



# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

## School of RAC Skills

### III Semester, 1<sup>st</sup> In-Sem. Examination

#### B. Voc. Program, Winter Semester (2020-21)

Course Code: HVA1301

Course Name: Refrigerant & Psychrometry

Time: 1 Hour

Max. Marks: 20

#### Instruction:

1. Attempt all Questions.
2. Each question of Section – A carries 01 mark.
3. Each question of Section – B carries 02 mark.
4. Each question of Section – C carries 03 mark.

#### Section – A

05\*01 = 05 Marks

1. The ozone friendly refrigerant R-134a contains:

- a. One Chlorine atom
- b. Two Chlorine atom
- c. Four Chlorine atom
- d. No Chlorine atom

2. Which refrigerant is most environmentally friendly among the HC, HFC and HCFC refrigerant?

- a. HC
- b. HFC
- c. HCFC
- d. Not comparable

3. For large commercial installations, NH<sub>3</sub> is used as a refrigerant because of its:

- a. Large latent heat
- b. Relatively cheaper price
- c. Moderate working pressure
- d. All of the above

4. The rate of body heat loss is affected by-

- a. Air Humidity
- b. Air motion
- c. Both a and b
- d. None of the ab above

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5. specific enthalpy is measured in-

- a. KJ/Kg
- b. KJ
- c. KJ/Kg-K
- d. None

### Section – B

03\*02 = 06 Marks

1. What is the importance of degree of sub- cooling in a VCRS?
2. Why do we use refrigerant in refrigeration system? How it works in the cycle?
3. Which component of refrigeration system is of greatest size? Give the explanation.

### Section – C

03\*03 = 09 Marks

1. Describe the classification of refrigerant.
2. Describe VCRS in detail with a neat sketch.
3. Explain the basic properties of an ideal refrigerant.



**BHARTIYA SKILL DEVELOPMENT UNIVERSITY****School of RAC Skills****III Semester, 1<sup>st</sup> In-Sem. Examination****B. Voc. Program, Winter Semester (2020-21)****ANSWER KEY****Course Code: HVA1301****Time: 1 Hour****Course Name: Refrigerant & Psychrometry****Max. Marks: 20****Section – A**

05X01 = 05 Marks

1. D. No Chlorine atom
2. A. HC
3. D. All of the above
4. C. Both a and b
5. A. KJ/Kg

**Section – B**

03X02 = 06 Marks

1. What is the importance of degree of sub- cooling in a VCRS?

**Answer:** To ensure low temperature refrigerant after expansion device for high amount of latent heat of vaporization.

2. Why do we use refrigerant in refrigeration system? How it works in the cycle?

**Answer:** Refrigerant- A heat carrier substance.

For working – It undergoes phase changes at suitable pressure and temperature.

3. Which component of refrigeration system is of greatest size? Give the explanation.

**ANSWER:** Condenser

Heat rejected by condenser= Heat from evaporator+ Heat from compressor

**Section – C**

03X03 = 09 Marks

1. Describe the classification of refrigerant.

Chlorofluorocarbons (CFCs)

