1. Find the value of $\log_3 9 + \log_3 12 - \log_3 4$

(1) zero (2) 1 (3) 2 (4) 3

Ans:4

2. If x+y = 7 and $x^2 + y^2 = 25$, find the value of $\left[\frac{1}{x}\right] + \left[\frac{1}{y}\right]$

(1) 7/25 (2) 25/7 (3) 7/12 (4) 12/7

Ans:3 (For the given sum, xy = 12 → $x = 3$ *and* $y = 4$ *or cice* − *versa.*)

3. Air vessels in reciprocating pump are used to :

(1) smoothen flow (2) reduce acceleration to minimum

(3) same pump from cavitation (4) increase pump head

Ans: 1

4. A diesel engine as compared to petrol engine (both running at rated load) is

(1) more efficient (2) less efficient

(3)equally efficient (4) unpredictable

Ans:1

5. Rotary compressors are suitable for :

(1) large discharge a high pressure

(2)low discharge at high pressure

(3) large volume discharge at a low pressure

(4)low discharge a low pressure

Ans:3

6. Inter cooling in compressors:

(1) Cools the delivered air

(2) Results in saving of power in compressing a given volume to given pressure

(3) Is the standard practice for big compressor

(4) Enables compression in two stages

Ans:2

7. Supercharging is the process of :

(1) Supplying the intake of an engine with air at a density greater than the density of the surrounding atmosphere

(2) Providing forced cooling air

(3) Injecting excess fuel for raising more load

(4) Supplying compressed air to remove combustion products fully

Ans:1

8. The two rams in a hydraulic press have diameter ratio of 1:30. The ratio of the pressures against each ram will be

(1) 1:1 (2) 1:30 (3) 30:1 (4) 15:1

Ans:1 (as per Pascal's law, a uniform pressure acts on all surfaces that are in contact the the fluid)

9. Thermocouples work on :

(1) Thomson effect (2) Seeback effect

(3) Peltier effect (4) Joule effect

Ans:2

10. In refrigeration cycles, throttling/expansion device work on :

(1) Thomson effect (2) Seeback effect

(3) Peltier effect (4) Joule-Thompson effect

Ans:4

11. A device converts heat energy into work is called:

(1) refrigerator (2) heat pump

(3) heat motor (4) heat engine

Ans:4 (e.g., IC engines, steam/gas turbines, etc)

12. Piezoelectric effect is the production of electricity by :

(1) chemical energy (2) varying field

(3) Temperature (4) application of pressure

Ans:4

13. A hunter aims his gun at a monkey sitting on a tree. At the instant bullet leaves the barrel of the gun, the monkey drops himself from the tree. The bullet will

(1) go just above the tree (2) not hit the monkey

(3) not move very far (4) hit the monkey

Ans:4. (both are freely falling bodies from same height. Hence vertical distance travelled is same for both the cases.)

14. Which of the following refrigerants has the highest critical point pressure? key are normally made form:

(1) Freon-11 (2) Freon-12 (3) Freon-22 (4) Ammonia

Ans:4

15. Which of the following materials is antifriction bearing is made of?

Most ball bearings are made of a **type of steel known as high carbon chromium steel**, often called chrome steel. This is used for reasons of cost and durability. Bearings are also made from other materials such as stainless steel, ceramics and plastic.

Journal bearings are fabricated from bimetallic steel-babbitt strip. The bearing materials having a copper base are the **tin bronzes**, the tin-lead bronzes, the leaded bronzes, some tin-less bronzes, and also some brasses.

