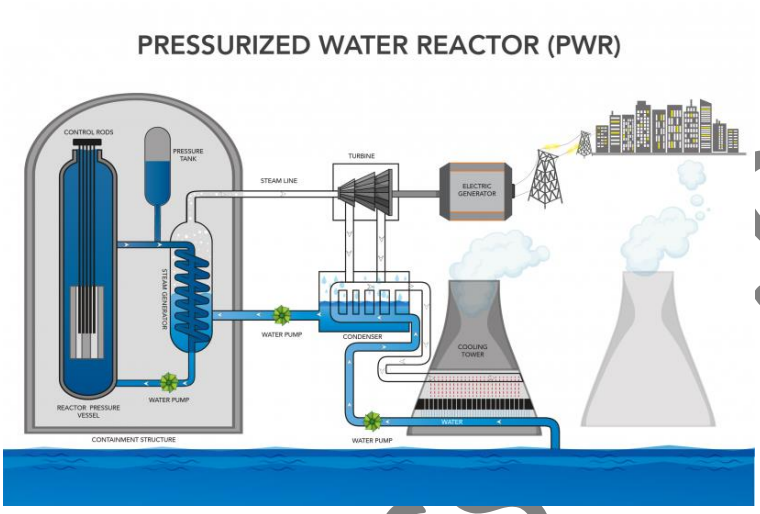
1. List two major types of nuclear reactors.

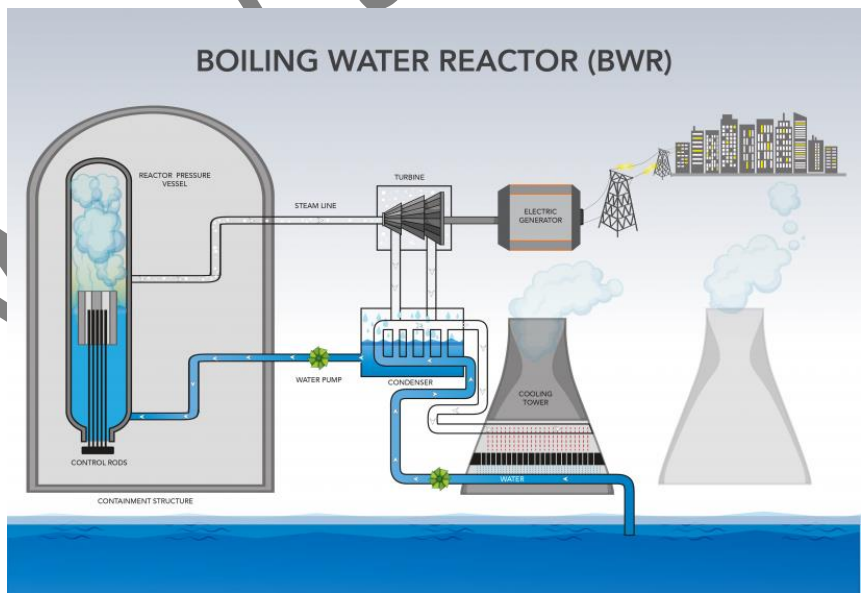
Types of Reactors

The Nuclear reactors currently operating in many countries are either boiling water reactors or pressurized water reactors. Both use steam to power a generator, but the difference is how they create it. A **boiling water reactor** heats up the water in the reactor until it boils into steam and spins the turbine. A **pressurized water reactor** heats up the water in the reactor too. However, that water is kept under pressure so it doesn't boil and is piped to another supply of water that becomes steam and spins the turbine.



Graphic by Sarah Harman | U.S. Department of Energy

https://www.energy.gov/ne/articles/nuclear-101-how-does-nuclear-reactor-work



Graphic by Sarah Harman | U.S. Department of Energy

https://www.energy.gov/ne/articles/nuclear-101-how-does-nuclear-reactor-work

2. The mechanical efficiency of an I.C. engine is equal to

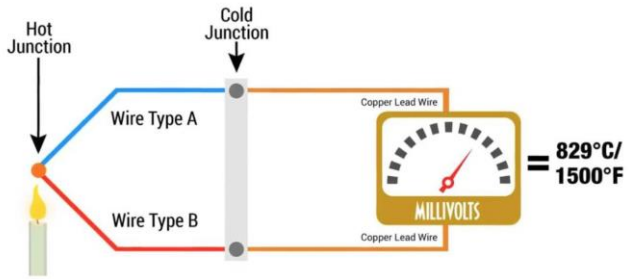
1. $\frac{\text{I.H.P.}}{\text{B.H.P.}}$ 2. $\frac{\text{F.H.P.}}{\text{B.H.P.}}$ 3. $\frac{\text{B.H.P.}}{\text{F.H.P.}}$ 4. $\frac{\text{B.H.P.}}{\text{I.H.P.}}$