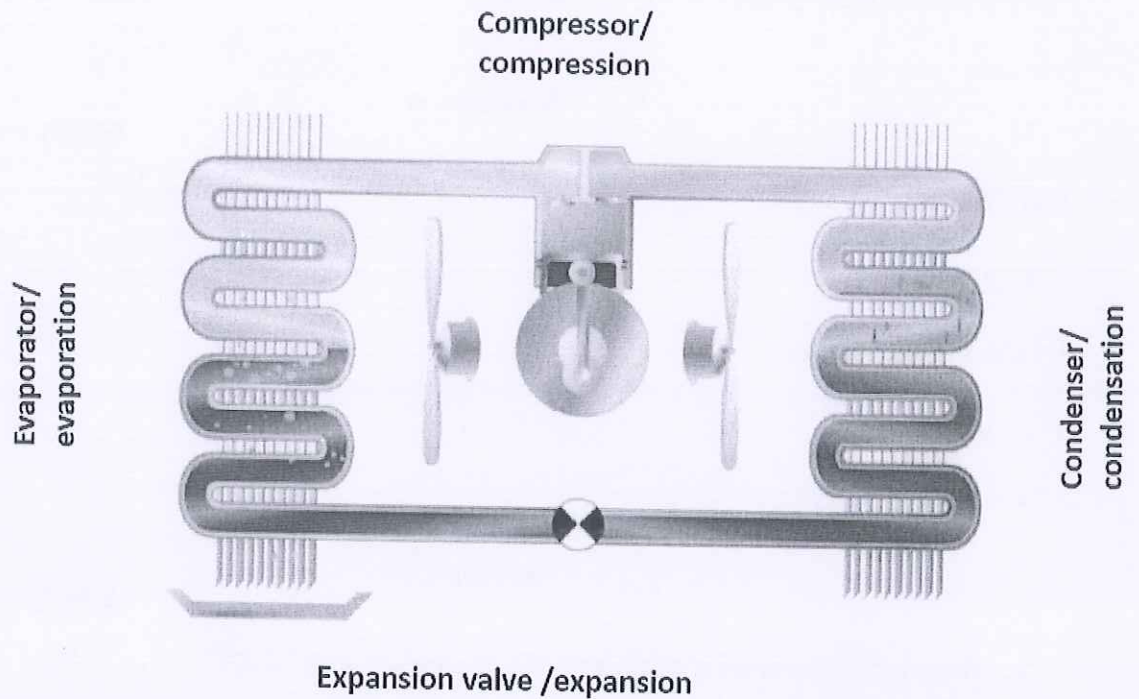
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Hydrochlorofluorocarbons (HCFCs)

Hydrofluorocarbons (HFCs)

Hydrocarbons (HCs)

2. Describe VCERS in detail with a neat sketch.



3. Explain the basic properties of an ideal refrigerant.

**ANSWER:**

Low boiling and freezing point.

High critical pressure and temperature.

High latent heat of vaporization.

Low specific heat of liquid, and high specific heat of vapor.

Low specific volume of vapor.

High thermal conductivity.

Non- corrosive to metal.

Non-flammable and non-explosive.

Non-toxic.

Low cost.

Easily and regularly available.

Easy of locating leaks by odour or suitable indicator.

Mixes well with oil.

High coefficient of performance & Environment friendly.





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Registration No.: .....

School of RAC Skills

Session: 2020-21 (Winter Semester)

B. Voc. Program III Semester,

1<sup>st</sup> In-Sem. Examination

Course Code: HVA1302

Course Name: Compressor Condenser Evaporator

Instruction: In section A, write both option and answer.

Time: 1 Hour

Max. Marks: 20

## Section – A

05X01 = 05 Marks

- Which oil is most suited with refrigerant R134a?
  - PAG
  - Mineral oil
  - AB
  - POE
- Which is the main function of a compressor?
  - Increase temperature
  - Convert liquid into gas
  - Exchange heat
  - None of them
- Which is the main function of an evaporator?
  - Increase pressure
  - Heat Exchange
  - Condense the vapour
  - None of them
- Diaphragm type compressor is a type of \_\_\_\_\_ compressor.
  - Reciprocating Compressor
  - Rotary Compressor
  - Axial Compressor
  - Centrifugal Compressor
- \_\_\_\_\_ is a type of plate in tube heat exchange.
  - Compressor
  - Condenser
  - evaporator
  - Both compressor and evaporator

## Section – B



03X02 = 06 Marks

6. Write a short note on reciprocating compressor.
7. What are the various modes of heat transfer?
8. How does condenser work, explain with diagram?

**Section – C**

03X03 = 09 Marks

9. Write a note on classification of condenser.
10. Explain the all types of rotary compressors.
11. Explain any three types of evaporator.

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School of RAC Skills  
Session: 2020-21 (Winter Semester)  
B. Voc. Program III Semester,  
1<sup>st</sup> In-Sem. Examination

Course Code: HVA1302

Time: 1 Hour

Course Name: Compressor Condenser and Evaporator

Max. Marks: 20

Instruction: In section A, write both option and answer.

