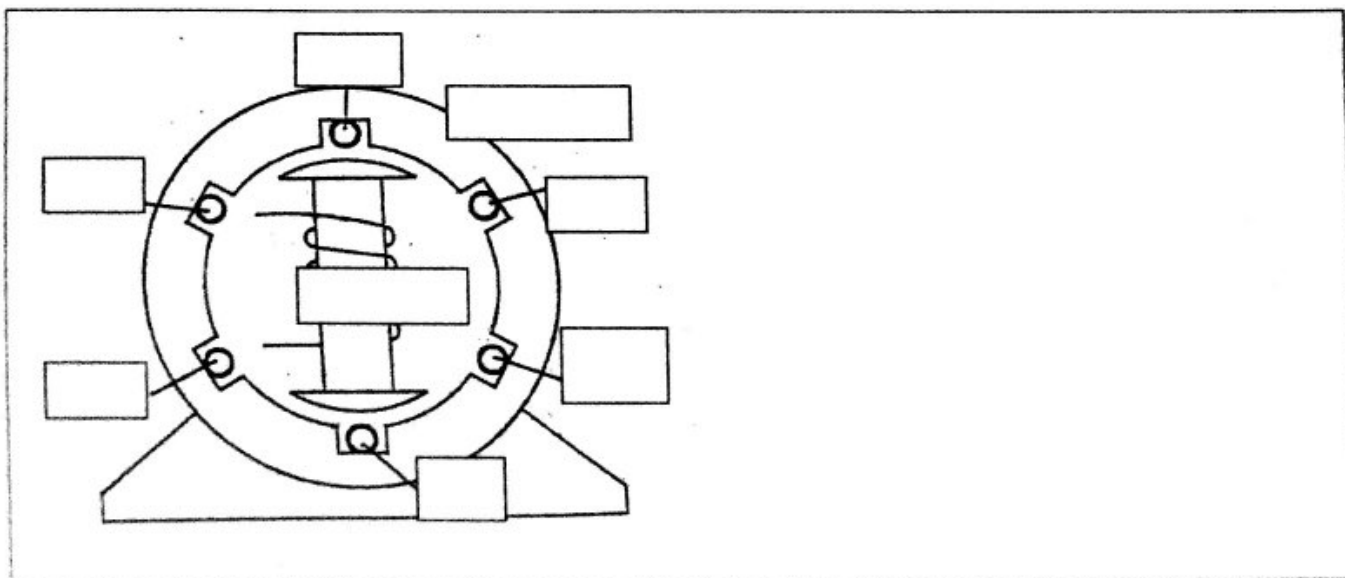


Assessment

Question 1

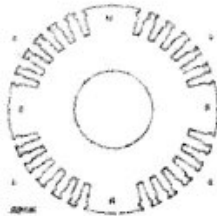
On the sketch shown below, label the stator, rotor and the start and the ends of each of the three phase windings



(ER 1.1)

Question 2

Complete the table to identify the type of alternator rotor. Insert the corresponding word from the list below

Rotor cross section	Type of rotor
	
	

Types to choose from:

(note that you will not need to use all the words and phrases in this list)

Squirrel cage rotor	Cylindrical rotor
Wound rotor	Salient pole rotor

(ER 1.1)

Question 3

Complete the following description using words from the list below to describe the operating principle of an alternator.

To induce an _____ in a winding, _____ motion between the _____ and a _____ field is required.

In larger alternators the magnetic field is easier to move than the windings, so the rotor, which is driven by a prime mover (such as steam), consists of an electromagnet.

The revolving electromagnet must be supplied with current from a stationary _____ voltage source via slip rings.

As the electromagnet moves past the winding, an EMF is induced in the winding proportional to its angular position, creating a _____ waveform.

For a single phase alternator there is _____ winding and for a three phase alternator there are _____ windings. Each winding produces an alternating voltage.

Words to choose from:

