1. In heat conduction, which of the following dimensionless number gives an indication of the ratio of conduction resistance to the surface (convective) resistance?

a) Biot number

b) Fourier number

c) Stanton number

d) Nusselt number

Ans: a

Explanation: Biot number Bi is the ratio of conduction resistance to that of convective resistance.

2. The total area under the stress-strain curve of a mild steel specimen tested up to failure under tension is a measure of

(1) ductility
(2) ultimate strength
(3) stiffness
(4) toughness

Ans: 4

Strength is defined as the ability of the material to resist, without rupture, external forces causing various types of stresses. **Breaking strength** is the ability of a material to withstand a pulling or tensile force.

Toughness is defined as the ability of the material to absorb energy before fracture takes place. In other words, toughness is the energy for failure by fracture. Toughness is measured by a quantity called modulus of toughness. Modulus of toughness is the total area under a stress-strain curve in tension test, which also represents the work done to fracture the specimen.

3. For hydrogen and hydrogen like single electron systems, the energy and size of an orbital is determined exclusively by

(1) principal quantum number, n
(2) principal and spin quantum numbers
(3) spin and magnetic quantum numbers
(4) magnetic and principal quantum numbers

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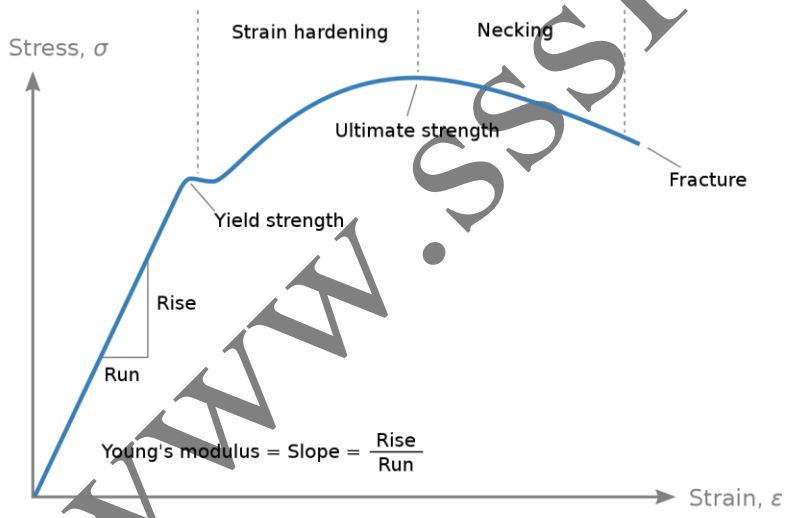
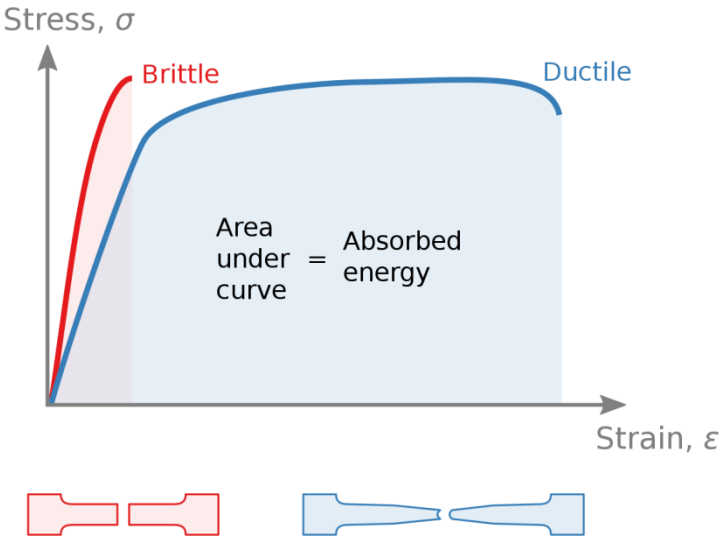
A **stress-strain curve** for a material gives the relationship between stress and strain. It is obtained by gradually applying load to a test coupon and measuring the deformation, from which the stress and strain can be determined (see tensile testing). These curves reveal many of the properties of a material, such as the Young's modulus, the yield strength and the ultimate tensile strength.