Answer Key  
Section – A

05X01 = 05 Marks

1. Which oil is most suited with refrigerant R134a?  
(a) PAG
2. Which is the main function of a compressor?  
(d) None of them
3. Which is the main function of an evaporator?  
(b) Heat Exchange
4. Diaphragm type compressor is a type of \_\_\_\_\_ compressor.  
(a) Reciprocating
5. \_\_\_\_\_ is a type of tube in plate heat exchange.  
(c) Evaporator

Section – B

03X02 = 06 Marks

6. Write a short note on reciprocating compressor.  
Reciprocating Compressor has piston, cylinder, inlet valve, exit valve, connecting rod, crank, piston pin, crank pin and crank shaft. Inlet valve and exit valves may be of spring loaded type which get opened and closed due to pressure differential across them. Let us consider piston to be at top dead centre (TDC) and move towards bottom dead centre (BDC). Due to this piston movement from TDC to BDC suction pressure is created causing opening of inlet valve. With this opening of inlet valve and suction pressure the atmospheric air enters the cylinder. 5 Air gets into cylinder during this stroke and is subsequently compressed in next stroke with both inlet valve and exit valve closed. Both inlet valve and exit valves are of plate type and spring loaded so as to operate automatically as and when sufficient pressure difference is available to cause deflection in spring of valve plates to open them. After piston

7. What are the various modes of heat transfer?

Conduction of Heat

Heat conduction is a process in which heat is transferred from the hotter part to the colder part in a body without involving any actual movement of the molecules of the body. Heat transfer takes place from one molecule to another molecule as a result of the vibratory motion of the molecules. Heat

transfer through the process of conduction occurs in substances which are in direct contact with each other. It generally takes place in solids.

Conduction example: When frying vegetables in a pan. Heat transfer takes place from flame to the pan and then to the vegetables.

Based on the conductivity of heat, substances can be classified as conductors and insulators. Substances that conduct heat easily are known as conductors and those that do not conduct heat are known as insulators.

## 2. Convection of Heat

In this process, heat is transferred in the liquid and gases from a region of higher temperature to a region of lower temperature. Convection heat transfer occurs partly due to the actual movement of molecules or due to the mass transfer. For example. Heating of milk in a pan.

## 3. Radiation of Heat

It is the process in which heat is transferred from one body to another body without involving the molecules of the medium. Radiation heat transfer does not depend on the medium.

For example: In a microwave, the substances are heated directly without any heating medium.

### 8. How does a condenser work, explain with diagram?

When the heat is absorbed by the evaporator, it passes through the compressor, is compressed to a higher pressure, then passes to the condenser.

With the higher pressure, the boiling point of the refrigerant is raised to above the outdoor ambient temperature/pressure. Sensible heat (superheat) that has been added to the gas by the heat of compression begins to bleed off the refrigerant until it reaches a temperature that corresponds to the pressure at which it can condense. At that time, the refrigerant condenses. Here both gas and liquid are present. The refrigerant is now called saturated. The liquid/gas mix at this point will not change in temperature but will change its state to a liquid. The vast majority of the heat is released during this phase.

Once the latent heat has been removed, there will be no more gas in the pipe. The liquid then can sub cool. The last few passes of the condenser will release sensible heat before it travels to the expansion device.

## Section – C

03X03 = 09 Marks

### 9. Write a note on classification of condenser.

construction, water cooled condenser are of three types viz.

- (1) shell and tube type,
- (2) double pipe and
- (3) shell and coil type.

In double pipe arrangement, the refrigerant condenses in the outer pipe and the cooling water flows through the inner pipe in counter current direction.

The shell and coil type condenser consists of shell in which water coil is placed for the circulation of water. Both of these types are not commonly used on account of difficulty of cleaning the water side surface of the pipe or coil.

It is necessary to use soft water for the water cooled condenser. The regular cleaning of the condenser tubes is necessary to maintain optimum heat transfer rate.

#### Evaporative condenser

The evaporative condenser uses both, water and air for the condensation of the refrigerant. The evaporative condenser consists of a coil in which the refrigerant is flowing and condensing inside and its outer surface is wetted with water and exposed to stream of air to which heat is rejected principally by evaporation of water. The water is sprayed over the pipes carrying hot refrigerant vapour and movement of air over the wet tubes creates evaporation of water resulting into cooling of the refrigerant. The heat lost from the refrigerant is carried by the air-water mixture leaving the condenser.

### 10. Explain the any two types of rotary compressors.

- Rotary screw compressors



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It uses two Asymmetrical rotors that are also called helical screws to compress the air. The rotors have a very special shape and they turn in opposite directions with very little clearance between them. The rotors are covered by cooling jackets. Two shafts on the rotors are placed that transfer their motion with the help of timing gears that are attached at the starting point of the shafts/compressor.

- Rotary scroll compressor

They are one of the best compressor type in rotary compressors. The air is compressed using two spiral elements. One element is stationary and the other one moves in small eccentric circles inside the spiral. Air gets trapped inside the spiral way of that element and get transported in small air-pockets to the center of the spiral.