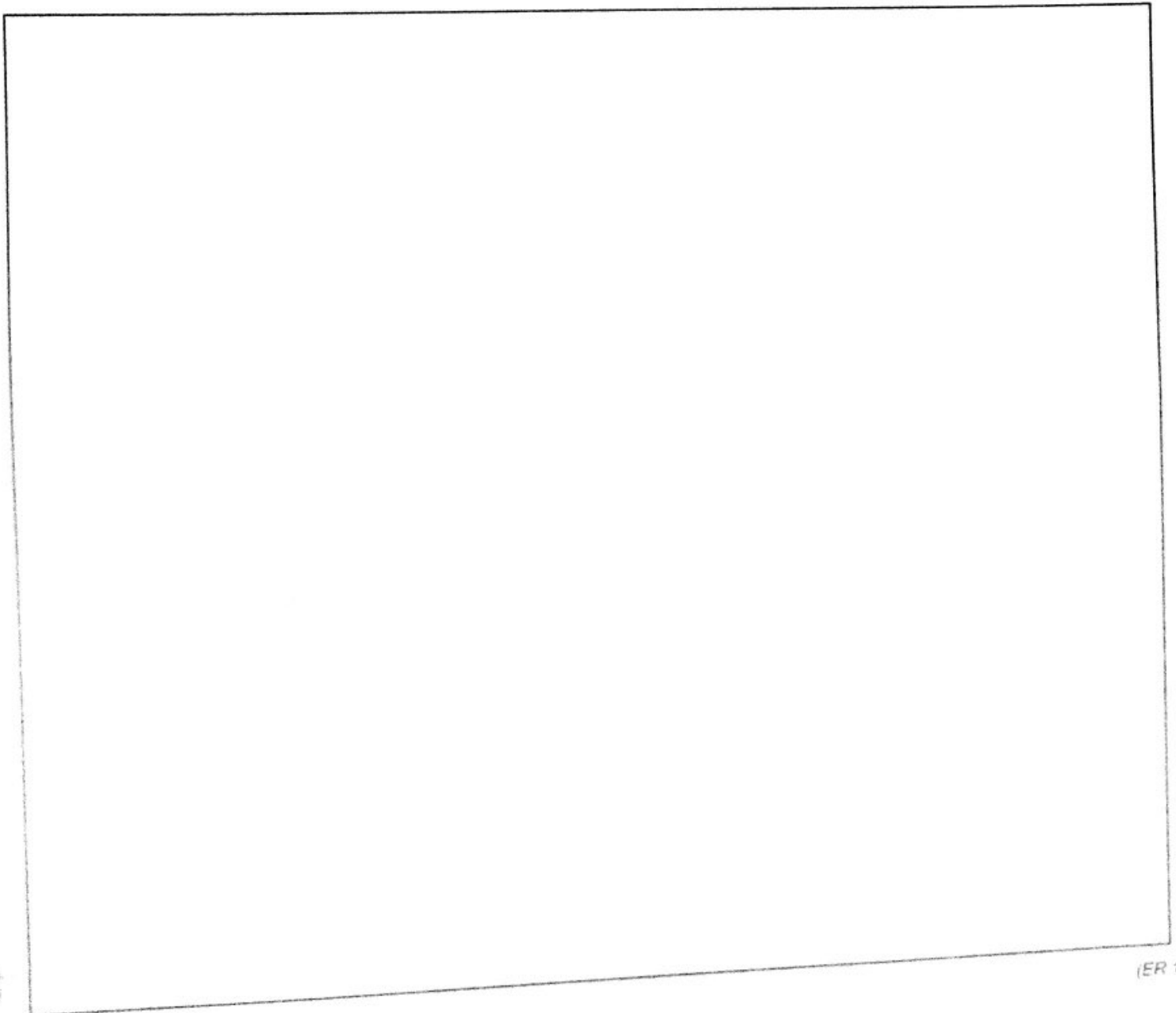
(note that you will not need to use all the words and phrases in this list)

DC	relative	constant	magnetic	electric
four	winding	electromagnet	one	AC
two	sinusoidal	square	three	EMF

(ER

Question 4

Sketch the waveforms of the three outputs of a two pole three phase alternator for one revolution. Divide the horizontal axis into 30 degree intervals. Use a different style or colour for each waveform.



(ER 1 2)

Question 5

Carry out the following calculations:

- a) Calculate the speed of a 16 pole alternator to produce a frequency of 50Hz.
- b) Calculate the number of poles required for a cylindrical alternator to produce a frequency of 50Hz if it rotates at 3000rpm.
- c) Calculate the frequency of a 4 pole alternator running at 1500rpm.
- d)

(ER 1.3)