By Nicoguaro - Own work, CC BY 4.0, https://commons.wikimedia.org/w/index.php?curid=89891144



5. The relationship between Young's modulus (E), Bulk modulus (K) and Poisson's ratio (μ) is given by

(1) $E=3K(1-2\mu)$
(2) $K=3E(1-2\mu)$
(3) $E=3K(1-\mu)$
(4) $K=3E(1-\mu)$
Ans: 1

Note: **E** = 2G(1 + **μ**) = 3K(1 – 2μ) = 9KG/(3K + G) to get **the relation between E**, **K** and G.

8. Which of the following has greater affinity for hydrogen?

(1) Chlorine (2) Bromine
(3) Iodine (4) Water
Ans: 1

The halogens are located on the left of the noble gases on the periodic table. These five toxic, non-metallic elements make up Group 17 of the periodic table and consist of: fluorine (F), chlorine (Cl), bromine (Br), iodine (I), and astatine (At). Because the halogen elements have seven valence electrons, they only require one additional electron to form a full octet. This characteristic makes them more reactive than other non-metal groups.

9. Aluminium is extracted from purified bauxite (Alumina) by

(1) Chemical reduction
(2) Electrolytic reduction
(3) Thermal decomposition
(4) Electrolytic oxidation

Ans: 2

The **bauxite** is **purified** to produce **aluminium** oxide, a white powder from which **aluminium** can be **extracted**. The **extraction** is done by electrolysis. The ions in the **aluminium** oxide must be free to move so that electricity can pass through it.

Electrolytic reduction- Electrolytic reduction is a form of electrolysis in which electric current passes through an ionic substance in a molten or dissolved state causing the electrodes to react chemically and the materials to decompose. By using this process, the hydroxides, oxides and chlorides of metals in the combined state are electrically reduced. At the cathode, the metals are collected. Some metals such as K, Na, Al are obtained through the process of electrolytic reduction.

https://www.bbc.co.uk/bitesize/guides/zxyq4qt/revision/4

10. The colour of the moist silica gel is:

(1) pale yellow
(2) pale pink
(3) Blue
(4) Green

Ans: 2

Silica gel packets are dessicants. These packets adsorb moisture and prevent damage to stored valuables and supplies.

Silica gel is silicon dioxide, SiO_2, like sand on the beach. Inside each small silica gel granule is a network of inter-connecting microscopic pores, which attract and hold moisture by a phenomena known as adsorption. Silica gel is packaged in a fibrous material that is capable of withstanding normal handling and be able to breathe. This means that water molecules can pass through the material and be adsorbed by the silica gel.

Ready to use silica gel is blue in colour. When the silica gel has soaked up a lot of moisture, the silica gel turns to pink. Once the silica gel turns pink it cannot adsorb any more moisture. It needs to be regenerated. This can be accomplished by heating it in an oven. The heat expels the moisture, the silica gel turns blue and becomes reusable.

Ready to use silica gel

Silica gel turns pink once it has soaked up moisture.

http://nobel.scas.bcit.ca/debeck_pt/science/silicaGel/gel_p1.htm

11. The purpose of the fusible plug fitted on the top of the water heater casing is to

(1) Disconnect the supply of electricity in case of short circuit
(2) Release the pressure inside the tank in case of thermostat failure.
(3) Fuse and release the steam inside the heater in case of overheat
(4) eject the three pin plug so as to disconnect the supply in case of earth fault

Ans : 1

Fusible plug Function. The function of fusible plug is to protect the boiler from damage due to overheating of boiler tubes by low water level. When the water in the boiler is at its normal level, fusible plug remains submerged in water and its temperature does not exceed its melting temperature, because its heat is transferred to water easily. If under some unwanted condition, water level comes down to unsafe limit; fusible plug is exposed to steam in place of water. On the other side it is exposed to fire. So its temperature exceeds its melting point due to very low heat transfer to steam and it melts down. Immediately steam and water under high pressure rush to the fire box and extinguish the fire.

https://www.ramauniversity.ac.in/online-study-material/fet/me/btech/viisemester/powerplantengineering/lecture-12.pdf

12. The rate of change of displacement of a moving body is

(1) Acceleration (2) Velocity (3) Momentum (4) Impulse

Ans : 2 (ds/dt = v, velocity and dv/dt = a, acceleration)

13. The rate of change of velocity of a moving body is

(1) Acceleration (2) Velocity (3) Momentum (4) Impulse

Ans : 1

14. Area under the velocity- time diagram of a moving body

(1) Acceleration (2) Displacement (3) Momentum (4) Impulse

Ans : 2

15. The rate of change of liner momentum of a moving body is

(1) Acceleration (2) Velocity (3) Momentum (4) Impulse

Eqn.