Simply air gets trapped at the outer edge and get compressed due to reduction of area as it travels from outer edge to inner edge. It takes about 2 to 3 turns for the air to reach the pressure output in the center.

### 11. Explain the working of any two types of evaporators with neat sketch.

#### Plate Type of Evaporators

In the plate type of evaporators the coil usually made up of copper or aluminum is embedded in the plate so as to form a flat looking surface. Externally the plate type of evaporator looks like a single plate, but inside it there are several turns of the metal tubing through which the refrigerant flows. The advantage of the plate type of evaporators is that they are more rigid as the external plate provides lots of safety. The external plate also helps increasing the heat transfer from the metal tubing to the substance to be chilled. Further, the plate type of evaporators are easy to clean and can be manufactured cheaply.





**School of RAC Skills**

**Session: 2020-21 (Winter Semester)**

**B. Voc. 3<sup>rd</sup> Semester,**

**1<sup>st</sup> In-Sem. Examination**

**Course Code: HVA1303**

**Time: 1 Hours**

**Course Name: Air distribution**

**Max. Marks: 20**

**Instruction: Attempt all questions**

**Section – A**

05X05 = Marks

1. Unit of clothing is called ?
  - a) clo
  - b) met
  - c) Psia
  - d) Inches .
2. Warm air heats a room better if distributed
  - a) low in the room.
  - b) high in the room.
  - c) behind the furniture.
  - d) under the curtains.
3. The perception of comfort relates to which of the following?
  - a) individual physical condition
  - b) body heat exchange with the surroundings
  - c) physiological characteristics
  - d) all of the above
4. Air flow above \_\_\_\_\_ fpm is considered not good for human comfort.
  - a) 30 b) 40 c) 60 d) 100
5. Evaporation occurs in human body through:
  - a). Perspiration
  - b). Respiration
  - c) Both A&B
  - d) None of the above

**Section – B**

03X02 = 06 Marks

1. What is thermal comfort for humans?
2. How does metabolism affect perception of thermal comfort?
3. What is the importance of air and air flow?

**Section – C**

03X03 = 09 Marks

1. What are body heat rejection mechanisms?
2. How will you design for thermal comfort.
3. How to account for and manage human comfort using HVAC systems?





School of RAC Skills

Session: 2020-21 (Winter Semester)

B. Voc. 3<sup>rd</sup> Semester,

1<sup>st</sup> In-Sem. Examination

Course Code: HVA1303

Course Name: Air distribution

Instruction: Attempt all questions

Time: 1 Hours

Max. Marks: 20

*Answer key*  
Section – A

05X05 = Marks

1. a
2. a
3. d
4. b
5. c

Section – B

03X02 = 06 Marks

1. Comfort is a feeling of physical contentment with the environment. For Humans it is at 73°F and 50-55 % RH

2. **Metabolism affects perception of thermal comfort**

- Muscular activity
- Digestive process
- Daily cycle
- Health
- Age
- Gender

3. Understanding importance of air and airflow is necessary to troubleshoot and maintain an HVACR system.

- Factors affecting airflow will affect system performance.
- Most properties responsible for human comfort are all dependent on air.
- Fresh Air flow is necessary to maintain oxygen level in a space.
- 

Section – C

03X03 = 09 Mark



2. Designing for Thermal Comfort

- ⊕ Weather conditions/Geographical location
- ⊕ Building use and occupancy
- ⊕ Architectural details
- ⊕ Heating/cooling sources
- ⊕ Heating/cooling distribution systems
- ⊕ HVAC system controls

3. List the factors that affect people's comfort

- ⊕ Explain the role of metabolism in thermal comfort
- ⊕ List three means of losing metabolic heat
- ⊕ Compare the effects of air conditions on metabolic heat transfer
- ⊕ Describe how the body reacts to thermal extremes

*Q*

*Ans!*

# BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Refrigeration & Air conditioning Skills

3<sup>rd</sup>-Semester, 1<sup>st</sup> In-Sem. Examination

B. Voc. Program, Winter Semester

Course Code: HVA1304

Course Name: Thermal Insulation

Time: 1 Hour

Max. Marks: 20

**Instruction:** Attempt all questions.

## Section – A

05X01 = 05 Marks

Q1. Formula of critical thickness of insulation through spherical wall?