Ans: 4

3. When two dissimilar metals are heated at one end and cooled at the other end, an e.m.f. is developed which is proportional to
   1. ratio of temperatures at the two ends
   2. difference of temperatures at two ends
   3. product of temperatures at two ends
   4. length of the metals

   Ans: 2.

Definition
Thermocouple is a combination of two different metallic strips joined together in such a way to form a loop. When the two junctions are kept at different temperatures, there is an electric current in the loop and an emf is developed. The magnitude of emf developed depends on the metals and the temperature difference of hot and cold junction. Such combination of two metals is popularly known Thermocouple. Figure below shows the construction of thermocouple.



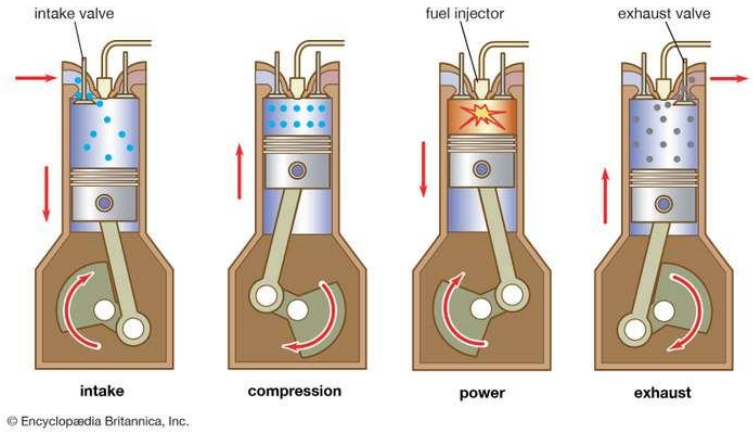
https://www.omega.com/en-us/resources/thermocouple-hub

4. Fuel injector is used in a

1. spark ignition engine
2. steam engine
3. compression ignition engine
4. gas engine

Ans: 3

Injector, a device for injecting liquid fuel at high pressure into an internal-combustion engine. The term is also used to describe an apparatus for injecting boiler feed water into a boiler.



Four-stroke diesel engine

In a DSL engine, injected fuel is ignited by its reaction to compressed hot air in the cylinder, a more efficient process than that of the spark-ignition internal-combustion engine.

In diesel engines fuel must be in a highly atomized form for proper combustion. Usually this is accomplished with a plunger and cylinder arrangement (solid injection), which forces accurately measured amounts of liquid fuel into the combustion chambers through atomizing nozzles. Compressed air (air injection) is sometimes used in place of a plunger.

The main purpose of the fuel injection system is to deliver fuel into the cylinders of an engine. In order for the engine to effectively make use of this fuel:

1. Fuel must be injected at the proper time, that is, the injection timing must be controlled and
2. The correct amount of fuel must be delivered to meet power requirement, that is, injection metering must be controlled.

Britannica, The Editors of Encyclopaedia. "Injector". *Encyclopedia Britannica*, 3 Dec. 2019, https://www.britannica.com/technology/injector. Accessed 16 October 2021.

5. For a four cylinder in-line internal combustion engine, the most popular firing order is

1). 1-3 -4 -2 2.1-4 -3 -2 3.1-2 -3 -4 4. 1-2 -4 -3

Ans:1

6. On a steam power plant, a condenser

1. reduces back pressure of steam
2. increases expansion ratio of steam
3. reduces temperature of exhaust steam
4. all of the above

Ans: 4

The supercritical pressure thermal power plant (SC) adopts, in general, 24.1 MPa g inlet steam pressure and 538/566°C inlet steam temperature as a standard steam condition. Thermal efficiency of an SC plant is about 40%. The USC pressure thermal power plant was developed to improve thermal efficiency compared to SC plants. For the USC plant, inlet steam pressure is raised from 24.1 to 31 MPa g, and the two-stage reheat cycle is adopted with 566/566/566°C steam temperature conditions. This steam condition was applied to Kawagoe thermal power plant of Chubu Electric Power Company, where the thermal efficiency is as high as 42%. After the Kawagoe thermal power plant, the steam pressure was reduced to 25 MPa g while steam temperature has been raised to 600°C from 566°C. A thermal power plant with this elevated steam condition is called as USC plant and can achieve approximately 42% thermal efficiency.