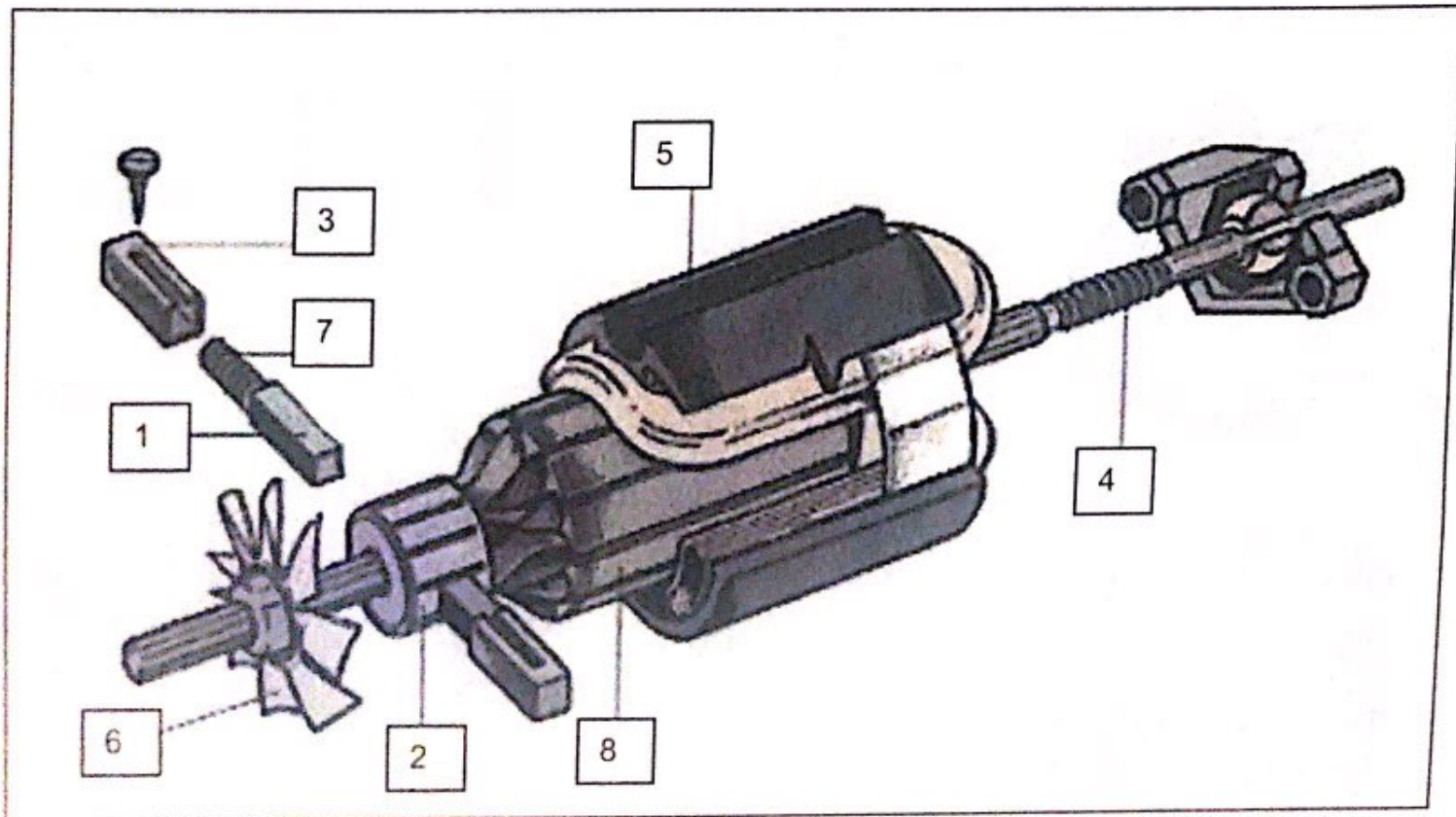
Question 6

Answer the following questions:

- a) Define the units "watts" and "horsepower" and state the relationship between them.
- b) Calculate the minimum rating of a motor in kW to replace a 5hp motor.

Question 7

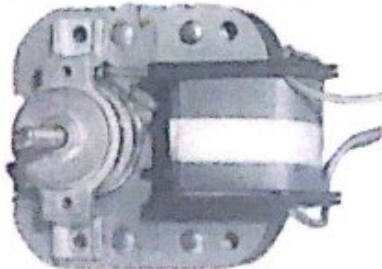
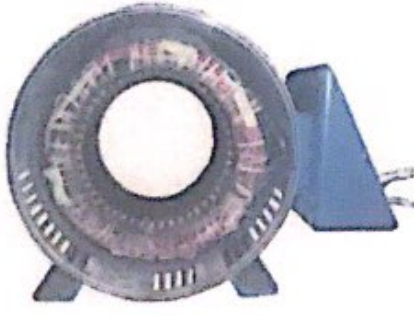
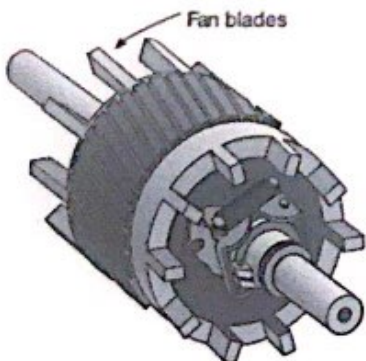
Enter the label number from the diagram into the table below, to match the motor component description.

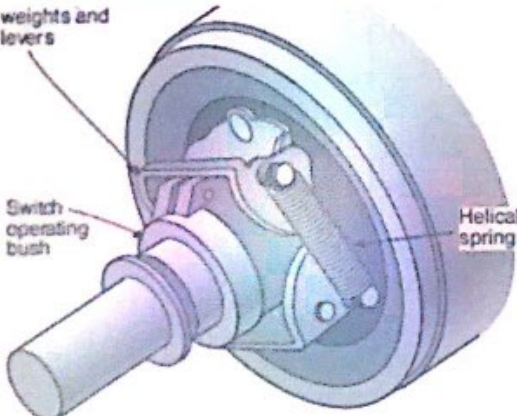


Description of universal motor component	Label number
Motor Shaft	
Armature	
Motor housing	
Fan	
Commutator	
Spring	
Brush holder	
Carbon Brush	

Question 8

Using the descriptions in the list at the end of the question, complete the table to describe single phase motors or components.

Motor or motor component	Description of component
	
	
	
	

Motor or motor component	Description of component
	
	

Descriptions to choose from:

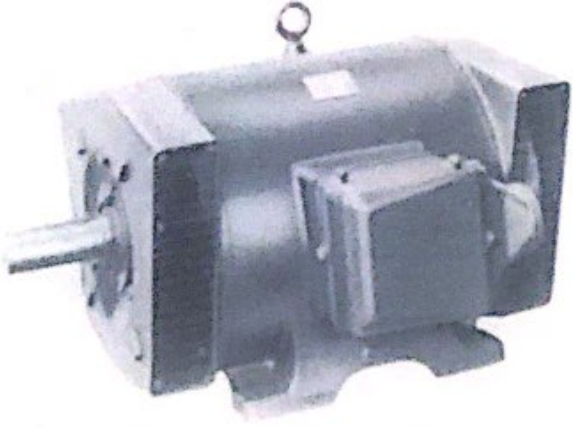
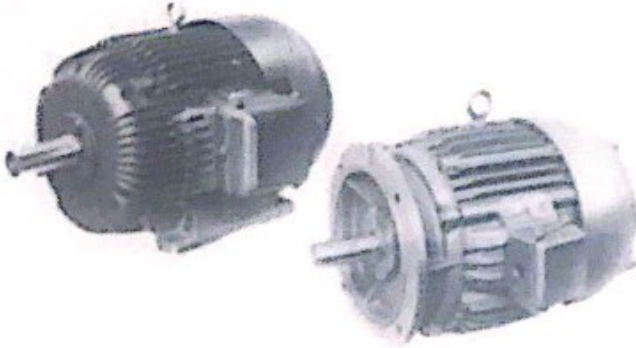
(note that you will not need to use all the words and phrases in this list)

