

1. Graphite is made of

- (1) **Carbon** (2) Lead (3) Coal (4) petrol

Ans (1)

Note: Both diamond and graphite are made out of carbon, as is the more recently discovered buckminsterfullerene containing carbon 60 atoms. The way the carbon atoms are arranged in space, however, is different for the three materials, making them allotropes of carbon. The differing properties of carbon and diamond arise from their distinct crystal structures.

2. The four piston strokes follow each other in the order of

- (1) **Intake, compression, power, exhaust**
(2) Intake, power, exhaust, compression
(3) Compression, power, intake, exhaust
(4) Exhaust, compression, intake, power

Ans (1)

3. A basic difference between the spark-ignition engine and the diesel engine is

- (1) The diesel engine compresses air alone instead of an air-fuel mixture in petrol engine
(2) Air temperature ignites the fuel in the diesel engine
(3) The fuel is sprayed into the combustion chamber in the diesel engine as the piston nears TDC on the compression stroke.
(4) **all of the above**

Ans (4)

4. The ratio of ultimate tensile stress to the permissible stress is known as

- (1) Young's modulus (2) Shear modulus
(3) Modulus of rigidity (4) **Factor of safety**

Ans (4)

NOTE: WHAT IS THE FACTOR OF SAFETY?

A factor of safety is the load carrying capacity of a mechanical system/structures/structural members beyond what the system actually supports. Bridges, buildings, components of machineries, etc. are designed with a factor of safety taken in to considerations while designing these items. A factor of safety increases the safety of people and reduces the risk of failure of a product.

5. According to Hooke's Law- within elastic limit

- (1) Stress is directly proportional to strain
- (2) Stress is directly proportional to rate of strain
- (3) Stress is directly proportional to strain within elastic limit
- (4) None of the above

Ans (1)

NOTE: HOOKE'S LAW

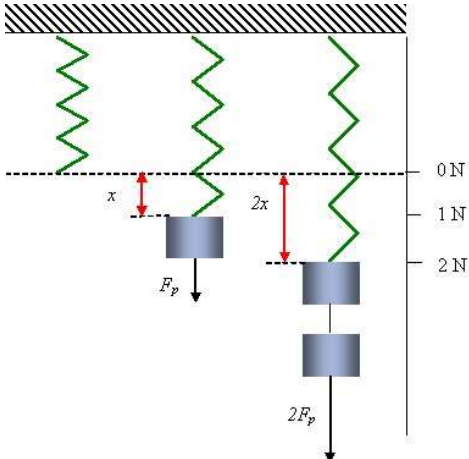


Diagram of Hooke's Law: The extension of the spring is linearly proportional to the force.

Mathematically, Hooke's law is stated as:

$$F = -kx$$

Where x is the displacement of the spring's end from its equilibrium position (a distance, in SI units: meters); F is the restoring force exerted by the spring on that end (in SI units: N or $\text{kg}\cdot\text{m}/\text{s}^2$); and k is a constant called the rate or spring constant (in SI units: N/m or kg/s^2). When this holds, the behavior is said to be linear. If shown on a graph, the line should show a direct variation.

<https://courses.lumenlearning.com/boundless-physics/chapter/hookes-law/>

6. Poisson's ratio is the ratio of (within elastic limit)

- (1) Lateral strain to longitudinal strain
- (2) Longitudinal strain to lateral strain
- (3) Change in volume to original volume
- (4) None of the above

Ans. (1)

Poisson's ratio is the ratio of transverse contraction strain to longitudinal extension strain in the direction of stretching force. Tensile deformation is considered positive and compressive deformation is considered negative. For most materials ν is found to vary between 0.2 and 0.5.