Steam turbine cycles and cycle design optimization
A. Ohji, M. Haraguchi, in Advances in Steam Turbines for Modern Power Plants, 2017
2.4.4 USC pressure thermal power plant
https://www.sciencedirect.com/topics/engineering/steam-inlet-pressure

7. A tensile force (P) is acting on a body of length (L) and area of cross section (A). The change in length ΔLwould be

1. P/IAE 2. PE/AI 3. PL/AE 4. AI/PE

Ans:3

8. The ratio of shear stress to shear strain is called

1. Poisson's ratio 2. bulk modulus
3. modulus of rigidity 4. modulus of elasticity

Ans: 3

9. The cross-sectional area of a rod is 10 cm^2. A pull of 10 tonnes is maximum stress produced in the rod would be

1. 1 tonne/cm^2 2. 0.5 tonne/cm^2 3.4 tonne/cm^2 4.2 tonne/cm^{2A}

Note: Stress = Force/area of cross section

Ans: 1

10. The Hook's law is valid to

1. yield point 2. plastic limit 3. elastic limit 4.all of the above

Ans: 3. (Hook's law states that within elastic limit, stress, σ is preoperational to strain, ε, i.e., $\sigma \propto \varepsilon$)

11. Modulus of resilience is

1. property to resist shocks
2. an index of elasticity
3. an index of compressibility
4. the property to store strain energy without undergoing permanent deformation

Ans: 4

The modulus of resilience is the amount of strain energy per unit volume (i.e., strain energy density) that a material can absorb without permanent deformation results. It can be calculated by integrating the stress–strain curve from zero to the elastic limit.

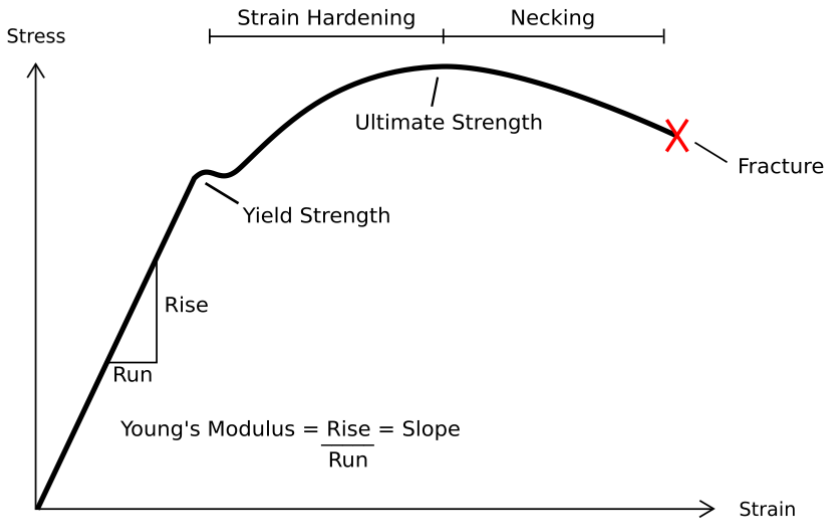
Proof resilience is defined as the maximum energy that can be absorbed up to the elastic limit, without creating a permanent distortion.

The modulus of resilience is defined as the maximum energy that can be absorbed per unit volume without creating a permanent distortion. It can be calculated by integrating the stress–strain curve from zero to the elastic limit. In uniaxial tension, under the assumptions of linear elasticity,

$$U_r = \frac{\sigma_y^2}{2E} = \frac{\sigma_y \varepsilon_y}{2}$$

where U_r is the modulus of resilience, σ_y is the yield strength, ε_y is the yield strain, and E is the Young's modulus.[1] This analysis is not valid for non-linear elastic materials like rubber, for which the approach of area under the curve till elastic limit must be used.

https://www.engineeringchoice.com/modulus-of-resilience/



The area under the linear portion of a stress–strain curve is the resilience of the material.

https://en.wikipedia.org/wiki/Resilience_(materials_science)#/media/File:Stress_Strain_Ductile_Material.png

12. 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.