Capacitor start capacitor run motor	Centrifugal switch	Rotor
Wound rotor	Reversing switch	Split phase motor
Starting capacitors	Stator	Shaded pole motor

(ER 2 1

Question 9

Complete the table to identify the type of enclosure and to describe the features of the following motor enclosures. Insert the corresponding types and features from the list below.

Motor enclosures	Type of enclosure	Features
		
		
		

Types and features to choose from:

(note that you will not need to use all the words and phrases in this list)

Totally enclosed fan ventilated	Flame proof	Openings positioned to protect against drops of water and screen to protect vents
Splash proof	Has no external vents	Totally enclosed and strong enough to contain any explosion that occurs in the motor
waterproof	dustproof	Drip proof and screen protected

Question 10

Refer to the table on the next page to answer this question.

Complete the table below to show understanding of the operating principles and applications of single phase motors.

Insert the row number (from the table on the next page) in the corresponding column for each type of motor listed. Two have been done for you.

Motor type	Components for starting	Cause of rotating magnetic field and starting torque	Application	Reasons for choice
Split Phase				
Capacitor Start	3			
Capacitor Start capacitor run				3
Permanently Split				
Shaded pole				
Universal				

Row number	Components for starting	Cause of rotating mag field and starting torque	Application	Reasons for choice
1	None	The different winding impedances cause small current phase shift which produces partial rotating magnetic field and starting torque	Floor Polishers	High starting torque
2	Start winding of different impedance in series with centrifugal switch	Current applied to armature through series field coil to create second magnetic field to produce torque. (No rotating magnetic field)	Compressors and pumps	Quiet
3	Start winding in series with capacitor and Centrifugal switch	Small capacitor causes current phase shift between windings and produces partial rotating magnetic field and torque	Portable tools	High starting torque and smoother running
4	Shading ring around split pole	Large capacitor causes current phase shift between windings and produces partial rotating mag field and starting torque	Fans and Ventilation	Low starting torque
5	Auxiliary winding identical to main winding with a small capacitor connected between windings	Large and small capacitors in parallel causes large current phase shift between windings and produces partial rotating mag field and large starting torque	Extractor fans	High torque at low speed and easy speed control
6	Auxiliary winding identical to main winding with small capacitor connected between windings plus starting capacitor with centrifugal switch	Induced current in shading ring causes time shift in production of second magnetic field which produces partial rotating magnetic field and small starting torque	Bench grinder	Low starting torque and Cheap

Question 11

Provide one method of speed control for a single phase induction motor **AND** state how this can be achieved.

(ER 2.4)

Question 12

List five methods of speed control for a universal motor.

	Speed control method
1	
2	
3	
4	
5	

(ER 2.4)

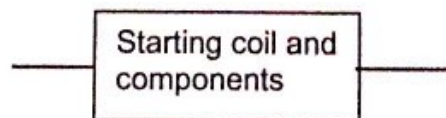
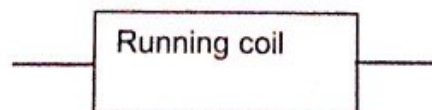
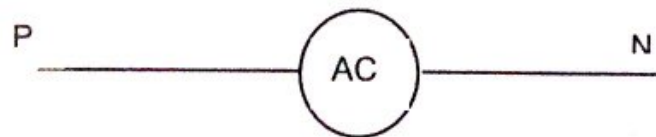
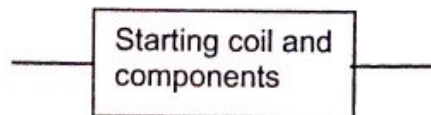
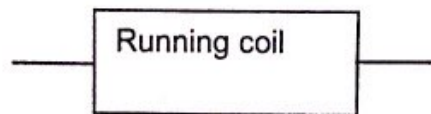
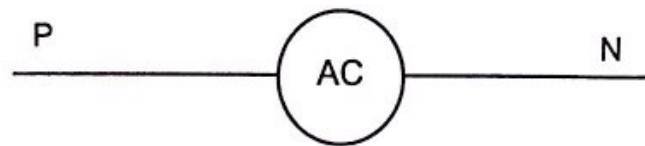
Question 13

Briefly describe how rotation reversal may be achieved in a universal motor.