7. Which of the following has the highest density?

- (1) Gold
- (2) Silver
- (3) Iron
- (4) Brass

Ans (1) (Gold density 19.3 gm/cc)

8. Which of the following has the highest density?

- (1) Gold
- (2) Platinum
- (3) Osmium
- (4) Caesium

Ans (3) (Osmium density 22.59 gm/cc)

Element	Atomic number	Density, kg/m ³
Osmium	76	22,590
Iridium	77	22,560
Platinum	78	21,450

<https://www.technology.matthey.com/article/33/1/14-16/>

9. Which of the following is the unit of measuring the distance of stars from the earth?

- (1) Nautical Miles
- (2) Light Year
- (3) Angstrom
- (4) Kilometre

Ans (2)

Note: Also, Parsec is used.

10. Which of the following is adopted to indicate the travelling speed of aircrafts?

- (1) Nautical Miles
- (2) Light Year
- (3) Angstrom
- (4) Kilometre

Ans (1)

Note: One Nautical Mile = 1.852 km

11. Which of the following is adopted to indicate the travelling speed of ships?

- (1) **Nautical Miles** (2) Light Year (3) Angstrom (4) Kilometre

Ans (1)

12. The voltage of a.c. main supply in India is

- (1) **230V AC** (2) 110 V DC (3) 430V AC (4) 25 KV

Ans (1)

Note: In **India** the standard **voltage** is 230 V and the frequency is 50 Hz

13. Which of the following waves has the longest wavelength?

- (1) **Radio waves** (2) X-rays
(3) Ultraviolet rays (4) Infrared rays.

Ans (1)

13. Which of the following waves has the maximum frequency?

- (1) Radio waves (2) **γ -rays**
(3) Ultraviolet rays (4) Infrared rays.

Ans (2) (also smallest wave length)

14. The magnitude of wave length of visible **spectrum is 400 nm- 700 nm**

15. Which of the following atmospheric layers is nearest to the surface of the earth?

- (1) Exosphere (2) Ionosphere (3) Stratosphere (4) **Troposphere**

Ans (4)

16. Which of the following planet is closest to the Sun?

- (1) Jupiter (2) Mars (3) **Mercury** (4) Venus

Ans (3)

17. Earlier, balloons are filled with hydrogen on account of

- (1) Its being colourless
 (2) Its being odourless
 (3) Its extreme lightness
 (4) its extreme heaviness

Ans (3)

18 Nowadays balloons are filled with helium on account of

- (1) Its being colourless
 (2) It is an inert gas and lighter than air
 (3) Its extreme lightness
 (4) its extreme heaviness

Ans (2)

Answer: Helium gas is lighter than air (Air $\rho = 1.274$ and Helium $\rho = 0.1761$ kg/cu. m), therefore, a helium balloon rises, it is known as a noble gas and is therefore not reactive. However, hydrogen is not used in balloons because it is highly explosive and flammable.

19. Steam locomotive was invented by

- (1) Richard Trevithick
 (2) James Watt
 (3) George Stephenson
 (4) Michel Faraday

Ans (1)

Note: A steam **locomotive** produces its pulling power through a steam engine. These locomotives are fuelled by burning coal or oil—to produce steam in a boiler. The steam moves reciprocating pistons which are mechanically connected to the locomotive's main wheels (driving wheels). Both fuel and water supplies are carried with the locomotive, either on the locomotive itself or in wagons (tenders) pulled behind.

Steam locomotives were first developed in the United Kingdom during the early 19th century and used for railway transport until the middle of the 20th century. Richard Trevithick built the first steam locomotive in 1802. The first commercially successful steam locomotive was built in 1812–13 by John Blenkinsop, the Salamanca (locomotive); the *Locomotion* No. 1, built by George Stephenson and his son Robert's company Robert Stephenson and Company, was the first steam locomotive to haul passengers on a public railway, the Stockton and Darlington Railway in 1825. In 1830 George Stephenson opened the first public inter-city railway, the Liverpool and Manchester Railway. Robert Stephenson and Company was the pre-eminent builder of steam locomotives in the first decades of steam for railways in the United Kingdom, the United States, and much of Europe.