13. In a free expansion process

1. work done is zero
2. heat transfer is zero
3. work done and heat transfer is zero
4. work done is zero but heat increases.

Ans : 3.

14. Thermal conductivity of air with raising temperature

1. increases
2. decreases
3. remains constant
4. may increases or decrease depends on temperature.

Ans: 1

As the temperature of **air** increases the molecular diffusion also gets increases and in case of air, Thermal conductivity is directly proportional to the lattice vibration and molecular diffusion and hence as the temperature increases the thermal conductivity of air increases.
Thermal conductivity is a material property that describes *ability to conduct heat*. Thermal conductivity can be defined as the quantity of heat transmitted through a unit thickness of a material - in a direction normal to a surface of unit area - due to a unit temperature gradient under steady state conditions. Its unit is W/(m K) in the SI system and Btu/(h ft °F) in the Imperial system.

15. Dew point temperature is an indication of

1.dryness of air
2. latent heat
3. moisture content of air
4. coolness of air

Ans: 3

Dew points indicate the amount moisture in the air. The higher the dew points, the higher the moisture content of the air at a given temperature. Dew point temperature is defined as the temperature to which the air would have to cool (at constant pressure and constant water vapor content) in order to reach saturation.

16. Liquids

1. are incompressible
2. occupy a definite volume
3. are viscous
4. all of the above

Ans: 4

17. Falling drops of rain water becomes spheres due to the property of

1. adhesion
2. cohesion
3. surface tension
4. viscosity

Ans: 3

18. In continuity equation for a steady flow of fluid is given by

1. $A_1V_1 = A_2V_2$
2. $\rho_1A_1 = \rho A_2$
3. $P_1A_1V_1 = P_2A_2V_2$
4. $\rho_1A_1V_1 = \rho_2A_2V_2$

Ans: 4 (In fluid dynamics, continuity equation signifies ‘conservation of mass’)

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

1. Biot number
2) Fourier number
3) Stanton number
4) Nusselt number

Ans : 1

Explanation: It is the ratio of conduction resistance to that of convective resistance.

20. The value of Biot number is very small (less than 0.01) when

(1)The convective resistance of the fluid is negligible
(2)The conductive resistance of the solid is negligible but the convective resistance of the fluid is significant.
(3)The conductive resistance of the solid is negligible
(4)None of these

Ans : 2

The Biot Number is a dimensionless group named after J. B. Biot who analysed the interaction between conduction in a solid and convection at its surface. The numerical value of Biot Number (Bi) is a criterion which gives a direct indication of the relative importance of conduction and convection in determining the temperature history of a body being heated or cooled by convection at its surface, for which Bi < 0.1 and for which it is seldom necessary to solve the conduction equation, i.e., convection is the rate controlling process.

$B_i = h L_C/k$.

21. Which class of amplifiers operates with least distortion?

(1)Class A (2)Class B (3)Class C (4)Class AB

Ans : 1

The most commonly constructed amplifier classes are those that are used as audio amplifiers, mainly class A, B, AB and C

Class A amplifier
Class A amplifier has the highest linearity and the lowest distortion. The amplifying element is always conducting and close to the linear portion of its transconductance curve. The point where the device is almost off is not at a zero signal point and hence its distortions compared to other classes are less.

Class “A” amplifiers are considered the best class of amplifier design due mainly to their

excellent linearity, high gain and low signal distortion levels when designed correctly. Although seldom used in high power amplifier applications due to thermal power supply considerations, class-A amplifiers used in high-fidelity audio amplifier designs.

https://www.electronics-tutorials.ws/amplifier/amplifier-classes.html
https://www.elprocus.com/types-of-amplifiers-with-workings/

Box: Willians line

Note: **Willian's line** method is used to find the friction power of the engine.

The Willans line represents the relationship between fuel energy input and engine output. Extrapolation to a zero line of fuel input provides a useful approximation of the mechanical losses.

Source: https://www.sae.org/publications/technical-papers/content/690182/

Box: units of Pressure

Common Pressure Units frequently used as alternative to "*one Atmosphere*"

76 cm (760 mm) of Mercury
29.921 Inches of Mercury
10.332 M of Water
406.78 Inches of Water
33.899 Feet of Water
14.696 psi
2116.2 lb/ft^2
1.033 kg/cm^2
101.33 kPa
https://www.engineeringtoolbox.com/air-composition-d_212.html

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