(ER 2.5)

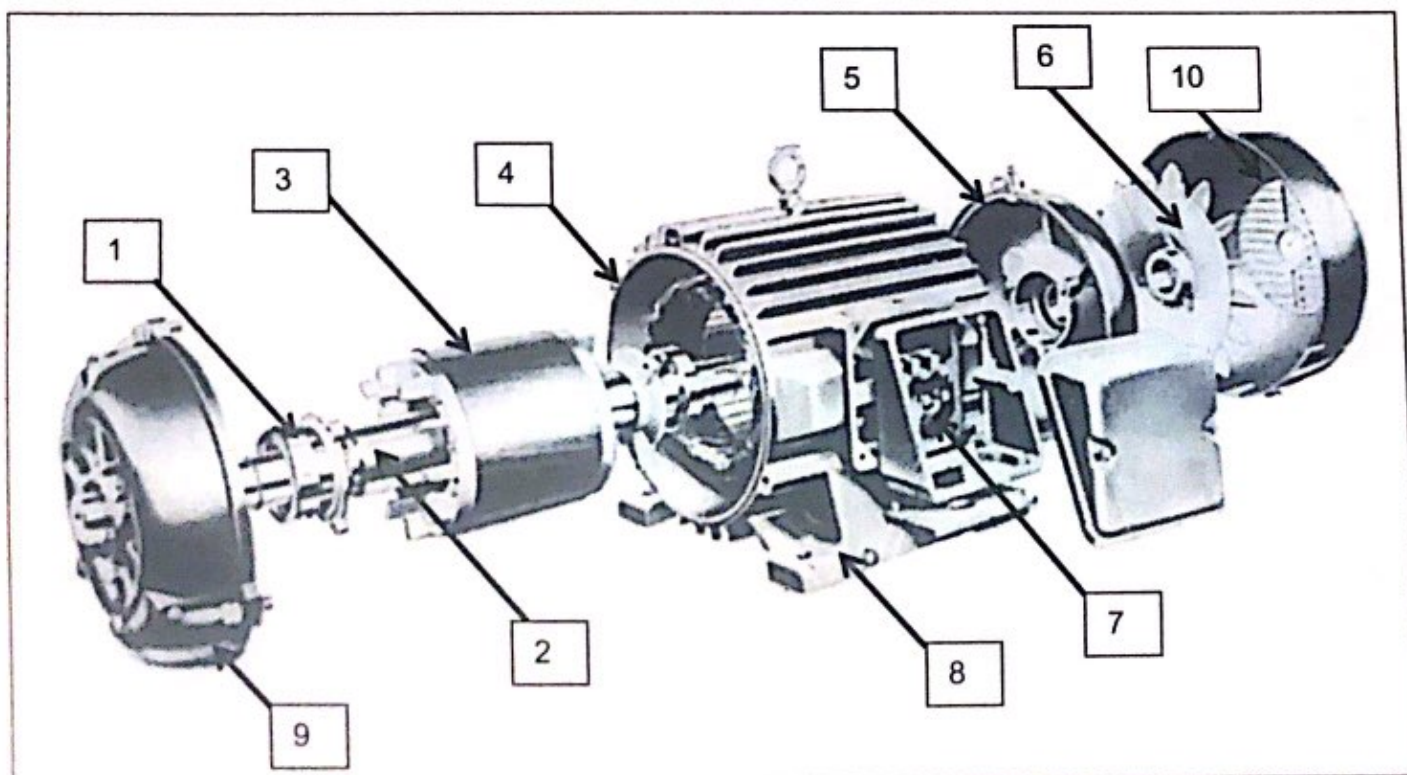
Question 14

Add lines to the two sketches below, showing two sets of connections for the windings of single phase induction motors running in opposite directions. **ALSO** briefly describe the method of reversal.



Question 15

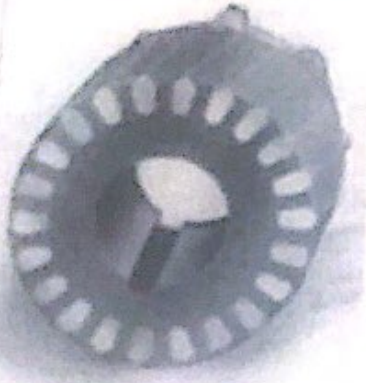
Enter the label number from the diagram below into the table which follows to match the three phase motor component description.



Description of component	Label number
Rotor	
Stator	
Terminal Box	
Fan	
Mounting Block or Foot	
End Shield DE	
Bearing	
End Shield NDE	
Shaft	
Fan Cover	

Question 16

Use the descriptions below to complete the table to identify the following **three phase motor components**.

Motor component	Description of component
	
	
	

Descriptions to choose from:

(note that you will not need to use all the words and phrases in this list)

Double cage rotor	Commutator	Squirrel cage Rotor
Armature	Wound rotor	Field pole

Question 17

Use the words in the table below to complete the following sentences to describe the **operating principle of a three phase squirrel cage induction motor**.

The _____ stator windings are situated 120 degrees apart from each other.

The three phase currents are _____ out of phase with one another.

These magnetic fields created by the stator thus produce a resultant _____ magnetic field.

This rotating magnetic field rotates past the rotor bars and induces an _____ in them.

The rotor bars are connected by the _____ and form an electric circuit.

An electric _____ flows in the _____

This rotor current produces another _____ field.

The two magnetic fields produce _____ in the direction of the stator rotating magnetic field.

The rotor starts to move in the _____ direction of the rotating magnetic field.