https://en.wikipedia.org/wiki/Steam_locomotive

20. The device used for measuring potential difference is

- (1) Potentiometer
 (2) Ammeter
 (3) Galvanometer
 (4) Voltmeter

Ans (4)

Note: A **voltmeter** is an instrument used for measuring **electrical potential difference** between two points in an **electric circuit**

21. In electroplating the desired metal to be coated on the base metal/article is taken as the

- (1) Electrolyte (2) Cathode (3) **Anode** (4) Vessel

Ans (3)

Note: Electroplating is the process of applying a metal coating on another piece of metal (or another conductive surface) through an electro-deposition process. In **electroplating**, the desired metal to be deposited becomes anode and the part/component to be plated becomes cathode.

22. Avogadro number N is

- (1) Constant at constant temperature.
 (2) Constant at constant pressure
 (3) Constant at constant volume
 (4) **Universal constant - of units in one mole of any substance**

Ans (4)

Note: avogadro's number, number of units in one mole of any substance (defined as its molecular weight in grams), equal to $6.02214076 \times 10^{23}$. The units may be electrons, atoms, ions, or molecules, depending on the nature of the substance and the character of the reaction (if any).

<https://www.britannica.com/science/Avogadros-number>

Avogadro's law, a statement that under the same conditions of temperature and pressure, equal volumes of different gases contain an equal number of molecules. This empirical relation can be derived from the kinetic theory of gases under the assumption of a perfect (ideal) gas. The law is approximately valid for real gases at sufficiently low pressures and high temperatures.

<https://www.britannica.com/science/Avogadros-law>

23. The power factor of a purely capacitor circuit is

- (1) Zero (2) lagging (3) **leading** (4) unity.

Ans (3)

24. The power factor of a purely resistive circuit is

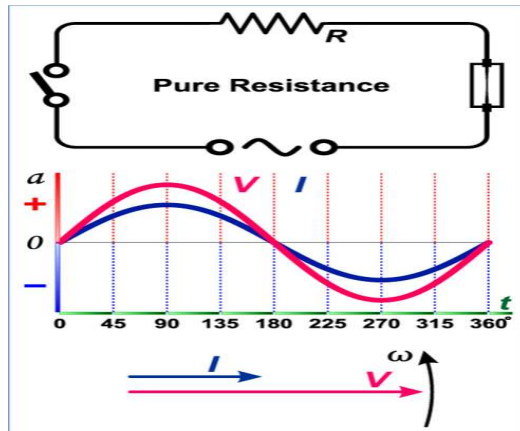
- (1) Zero (2) Lagging (3) leading (4) **unity.**

Ans (4)

Note: For the **purely resistive circuit**, the **power factor** is 1 (perfect), because the reactive **power** equals zero.

WHAT ARE PURE RESISTIVE CIRCUITS?

A purely resistive circuit is a circuit that has inductance so small that at its typical frequency, its reactance is insignificant as compared to its resistance. Furthermore, in a purely resistive circuit, the whole of the utilized voltage is consumed in overcoming the ohmic resistance of the circuit itself. Also, another name for a purely resistive circuit is a non-inductive circuit. Also, in a purely resistive circuit, the phase angle **between current and voltage** is zero.



The relationship between current and voltage depicts what kind of resistance your circuits are working with.

THE PURELY RESISTIVE AC CIRCUIT

A circuit that contains only a pure resistance (ohms) in an AC circuit is called a Purely Resistive AC Circuit. From a technical standpoint, this circuit does not contain capacitance or inductance. The alternating voltage and current moves synchronously forward in addition to backward in either direction of the circuit. Therefore, the alternating voltage and current exhibits the shape of a Sine wave and is thus called a **sinusoidal waveform**.