Momentum = mass • velocity

In physics, the symbol for the quantity momentum is the lower case p. Thus, the above equation can be rewritten as

p = m • v

where m is the mass and v is the velocity. The equation illustrates that momentum is directly proportional to an object's mass and directly proportional to the object's velocity.

The units for momentum would be mass units times velocity units. The standard metric unit of momentum is the kg•m/s.

Momentum is a vector quantity.

16. Impulse of a moving body when it collides with an another object is given by

(1)Force x time (2) Work done/time
(3)Force/time (4) None.

Ans : 1

17. ---------- is used to convert AC to DC

(1)Rectifier (2)Inverter (3)Transistor (4)Transformer

Ans : 1

18. ---------- is used to convert D.C to A.C

(1)Rectifier (2)Inverter (3)Transistor (4)Transformer

Ans : 2

19. Convert 72 kmph in to m/s

(1)10 m/s (2)15 m/s (3)20 m/s (4)25 m/s

Ans : 3

20. The spherical shape of raindrops is due to

(1)Atmospheric friction of air
(2)Gravity of spherical earth
(3) Surface tension
(4)Viscosity of rainwater

Ans : 3

21. Unit of measuring inductance is

1. Ohm 2. Coulomb 3. Mho 4. Henry

Ans : 4

Henry, **unit** of either self-**inductance** or mutual **inductance**, abbreviated H, and named for the American physicist Joseph Henry. One henry is the value of self-**inductance** in a closed circuit or coil in which one volt is produced by a variation of the inducing current of one ampere per second.

22. Copper loss in a transformer is that power loss caused by -

(1)Eddy current
(2)Magnetic field reversal
(3) resistance of conductors of winding wires
(4) Counter EMF

Ans : 3

23. Tachometer is used to measure

(1)RPM (2)Volt (3)Current (4)Velocity

Ans : 1

Dwyer TAC-L Tachometer
https://www.instrumart.com/products/41360/dwyer-tac-l-tachometer

The types of tachometers commonly found are:
Analog tachometers - Comprised of a needle and dial-type of interface. They do not have provision for storage of readings and cannot compute details such as average and deviation.

Digital tachometers - Comprised of a LCD or LED readout and a memory for storage..

Contact and non-contact tachometers – The contact type is in contact with the rotating shaft and uses an optical encoder ot magnetic sensor. The non-contact type is ideal for applications that are mobile, and uses a laser or optical disk. Both of these types are data acquisition methods.

Time and frequency measuring tachometers

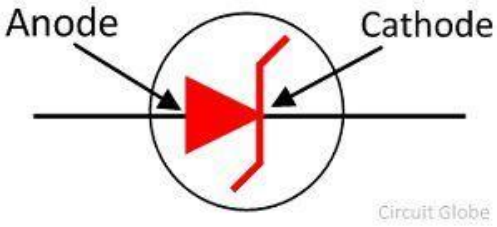
https://www.azosensors.com/article.aspx?ArticleID=310

24. Zener diode is used as

(1) Voltage regulator
(2)Rectifier
(3) Amplifier
(4) Inverter

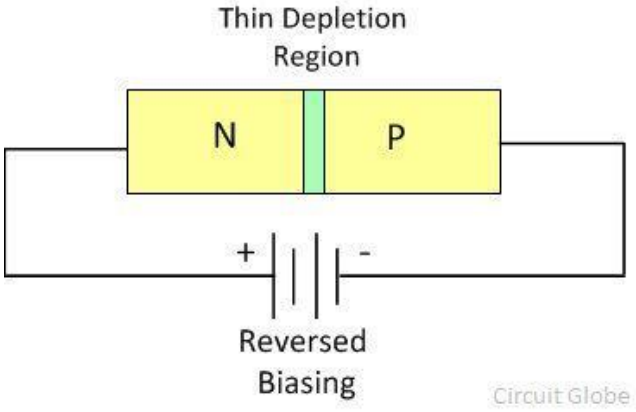
Ans : 1

Definition: A heavily doped semiconductor diode which is designed to operate in reverse direction is known as the Zener diode. In other words, the diode which is specially designed for optimising the breakdown region is known as the Zener diode. The symbolic representation of Zener diode is shown in the figure below.