Words to choose from:

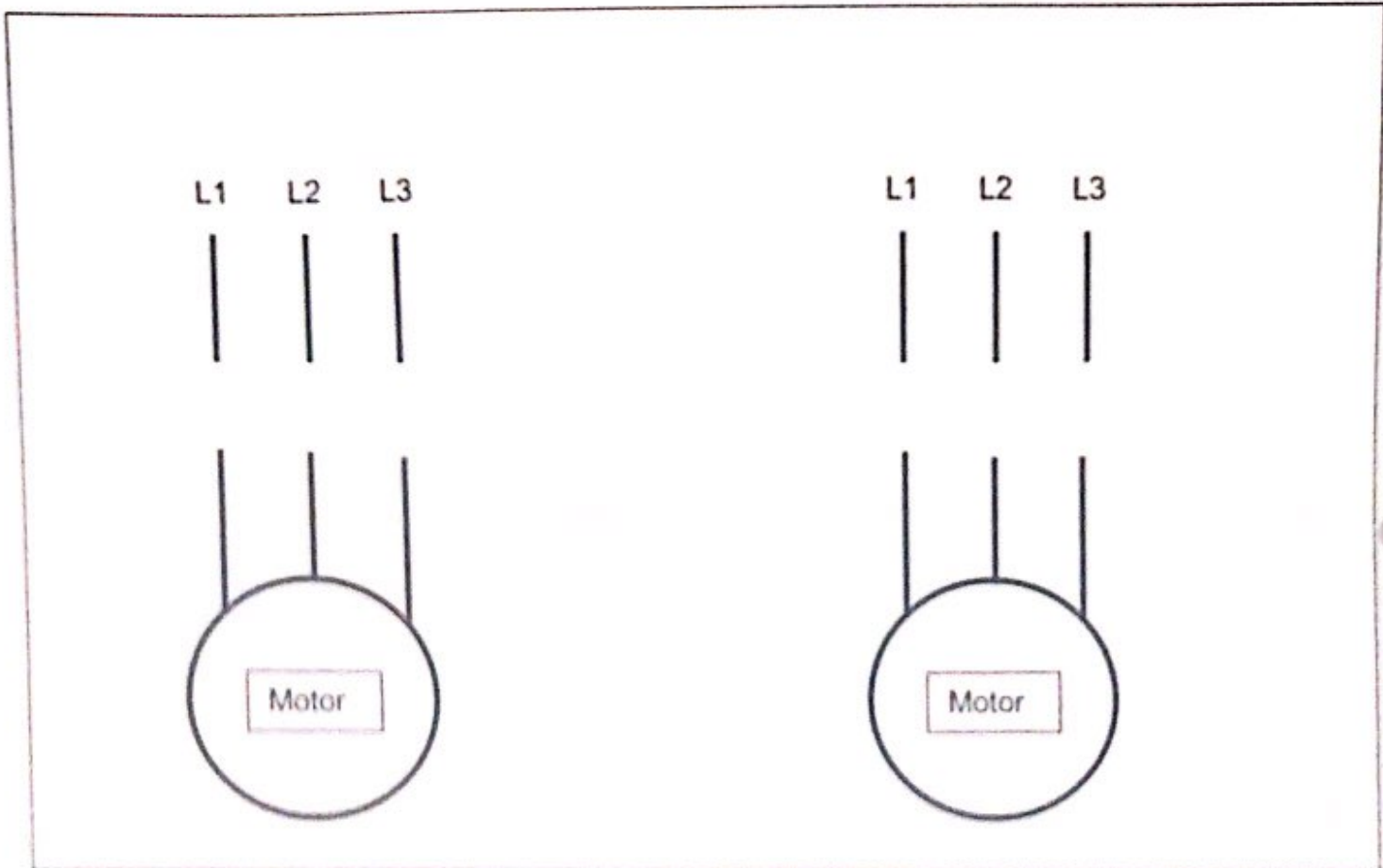
(note that you will not need to use all the words and phrases in this list)

a torque	opposite	120 degrees	90 degrees	two
four	three	magnetic	same	180 degrees
end rings	rotating	square	rotor bars	power
electric	static	EMF	current	voltage

(ER 5)