In these circuits, the resistors dissipate the power, while the phase of the current and voltage remain the same. The current and the voltage achieve their maximum value simultaneously. It is worth noting that a resistor is a passive component, and it neither produces nor consumes electrical power. So, what effect does a resistor have on the power within a purely resistive circuit? It converts the available energy into heat.

Waveforms are helpful representations of any expected output or input for a circuit.

Instantaneous power, $P = VI$

THE POWER FACTOR OF PURE RESISTIVE CIRCUITS

Firstly, what is meant by the phrase power factor? Well, in electrical engineering, we

define the power factor (PF or $\cos\phi$) as the ratio between the power that you can use in an electric circuit (real power, P) and the power calculated from multiplying the voltage and current in a circuit (apparent power, S). Furthermore, we define a PF as having a range from zero to one.

In a DC circuit, the result of $V \times I$ gives us the power (P) in watts (W) drawn by a circuit. However, in an AC circuit, this will deviate. Because in an AC circuit, the result of $V \times I$ gives us the apparent power (S) and not the real power (P) since the current and voltage are not in phase.

We can further define the PF in an AC circuit as follows:

1. Define the PF as the cosine of the phase angle between current and voltage
2. Define the PF or $\cos \phi$ as resistance (R) \div impedance (Z)
3. PF or $\cos \phi$ is also defined as: real power (P) \div apparent power (S)

Therefore, since the voltage and current are in phase for a purely resistive circuit, its PF is 1.

With pure **inductive or pure capacitive circuits**, the current is 90° out of phase with the circuit voltage; thus, the $\cos \phi = 90^\circ$. Hence, the PF of these circuits is zero. The PF of the RLC series circuit lies between zero and one.

The purely resistive circuit has unique characteristics that deviate from those of other circuit types. However, without these types of circuits, devices like Incandescent Lamps would not be possible.

<https://resources.pcb.cadence.com/blog/2020-what-is-a-pure-ly-resistive-circuit-and-what-are-its-characteristics>

25. The energy of a body by virtue of its motion is

- | | |
|----------------------|--------------------|
| (1) Potential energy | (2) Kinetic energy |
| (3) Dynamic energy | (4) Static energy. |

Ans (2)

26. The energy of a body by virtue of its position is

- | | |
|----------------------|--------------------|
| (1) Potential energy | (2) Kinetic energy |
| (3) Dynamic energy | (4) Static energy. |

Ans (1)

27. 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)

NOTE: COMMUTATOR

Commutators and brushes are used on all DC generators and DC motors. They are also used on some AC motors such as the repulsion, synchronous, and universal motors. All generators produce a sine wave, or AC currents when the rotor turns in the magnetic field. The commutator on the DC generator converts the AC into pulsating DC. The commutator assures that the current from the generator always flows in one direction. The brushes ride on the commutator and make good electrical connections between the generator and the load.

ON DC AND MOST AC MOTORS THE PURPOSE OF THE COMMUTATOR IS TO INSURE THAT THE CURRENT FLOWING THROUGH THE ROTOR WINDINGS IS ALWAYS IN THE SAME DIRECTION, AND THE PROPER COIL ON THE ROTOR IS ENERGIZED IN RESPECT TO THE FIELD COILS. BY MECHANICALLY POSITIONING THE BRUSHES ON THE COMMUTATOR, AN ANGLE OF DISPLACEMENT CAN BE SET UP BETWEEN THE MAGNETIC FORCE OF THE FIELD WINDINGS AND THE MAGNETIC FORCE OF THE ROTOR WINDINGS.

The commutator is conventionally made by assembling hard-drawn copper sectors interleaved with 0.7–2 mm sheet mica, these separators being ‘undercut’ by about 1 mm. The brushes, of a suitable carbon/graphite content, are mounted in boxes with spring loading to hold them against the commutator surface with a medium to strong pressure depending on the application.