Zener Diode Circuit Diagram

The circuit diagram of the Zener diode is shown in the figure below. The Zenerdiode is employed in reverse biasing. The reverse biasing means the n-type material of the diode is connected to the positive terminal of the supply and the p-type material is connected to the negative terminal of the supply. The depletion region of the diode is very thin because it is made of the heavily doped semiconductor material.



https://circuitglobe.com/zener-diode.html

25. Which component among the following reduces noise of exhaust gases in a petrol engine

(1)Exhaust pipe (2) Muffler (3)Inlet manifold (4)Tail pipe

26.The normal firing order in case of four stroke four cylinder diesel engine is

(1)1-2-3-4 (2)1-3-4-2 (3)1-4-2-3 (4)None

27. Identify the type of motor recommended for locomotive drive –

(1) D.C. Series motor (few decades ago) (2) D.C. Compound Motor
(3) D.C. Shunt motor (4) Synchronous motor (nowadays)

Till electronics came into the field of traction recently, the best suited drive for traction application was the dc series motor because of its inherent characteristics to give high torque at low speeds. With the development of GTO thyristors, power electronics and micro processor control, adoption of 3-phase induction motor for traction application.
Three types of motor are used in locomotives:

DC motors.
AC motors with variable frequency drives.
AC permanent magnet motors.

https://www.ee.co.za/article/traction-motors-diesel-locomotives.html

http://www.railway-technical.com/trains/rolling-stock-index-l/train-equipment/electric-traction-control-d.html

28. Sound waves cannot travel through

(1) Iron (2) Hydrogen (3) Oil (4) Vacuum

Ans : 4

29. A electric generator converts

(1) Mechanical energy into light energy
(2) Electrical energy into mechanical energy
(3) Mechanical energy into electrical energy
(4) None of these

Ans : 3

30. An electric motor converts

(1) Mechanical energy into light energy
(2) Electrical energy into mechanical energy
(3) Mechanical energy into electrical energy
(4) None of these

Ans : 2 (e.g., it drives a pump, compressor, etc)

31. The property of material which enables it to be drawn into wires is called?

(1) Ductility (2) Plasticity (3) Malleability (4) Toughness

Ans : 1

32. The property of material which enables it to be drawn into sheets/plates is called?

(1) Ductility (2) Plasticity (3) Malleability (4) Toughness

Ans : 3

33. When two cells, each of 12V, are connected in parallel, the voltage across them is ----------V.

(1) 12 (2) 24 (3) 6 (4) 10

Ans : 1

34. When two cells, each of 12V, are connected in series, the voltage across them is ----------V.

(1) 12 (2) 24 (3) 6 (4) 10

Ans : 2

35. Which of the following cannot convert AC to DC?

(1) Diode (2) Mercury arc rectifier
(3) Converter (4) Transformer

Ans : 4

Note: Transformer will work in alternating current, AC only

36. The internal energy of an ideal gas is

(1) a function of temperature alone (2) a function of pressure
(3)a function of volume (4) (1) and (2) above

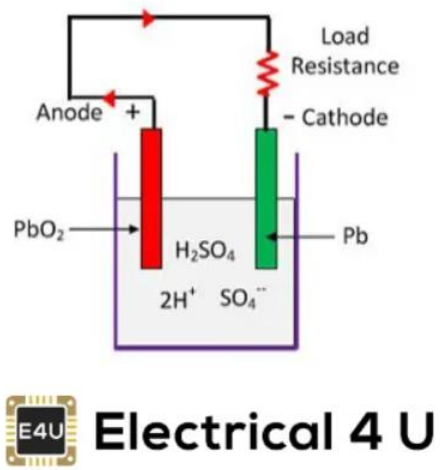
Ans : 1

(Internal energy = mC_vdT and enthalpy = mC_pdT)

The *First Law of Thermodynamics* contains an explicit statement about the amount by which the internal energy U of a gas changes when work W or heat Q is received or given up by the system. It must be emphasized that contrary to Q and W, U is a state variable, i.e., its value depends only on the state of the system and not on how this state was attained.