16. Which of the following is antifriction bearing ?

(1) Pedestal bearing (2) Collar bearing

(3) Full journal bearing (4) Needle bearing

Ans:4

17. Annealing of white cast iron results in production of :

(1) Malleable iron (2) Nodular iron

(3) Spherical iron (4) Grey iron

Ans:1

Malleable cast iron may be produced by taking a white iron casting and holding it at 950–1000 °C, when breakdown of the iron carbide occurs:

$Fe_3C \rightarrow 3Fe+C$

Producing graphite in the form of aggregates known as 'temper carbon'. These are not in flake form and are thus much less deleterious to the mechanical

properties; the result is a material which possesses a good measure of strength combined with ductility. Nodular, or spheroidal graphite (SG) cast iron contains graphite spheroids in the as-cast state, by the addition of cerium and/or magnesium to the iron

Metals and alloys
J.W. Martin, in Materials for Engineering (Third Edition), 2006
https://www.sciencedirect.com/topics/engineering/malleable-cast-iron

18. Bolts are designed on the basis of :

(1) Direct tensile stress with high safety factor

(2) Direct shear stress with high safety factor

(3) Direct compressive stress with high safety factor

(4) Direct bearing stress with high safety factor

Ans:1

19. Factor of safety is :

(1) yield stress/working stress

(2) tensile stress/working stress

(3) compressive stress/working stress

(4) bearing stress/working stress

Ans:2

20. In vapour compression cycle, the condition of refrigerant is saturated liquid-

(1) After passing through the condenser

(2) Before passing through the condenser

(3) after passing through the expansion or throttle valve

(4) Before entering the compressor

Ans:1

21. Magnetite is an ore of:

(1) Aluminium (2)Iron (3) Sodium (4) Gold

Ans:2

22. Different compounds with the same molecular formula but with different structures are called:

(1) Isomers (2) Isobars (3) Isotopes (4) Polymers

Ans:1

23. Carnot cycle has maximum efficiency for :

(1) reversible engine (2) irreversible engine

(3) new engine (4) petrol engine

Ans:1

24. Expansion in nozzle is a :

(1) isobaric process (2) isothermal process

(3) adiabatic process (4) isochoric process

Ans:3

25. Gas turbine works on :

(1) constant pressure cycle (2) constant volume cycle

(3) constant temperature cycle (4) constant enthalpy cycle

Ans:1

The gas-turbine operates on the principle of **the Brayton cycle**, where compressed air is mixed with fuel, and burned under constant pressure conditions. The resulting hot gas is allowed to expand through a turbine to perform work. A simple gas turbine is comprised of three main sections a compressor, a combustor, and a power turbine.

……..

HOW GAS TURBINES PRODUCE ELECTRICITY?

In order to generate electricity, the gas turbine heats a mixture of air and fuel at very high temperatures, causing the turbine blades to spin. The spinning turbine drives a generator that converts the energy into electricity.

1. Air-fuel mixture ignites:

The gas turbine compresses air and mixes it with fuel that is then burned at extremely high temperatures, creating a hot gas.

2. Hot gas spins turbine blades:

The hot air-and-fuel mixture moves through blades in the turbine, causing them to spin quickly.

3. Spinning blades turn the drive shaft:

The fast-spinning turbine blades rotate the turbine drive shaft.

4. Turbine rotation powers the generator:

The spinning turbine is connected to the rod in a generator that turns a large

magnet surrounded by coils of copper wire.