<https://www.sciencedirect.com/topics/engineering/commutator#:~:text=The%20commutator%20on%20the%20DC,the%20generator%20and%20the%20load.>

28. In SI units, Young’s Modulus is expressed in

- (1) Pascal
- (2) Bar
- (3) Newton
- (4) Joule.

Ans (1)

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

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

Ans (1)

Note: In a deep-cycle lead-acid cell, the **negative plate** is made of solid **lead**, and the **positive plate** is made of **lead dioxide**. Between them is an insulator/separator that

prevents them from touching and short circuiting. The electrolyte in a **lead-acid battery** is water and sulphuric **acid**.

30. In an Oscillator circuit, the feedback is

- (1) **Positive** (2) Zero
(3) Negative (4) None of the above.

Ans (1)

Note: The feedback in the amplifier section of an oscillator must be positive feedback. This is the condition where a fraction of the amplifier's output signal is fed back to be in phase with the input, and by adding together the feedback and input signals, the amplitude of the input signal is increased.

The use of positive feedback is useful for producing oscillators. The condition for positive feedback is that a portion of the output is combined in phase with the input

31. A light year is the distance travelled by light in a

- (1) Second (2) hour (3) day (4) **year.**

Ans (4)

32. In a series RLC circuit at resonance

- (1) Current is maximum, PF is zero
(2) **Current is maximum, PF is unity**
(3) Current is minimum, PF is unity
(4) None of these.

Ans (2)

33. The Power factor of a circuit can be improved by including in the circuit

- (1) **A capacitor** (2) An inductor
(3) A resistor (4) none of the above.

Ans (1)

Note: The low power factor is almost invariably due to inductive nature of load and, therefore, the logical corrective is to connect such devices across the load, which takes leading reactive power such as static capacitors, synchronous machines or synchronous condensers. The leading reactive component of current drawn by power factor correcting device neutralises the lagging reactive component of current drawn by the load partly or completely. Power factor of the system will become unity when lagging reactive component of load current is completely neutralised by the leading reactive component of current drawn by power factor correcting device.

<https://www.engineeringenotes.com/electrical-engineering/circuits/improvement-of-power-factor-in-ac-circuit-electrical-engineering/29919 Methods of Power Factor Improvement>

34. ECG is used for the diagnosis of ailments of

- (1) Brain (2) **Heart** (3) Kidneys (4) Stomach.

Ans (2)

Note: Doctor may use an electrocardiogram to determine or detect:

- Abnormal heart rhythm (arrhythmias)
- If blocked or narrowed arteries in your heart (coronary artery disease) are causing chest pain or a heart attack

How well certain heart disease treatments, such as a pacemaker, are working, etc.

35. In electric machines, laminated cores are used to reduce

- (1) Hysteresis loss – Silicon steel (2) Copper loss
 (3) **Eddy current loss** (4) Iron loss

Ans (3)

36. EEG is used for the diagnosis of ailments of

- (1) **Brain** (2) Heart (3) Kidneys (4) Stomach.

Ans (1)

Note: Electroencephalography is an electrophysiological monitoring method to record electrical activity of the brain. It is typically noninvasive, with the electrodes placed along the scalp, although invasive electrodes are sometimes used, as in electrocorticography, sometimes called intracranial EEG. The EEG may also be used to determine the overall electrical activity of the brain (for example, to evaluate trauma, drug intoxication, or extent of brain damage in comatose patients). The EEG may also be used to monitor blood flow in the brain during surgical procedures.

<https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/electroencephalogram-eeeg>

37. The Ratio of load lifted to effort applied is known as

- (1) Velocity ratio (2) Efficiency (3) Mechanical advantage (4) Force.

Ans (3)

38. What is the voltage of an electrical circuit with 3 ampere current and 60 ohms resistance?

- (1) 20 volt (2) 180 volt (3) 30 volt (4) 90 volt.