Question 18

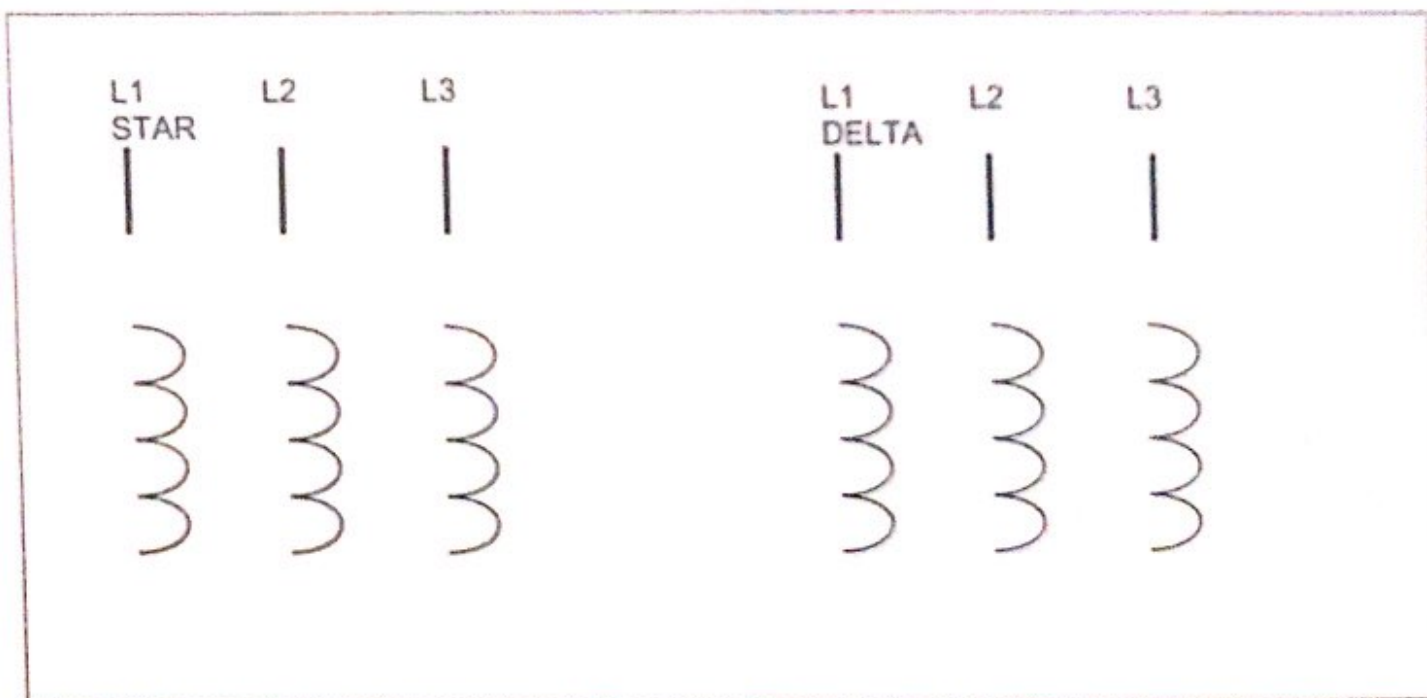
Add lines to the two sketches below, showing the connections to the power supply to ensure that the three phase motors run in opposite directions. **ALSO** briefly describe the method of reversal.



(ER 5.2)

Question 19

Add lines to the two sketches below, showing the connections of the windings and power supply for a delta and star configuration.

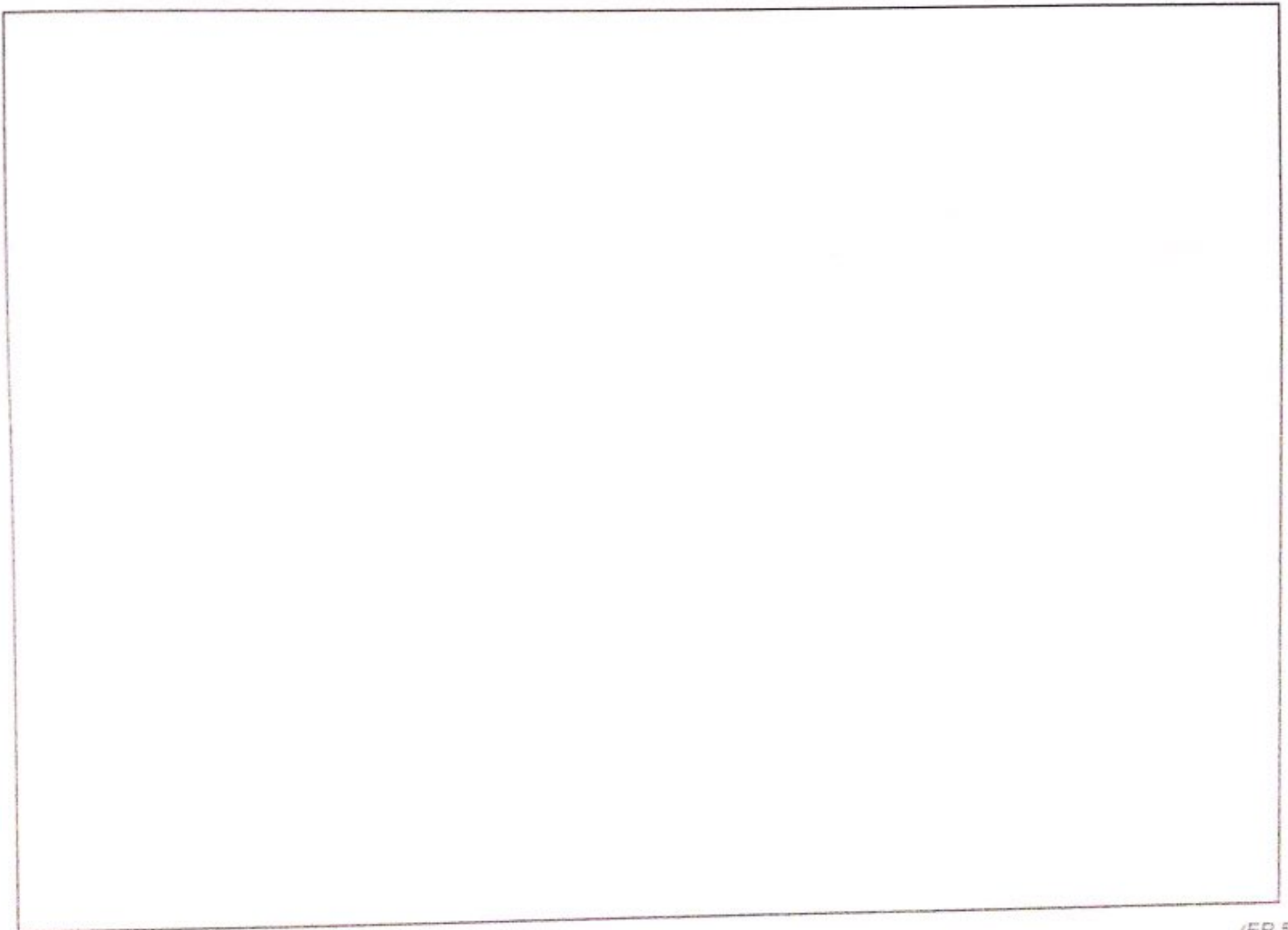


(ER 5.1)