https://www.ge.com/gas-power/resources/education/what-is-a-gas-turbine

26. Gas turbine works on …….(Brayton cycle).

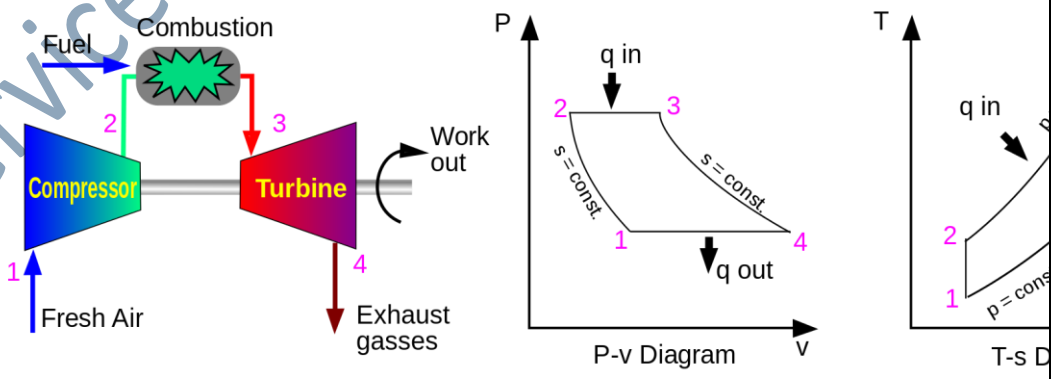
THE BRAYTON MODEL

A basic turbine engine consists of a compressor, a mixing chamber (a burner) and a turbine section. The Brayton cycle is characterized by two constant-pressure processes and two isentropic processes:

1. Adiabatic process - Air is drawn in and compressed in the compressor (volume decreases, pressure increases).

2. Isobaric process - Heat is added in the burner (volume increases, pressure constant).
3. Adiabatic process - Expansion of the gas takes place across the turbine section (volume increase, pressure decreases).

4. Isobaric process - Further heat loss as gas is returned to the atmosphere (volume decreases, pressure constant).



The idealized Brayton cycle where P = pressure, v = volume, T = temperature, s

= entropy, and q = the heat added to (q_{in}) or rejected (q_{out}) by the system.

https://en.wikipedia.org/wiki/File:Brayton_cycle.svg

27. Reversed Braton cycle is applied in ……(Bell Coleman cycle.)

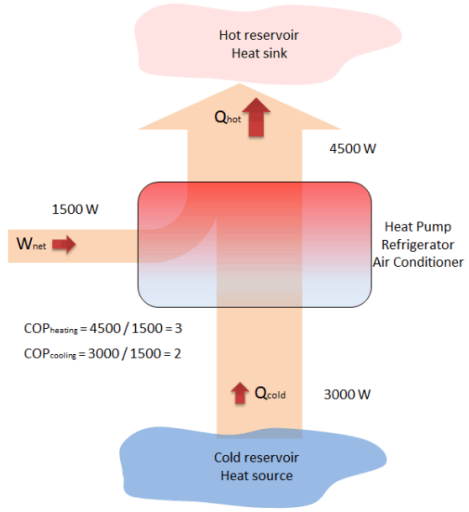
A Brayton cycle that is driven in reverse direction is known as the reverse Brayton cycle. Its purpose is **to move heat from colder to hotter body**, rather than produce work. This cycle is also known as the gas refrigeration cycle or Bell Coleman cycle used in aircraft refrigeration.

REVERSE BRAYTON CYCLE – BRAYTON REFRIGERATION CYCLE

A **Brayton cycle** that is driven in reverse direction is known as the **reverse Brayton cycle**. Its purpose is to move heat from colder to hotter body, rather than produce work.
This cycle is also known as the gas refrigeration cycle or Bell Coleman cycle. This type of cycle is widely used in jet aircrafts for air conditioning systems using air from the engine compressors. It is also widely used in the LNG industry.

WHAT IS HEAT PUMP

The term **heat pump** is usually reserved for a device that can heat a house in winter by using an electric motor that does work W to take heat Q_{cold} from the outside at low temperature and delivers heat Q_{hot} to the warmer inside of the house.