Ans (2)

39. One micron is equal to

- (1) 0.1 mm (2) 0.01 mm (3) 0.001 mm (4) 0.0001 mm

Ans (3) (also equal to 10^{-6} m)

40. Bronze is an alloy of

- (1) Copper and Tin (2) Lead and Tin
(3) Zinc and Tin (4) Copper and Zinc.

Ans (1)

41. MRI scan is used for the diagnosis of ailments of

- (1) Brain (2) Heart (3) Kidneys (4) Stomach.

Ans (1)

Note: MRI uses

Brain: MRI is the first-choice investigation for brain tumours, as it produces clearer images than computerised tomography (CT) and shows hard-to-reach areas of the brain. There is clear contrast between grey and white matter parts of the brain and this makes MRI the best choice for many other conditions, including multiple sclerosis, stroke, Alzheimer's disease and epilepsy.

Musculoskeletal system: here, MRI is used to look at the spine - to assess joint disease and soft tissue tumours.

Gastrointestinal system: MRI allows non-invasive assessment of inflammatory bowel disease and bowel tumours. It can also look at problems in the liver and pancreas.

Blood vessels and the heart: this is called magnetic resonance angiography (MRA) and it generates pictures of the arteries to look for abnormal narrowing or vessel wall dilatations (those at risk of bursting). MRA is often used to evaluate the arteries of the neck and brain, the thoracic and abdominal aorta, the renal arteries, and the legs. It might also be used to assess congenital heart disease.

Human Safety: MRI scans are painless and thought to be safe. MRI scans do not use X-rays so the possible concerns associated with X-ray pictures and CT scans (which use X-rays) are not associated with MRI scans.

<https://patient.info/treatment-medication/mri-scan#:~:text=There%20is%20clear%20contrast%20between,disease%20and%20soft%20tissue%20tumours.>

42. Brass is an alloy of

- (1) Copper and Tin
- (3) Zinc and Tin

- (2) Lead and Tin
- (4) Copper and Zinc.

Ans (4)

43. Monel is an alloy of

- (1) Copper and Nickel
- (3) Zinc and Tin

- (2) Lead and Tin
- (4) Copper and Zinc.

Ans (1)

44. Inconel is an alloy of

- (1) Copper and Tin
- (3) Nickel -Chromium

- (2) Lead and Tin
- (4) Copper and Zinc.

Ans (3)

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

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

Ans (1)

46. Which component among the following reduces noise of exhaust gases in an IC engine-diesel/petrol engine?

- (1) Exhaust pipe (2) muffler (3) inlet manifold (4) tail pipe.

Ans (2)

47. The power factor of a purely inductive circuit is

- (1) Zero (2) lagging (3) leading (4) unity.

Ans (2)

47.1 The power factor of a purely capacitive circuit is

- (1) Zero (2) lagging (3) leading (4) unity.

Ans (2)

48. In the recent past DC series motor was used for traction (diesel and electric) purpose (even now older locos are running with DC series motors) but the present trend is to use

- (1) D.C. series motor (2) D.C. Compound motor
(3) D.C. shunt motor (4) Synchronous motor

Ans (4)

49. Otto cycle consists of

- (a) Two constant volume processes, one reversible adiabatic compression and one reversible adiabatic expansion processes.
(b) Two constant pressure processes, one reversible adiabatic compression and one reversible adiabatic expansion processes.
(c) Two constant pressure processes, and two constant volume processes.
(d) None of these

Ans: (a).

The four-stroke **Otto cycle** is made up of the following four internally reversible processes: 1–2, isentropic compression; 2–3, constant-volume heat addition; 3–4, isentropic expansion; and 4–1, constant-volume heat rejection.

Fig...

50. Diesel cycle consists of

- (a) An air standard **diesel cycle consists** of one constant pressure, one constant volume and two adiabatic processes
- (b) Two constant pressure processes, one reversible adiabatic compression and one reversible adiabatic expansion processes.
- (c) Two constant pressure processes, and two constant volume processes.
- (d) None of these

Ans: (a)

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