- a)  $k/h$                       b)  $2k/h$                       c)  $h/2k$                       d)  $h/k$

Q2. Unit of convective heat transfer is?

- a)  $w/m^2 K$                       b)  $wm^2/K$                       c)  $w/m K$                       d)  $wm/K$

Q3. Thermal Insulation in Cold lines are for \_\_\_\_\_ ?

- a) Heat loss                      b) Heat Gain  
c) both a & b                      d) none of the above

Q4. What is the value of  $\lambda$  for Building Materials according to ISO & EN?

- a)  $\lambda < 0,065 W/MK$                       b)  $\lambda > 0,065 W/MK$   
c)  $\lambda = 0,065 W/MK$                       d)  $\lambda < \text{or} = 0,065 W/MK$

Q5. Which insulation has lowest working temperature?

- a) Rock Wool                      b) Plastic foams  
c) Glass wool                      d) Fiber Glass

## Section – B

03X02 = 06 Marks

Q6 What are different modes of heat transfer, explain in detail?

Q7 What is Thermal Insulation, explain with example?

Q8 Define thermal Conductivity?

## Section – C

03X03 = 09 Marks

Q9 Define Mean temperature for Thermal conductivity with Equation?

Q10 Types of Insulation and their classification?

Q11 Draw the flow chart for classification of DIN 4102?



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School of Refrigeration & Air conditioning Skills  
3<sup>rd</sup>-Semester, 1<sup>st</sup> In-Sem. Examination  
B. Voc. Program, Winter Semester

Course Code: HVA1304  
Course Name: Thermal Insulation

Time: 1 Hour  
Max. Marks: 20

Instruction: Attempt all questions.

## Section – A

*Answer key*

05X01 = 05 Marks

- A1. b) 2k/h
- A2. b)  $Wm^2/K$
- A3. a) Heat loss
- A4. b)  $\lambda > 0,065 W/MK$
- A5. b) Plastic foams

## Section – B

03X02 = 06 Marks

A6 There are three modes of Heat Transfer.

Conduction: - Thermal conduction is due to the motion of free electrons in the outermost shell of the atom. In liquids and poorly conducting solids, oscillation of the molecular lattice is reason of conduction.

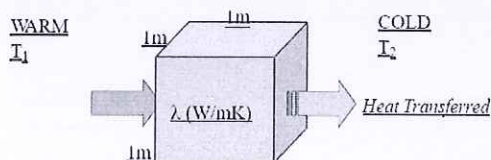
Convection -Heat transfer through convection, is due to the heat transfer between fluid and solid surface of matter.

There are two types of convection Natural and Forced.

Radiation is the transfer of energy through waves (electromagnetic radiation) or fast travelling particles (particulate radiation).

A7 *Thermal Insulation*, is the resistance offered to reduce the heat transfer in a considerable amount. To maintain equilibrium with System and surrounding in configuration  
Example is for cold lines prevents heat loss and heating lines prevents heat gains.

A8 It is the quantity of the energy which passes through a  $m^3$  of insulating material where there is 1 degree Celsius difference in temperature between opposite surfaces.



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## Section – C

03X03 = 09 Marks

A9 T mean is the average for the given range of Temperature.  
 Having temperature of medium and Temperature of ambience

$$t_{\text{mean}} = \frac{T_{\text{ambient}} + T_{\text{medium}}}{2}$$

A 10 There are Mainly classified in to Three Categories based on Physical.

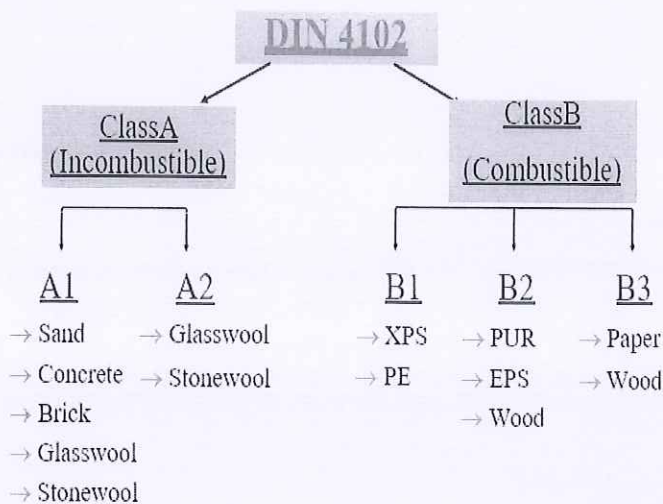
Solid, liquid, and gaseous

solid insulating materials are fibrous, ceramic, mica, glass, rubber, and resinous.