Question 20

Sketch and label speed versus torque curves that show starting torque, running torque, rated torque, pull-out speed, and rated speed for the following squirrel cage rotor induction motors:

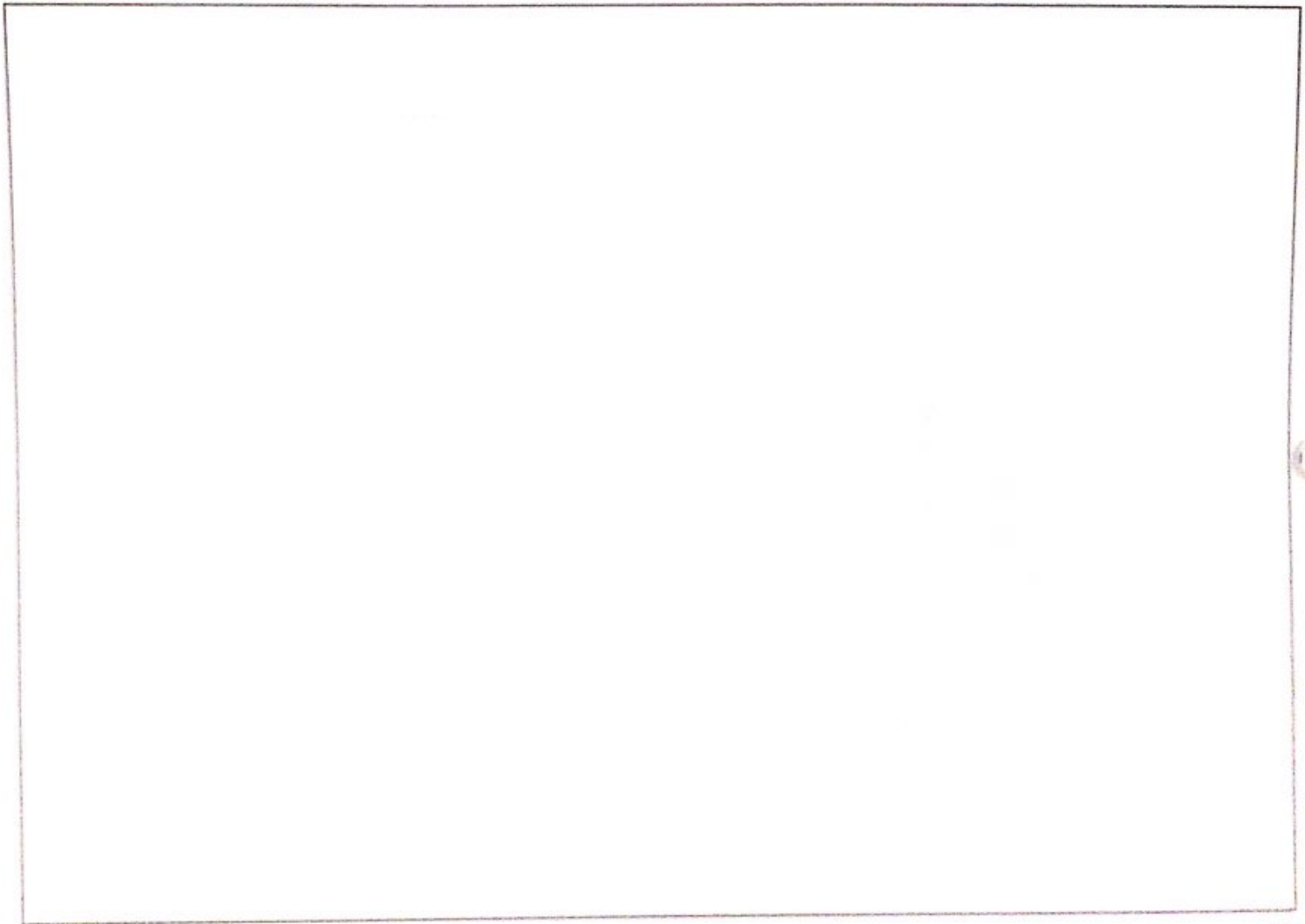
- Single
- Double



(ER 5.5)

Question 21

Sketch and label **speed versus torque curves** that show starting torque, running torque, rated torque, pull-out speed, and rated speed for a wound rotor induction motor.



(ER 5.5)

Question 22

Complete the table to describe the application and reasons for selection of the following motors. Insert the corresponding letter from the list below.

Rotor Type	Application	Reasons
Squirrel cage rotor		
Double cage rotor		
Wound rotor		

A	Lower starting current and increased starting torque – which can be adjusted
B	Water pumping motors
C	Cheapest
D	Lower starting current, increased starting torque and reduced pull out torque
E	General purpose minimum slip at rated load
F	Conveyor belts or spinning frames