37. In a lead acid cell/ battery, the electrolyte used is:

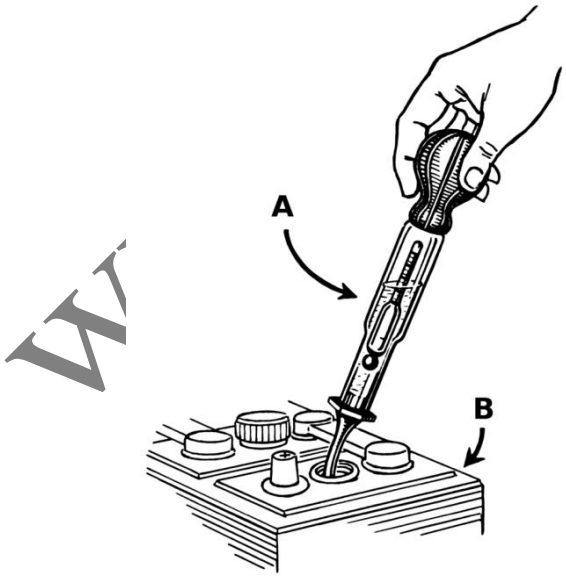
(1) Sulphuric acid (2) Nitric acid
(3) Hydrochloric acid (4) None of the above
Ans. 1



https://www.electrical4u.com/working-of-lead-acid-battery-lead-acid-secondary-storage-battery/

The **lead–acid battery** is a type of rechargeable battery first invented in 1859 by French physicist Gaston Planté.

A hydrometer can be used to test the specific gravity of each cell as a measure of its state of charge.



https://en.wikipedia.org/wiki/Lead%E2%80%93acid_battery#/media/File:Hydrometer_(PSF).png

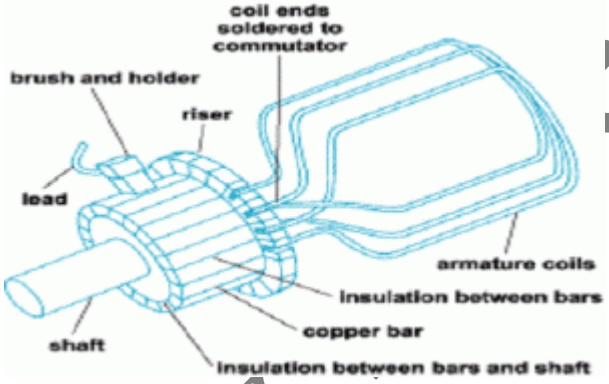
38. A commutator is provided in a DC generator:

(1) To convert induced alternating voltage in unidirectional pulse.
(2) To boost output voltage
(3) To prevent sparking
(4) None of the above.

Ans : 1

What is Commutator?

The output of any electrical machine is AC or alternating current whether it is direct current (DC) or AC generator. Thus, in DC generator, a device is necessary to change the current from alternating to direct. This necessity can be fulfilled by using a commutator. It is also called a split-ring commutator. The split rings are made of phosphorous bronze and it is a device connected with the armature core. It is used to collect the current from the armature winding. It changes the form of AC to DC or DC to AC depending upon the requirement. The figure that depicts the cross-sectional view is shown below.



Cross-sectional View of a commutataor

It consists of some segments which are arranged in series to which the ends of armature winding are connected. These divided segments are termed as the commutator segments. These segments are laminated by a thin layer of Mica with a thickness of 0.6 to 0.8mm. The dielectric strength of these segments is nearly 30V to 40V. The segments are made of hard drawn copper of high conductivity. Each segment consists of two coil sides (as one coil contains two coil sides).The number of these segments is equal to the number of coils.

It is attached to the brush which is used to collect the current from the segments. The segments are the rotating part whereas the brushes are the stationary part.