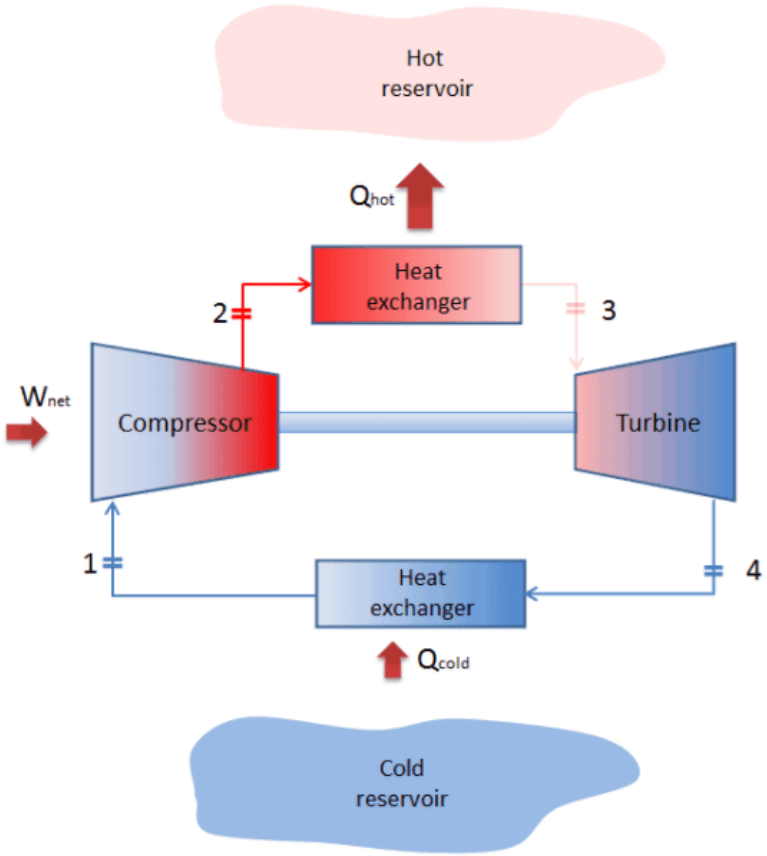
Heat Pump, Refrigerator, Air Conditioner – basic principle of operation

The operating principle of **refrigerators**, **air conditioners**, and **heat pumps** is **the same** and it is just the **reverse** of a **heat engine**. In general, a **heat pump** is a device that transfers heat energy from a **heat source** to a "**heat sink**", but in this case the transfer occurs in the opposite direction of spontaneous heat transfer by **absorbing heat** from a **cold space** and **releasing it** to a **warmer one**. As diagrammed in the figure, by doing external work W, heat is taken from a low-temperature region (heat

source) and a greater amount of heat is exhausted at a higher temperature (heat sink).

The most widely used thermodynamic cycle or method for heating, air-conditioning, refrigerators and heat pumps is the **vapor compression cycle**. But the **Brayton cycle** can be also used to drive the heat pumps.

Reverse Brayton Cycle – Brayton Refrigeration Cycle



https://nuclear-power.com/wp-content/uploads/2017/04/reverse-Brayton-cycle-cooling-and-heat-pumps-min.png

28. A non-metal which is a good conductor of heat and electricity is

(1) Iodine (2) Sulphur (3) Phosphorus (4) Graphite

Ans:4

29. Copper reacts with concentrated Sulphuric acid on heating to liberate which gas ?

(1) H_2 (2) SO_2 (3) H_2S (4) O_2

Ans:

30. Weld spatter refers to:

(1) shielding gas (2) flux

(3) filler material (4) welding defect

Ans:4

31. Which of the following is not a casting defect ?

(1) hot tear (2) blow hole

(3) scab (4) decarburisation

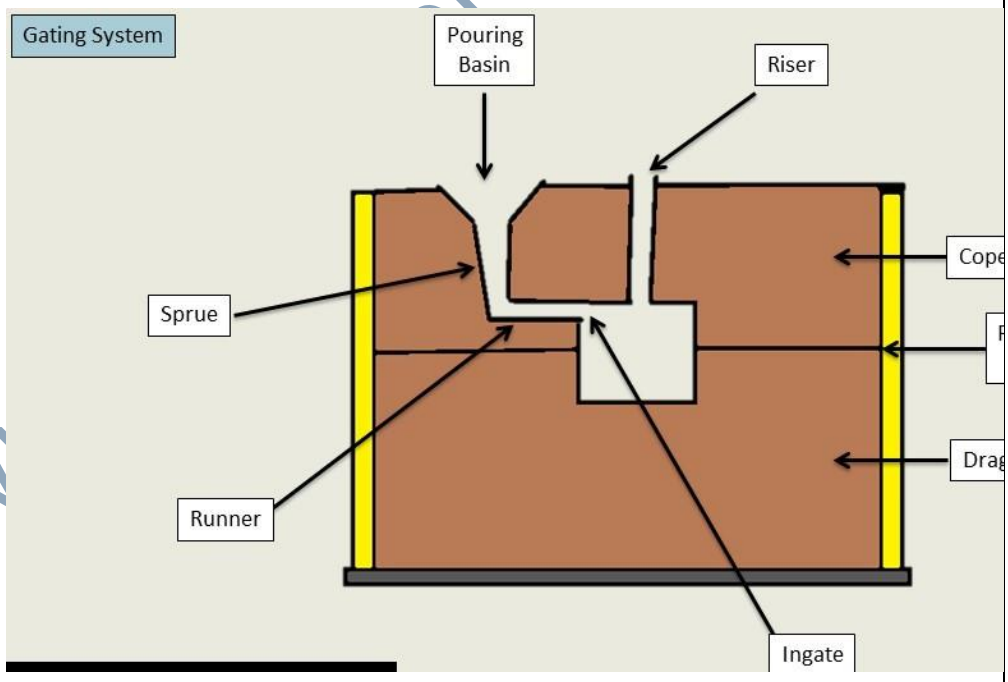
Ans:4

32. The runners and ingates, respectively are located as follows in casting of ferrous metals

(1) in cope and in drag (2) in drag an in cope

(3) both in cope (4) both in drag

Ans:1



ELEMENTS OF GATING SYSTEM - METAL CASTING

- Published on March 8, 2021

https://www.linkedin.com/pulse/elements-gating-system-metal-casting-the-

learning-hub/

The main elements needed for the gating system are as follows:

- Pouring basin
- Sprue or downspure.
- Sprue Well.
- Runner.
- Ingate.
- Ladle.
- Cope
- Drag
- Riser

1. **Pouring Basin** – Acts as reservoir for molten metal.

2. **Sprue** – Through which molten metal flows after pouring. A passage between pouring basin and runner.

"It is TAPERED to avoid ASPIRATION"

3. **Runner** – Allows the molten metal to enter the

cavity. A horizontal channel which connects the sprue with ingate.

"They are commonly made trapezoidal in cross-section"

4. **Ingate** – The last point where molten metal enters the cavity.

5. **Riser** – Also known as feed. It is a reservoir to compensate for the liquid and solidification shrinkage taking place.

33. The purpose of sprue is to ;

(1) Feed the casting at a rate consisted with the rate of solidification

(2) Act as a reservoir for molten metal

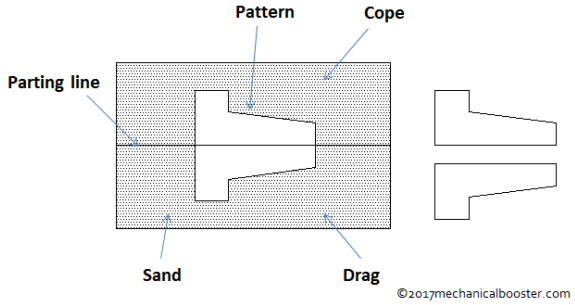
(3) Help feed the casting until all solidification