The liquid insulating materials are mineral oils, synthetic oils, transformer oils, and miscellaneous oils.

The gaseous insulating materials are air, hydrogen, nitrogen, and Sulphur hexafluoride.

A 11



*H. K. Sharma*

*[Signature]*



**School of RAC Skills**  
**Session: 2020-21 (Winter Semester)**  
**B. Voc. Program, IIIrd Semester,**  
**1<sup>st</sup> In-Sem. Examination**

**Set A**

**Course Code: HVA1305**

**Time: 1 Hour**

**Course Name: Electrical & Electronics Safety Testing**

**Max. Marks: 20**

**Instruction:**

1. Attempt all Questions.
2. Each question of Section – A carries 01 mark.
3. Each question of Section – B carries 02 mark.
4. Each question of Section – C carries 03 mark.

**Section – A**

05X01 = 05 Marks

1. Definition of Hazard?
  - a. Anything that can cause harm
  - b. Use of Equipment
  - c. Use of Tools
  - d. Measurement of risk
2. Type of Chemical Hazard:
  - a. Noise
  - b. Tools
  - c. Welding
  - d. None of the above
3. Biological Hazards Include?
  - a. Virus
  - b. Bacteria
  - c. Insects
  - d. All of the above

4. Most preferred control measures are :

- A. PPE
- B. Administrative controls
- C. Isolate
- D. Eliminate



5. Example of PPE:

- A. hand gloves
- B. insects
- C. Radiation
- D. Bacteria

## Section – B

03X02 = 06 Marks

1. Calculate total capacitance value connected in series:  $2\mu\text{F}$ ,  $5\mu\text{F}$  and  $15\mu\text{F}$ .
2. What is inductor?
3. What is Risk and Hazard? Explain by giving Examples.

## Section – C

03X03 = 09 Marks

1. Explain the hierarchy of controls.
2. What are the possible causes of risk?
3. Explain safety hazards with examples.

*Devi Singh*

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School of RAC Skills

III Semester, 1<sup>st</sup> In-Sem. Examination

B. Voc. Program, Winter Semester (2020-21)

Answer Key

Course Code: HVA1305

Time: 1 Hour

Course Name: Electrical &amp; Electronics safety testing

Max. Marks: 20

Section – A

05X01 = 05 Marks

1. Definition of Hazard:
  - a. Anything that can cause harm
2. Type of Chemical Hazard
  - d. None of the above
3. Biological hazard includes
  - d. None of the above
4. Most preferred control measures are
  - d. Eliminate
5. example of PPE
  - A. Hand Gloves

Section – B

03X02 = 06 Marks

1. Calculate total capacitance value connected in series: 2 $\mu$ F, 5 $\mu$ F and 15 $\mu$ F.

Answer  $1/C_{TOTAL} = 1/C_1 + 1/C_2 + 1/C_3 = 1/2 + 1/5 + 1/15$   
 $= 0.5 + 0.2 + 0.066 = 0.766 \mu F$

2. What is an Inductor.

Answer An Inductor (also known as a choke) is a passive two-terminal electrical component that store energy in a magnetic field when electric current flows through it.

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3. What is Risk And Hazard. Explain by giving examples

ANSWER: Hazard - A hazard is something that can cause harm,

Risk - A risk is the chance, high or low, that any hazard will actually cause somebody harm.

For Ex. Slippery surface is the hazard and slip on that and have major injury is the risk.

### Section – C

03X03 = 09 Marks

1. Explain Hierarchy of Controls

Answer Hierarchy of controls includes:

Eliminate : Physically remove the hazard.

Substitute: Replace the hazard

Engineering controls : Isolate people from hazard.

Administrative controls: Change the way people work.

PPE: Protect the worker with personal protective equipments.

2. What are the possible causes of risk?

Answer: Possible causes of risk are:

Fire

Slips and trips,

Electrical hazard,

Chemical,

back Injury,

Hazardous material,

workplace violence.

3. Explain safety hazards with examples.

Answer : These are hazards that create unsafe working conditions.

For ex. inappropriate machine guarding