The function of the Commutator segment

It is a device that converts either AC to DC or DC to AC I,e it can act as both “Rectifier” or as an “Inverter” depending upon the requirement.

In the DC generator, the segments convert the generated AC to DC and hence, it acts as a “full-wave uncontrolled mechanical Rectifier”.

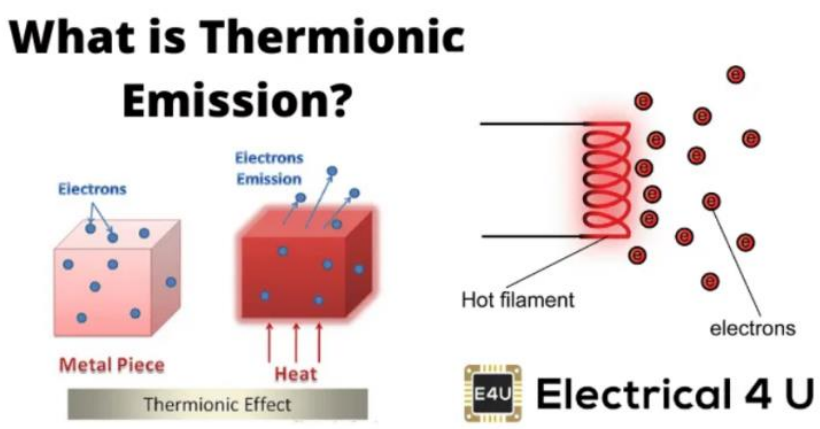
In DC Motor, the segments convert the generated DC to AC and hence, it acts as a "full-wave uncontrolled mechanical Inverter".

https://www.watelectrical.com/commutator-working-applications/

39. Thermionic emission of electrons from a heated electrode is due to

(1)electromagnetic field
(2)electrostatic field
(2) temperature
(4)photo electric effect

Ans : 2



Thermionic emission is the liberation of electrons from an electrode by virtue of its temperature (releasing of energy supplied by heat). This occurs because the thermal energy given to the charge carrier overcomes the work function of the material.

Applications of Thermionic Emission

Thermionic emission forms the basic principle on which many of the devices used in the field of electronics and communication operates. Example applications of thermionic emission include vacuum tubes, diode valves, cathode ray tube, electron tubes, electron microscopes, X-ray tubes, thermionic converters, etc.

https://www.electrical4u.com/thermionic-emission/

40. Cooling of water in an earthen pot is an example of

(1)Water jet refrigeration
(2) Cooling due to evaporation
(3)Vapour absorption refrigeration
(4)Vapour compression refrigeration

Ans : 2

41. The force equal in magnitude and opposite in direction to the resultant is known as the

(1)parallel force
(2) equilibrant
(3)downward force
(4) gravitational force

Ans : 2

42. A gas does not have a definite shape or fixed volume, because the molecules are

(1) at rest
(2). in linear motion
(3) in oscillator motion
(4) in random motion

Ans : 4

43. At present nuclear fusion is not used for generation of energy because

(1)energy released is less than in fission
(2)elements used in fusion are rare
(3)very high temperature and pressure is required for nuclear fusion to take place
(4)hazardous radiations are emitted during fusion

Ans : 3

Fusion technology

In the Sun, massive gravitational forces create the right conditions for fusion, but on Earth they are much harder to achieve. Fusion fuel – different isotopes of hydrogen – must be heated to extreme temperatures of the order of 50 million degrees Celsius, and must be kept stable under intense pressure, hence dense enough and confined for long enough to allow the nuclei to fuse.

45. Isotonic solutions must have the same

(1) Normality
(2) Molar concentration
(3) Density
(4) Critical temperature

Ans: 2

An isotonic solution is one that has the same osmolarity, or solute concentration, as another solution.

Isotonic solutions: Isotonic solutions are solutions with equal concentration of solute. That is the concentration of solutes per volume of the solution is the same in both solutions.

Molarity: The concentration of a solute per liter of a solution. Since isotonic solutions have the same solute concentration then we can say that isotonic solutions have the same molarity.

46. In galvanizing, layer of zinc is applied to the surface of steel by

(1) Hot peening (2) Cold peening

(3)Hot dipping or eletoplating (4) Cold dipping

Ans : 3

47. In superconducting state, materials are

(1)paramagnetic (2) ferromagnetic (3). diamagnetic (4) none

Ans : 3

Meissner Effect. Meissner discovered that a bulk superconducting material behaves like a perfect diamagnet with a zero magnetic induction in its interior. If a paramagnetic material is placed in a magnetic field, then the magnetic lines of force penetrate through the material. But when the same material is made superconducting by cooling to lower temperatures, then all the lines of force are expelled from the interior of this material. This is called the *Meissner effect*.

Superconductivity, H.R. Khan, in Encyclopedia of Physical Science and Technology (Third Edition), 2003
https://www.sciencedirect.com/topics/engineering/paramagnetic-material#:~:text=If%20a%20paramagnetic%20material%20is,is%20called%20the%20Meissner%20effect.

Modulus of toughness. Modulus of toughness is the total area under a stress-strain curve in tension test, which also represents the work done to fracture the specimen.

48. Thermoplastic objects are produced by

(1) die casting process (2) shell moulding process
(3) cold forming process (4) injection moulding process

Ans : 4

49. A Carnot cycle consists of the processes

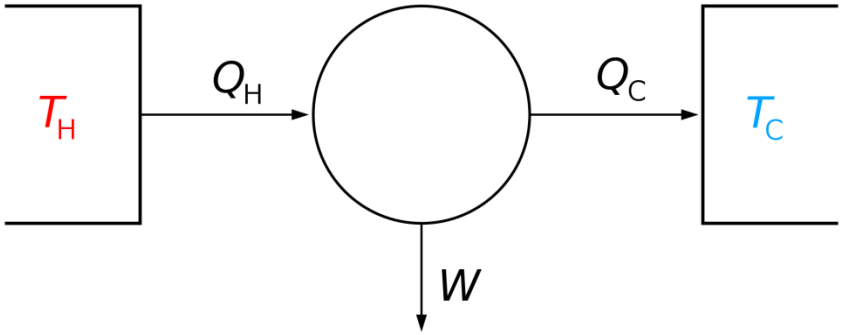
(1)two isothermals and two isentropics

(2) twoisobarics and two isothermals

(3) twoisochorics and two isobarics

(4) two isothermals and two isochorics

Ans: 1



Carnot engine diagram (modern) - where an amount of heat Q_H flows from a high temperature T_H furnace through the fluid of the "working body" (working substance) and the remaining heat Q_C flows into the cold sink T_C, thus forcing the working substance to do mechanical work W on the surroundings, via cycles of contractions and expansions.

https://en.wikipedia.org/wiki/Carnot_heat_engine#/media/File:Carnot_heat_engine_2.svg

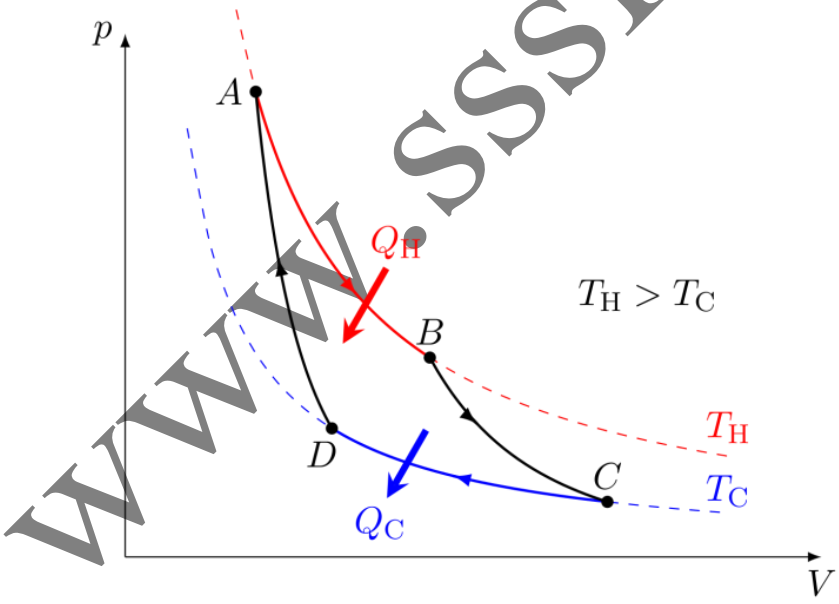


Figure: A Carnot cycle illustrated on a PV diagram to illustrate the work done.

Cristian Quinzacara - Own work.

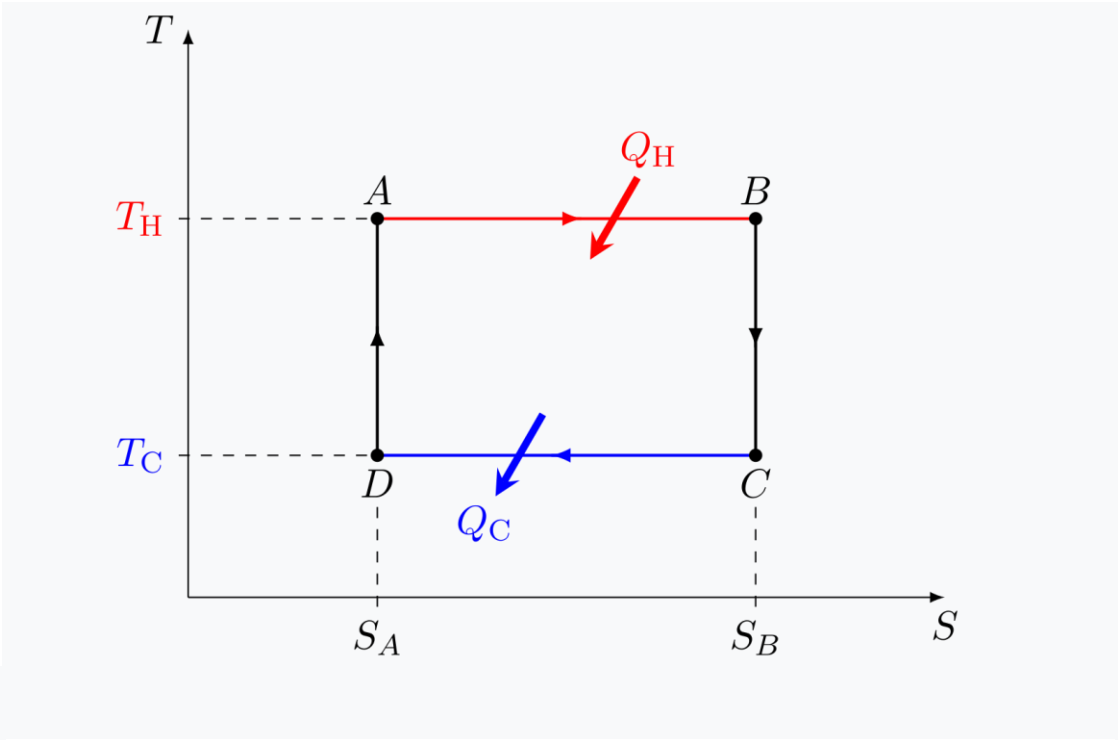


Figure:A Carnot cycle acting as a heat engine, illustrated on a temperature-entropy diagram. The cycle takes place between a hot reservoir at temperature T_H and a cold reservoir at temperature T_C. The vertical axis is temperature, the horizontal axis is entropy.
By Cristian Quinzacara - Own work, CC BY-SA 4.0,

https://commons.wikimedia.org/w/index.php?curid=103887770

Carnot Cycle

The Carnot cycle is composed of four totally reversible processes:
a. Isothermal heat addition at high temperature (T_H)
b. Isentropic expansion
c. Isothermal heat rejection at low temperature (T_L)
d. Isentropic compression.

Thermal efficiency of Carnot cycle:

$$\eta = \frac{T_1 - T_2}{T_1} = \frac{T_H - T_L}{T_H}$$

50. In a pulley drive, the driving pulley has a diameter of 30cm and rotates at 1500 RPM. The speed of driven pulley of 20 cm diameter will be …….. (2250 RPM)

($D_1N_1 = D_2N_2 \rightarrow 30x1500 = 20x\mathrm{N}2$)