(4) Feed molten metal from pouring basin to gate

Ans:4

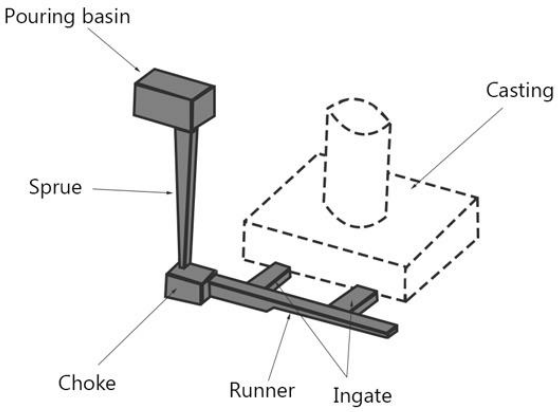
In the metal foundry, the gating system in casting is a metal pouring system that conducts molten metal into the mold cavity. Metal flows down from the pouring basin into the sprue and passes through the runner and gates before entering the mold cavity. The terms cope and drag refer respectively to the top and bottom parts of a two-part casting flask, used in sand casting. The flask is a wood or metal frame, which contains the molding sand, providing support to the sand as the metal is

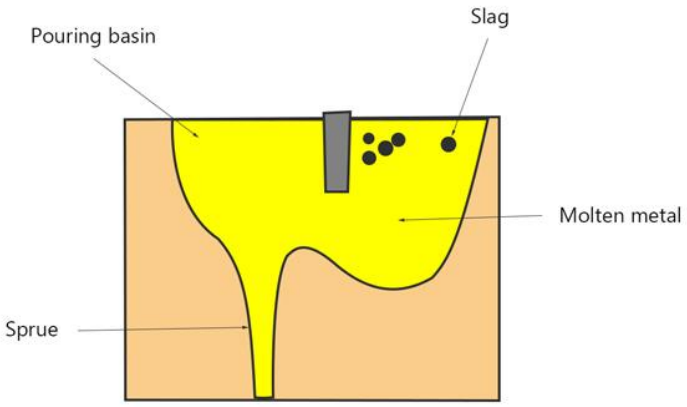
poured into the mold.Cope and Drag tooling consists of two patterns, one pattern for the cope and one pattern for the drag.



Cope and Drag Pattern

https://www.mechanicalbooster.com/2017/11/types-patterns-casting-process.html/cope-and-drag-pattern





https://vietnamcastiron.com/gating-system/

34. Which of the following is a gear finishing operation ?

(1) Hobbling (2) Shapping

(3) Milling (4) Shaving or burnishing

Ans:4

35. In resistance welding, the electrode is made of :

(1) carbon steel (2) stainless steel

(3) copper (4) high speed steel

Ans:3

36. A temperature of -273°C is called:

(1) Neutral temperature (2) absolute zero

(3) Temperature of inversion (4) critical temperature

Ans:2

37. When a tunning fork is vibrating, the vibrations of its two prongs have a phase difference of :

(1) zero (2) $\frac{\pi}{4}$ (3) $\frac{\square}{2}$ (4) $\frac{\square}{3}$

Ans:1 (There is no phase difference between the two forks)

38. The chemical properties of an atom are determined by:

(1) atomic number (2) mass number

(3) number of isotopes (4) binding energy

Ans:1

39. Who introduced the concept of quantum theory of radiation ?

(1) Albert Einstein (2) Max Planck

(3) Neils Bohr (4) Rutherford

Ans:2

40. The half life of a substance is 4 days. After 12 days, the fraction of atoms that would have decayed is

(1) 1/6 (2) 7/12 (3) 7/8 (4) 1/8

Ans:3

41. Sound waves cannot travel through:

(1) wood (2) vacuum

(3) liquid (4) oxygen gas

Ans:2

42. A sextant is used to :

(1) See distant objects

(2) Find height of distant objects above ground

(3) Analyze the spectrum of given light source

(4) Do survey work

Ans:2

43. Pick up the correct statement for milling

(1) cutter is rotated in the opposite direction of travel of job

(2) thickness of chip is maximum at the beginning of cut

(3) cutting force is directed downwards

(4) coolant can be easily poured on the cutting edge

Ans:

44. Twist fluted drills are preferred because

(1) it cuts holes efficiently

(2) it guides the chips move out freely

(3) cutting lip is supported rigidly

(4) it moves swiftly in the metal

Ans:2

45. Broaching operation is frequently used in automobile industry to make:

(1) it is an automatic machine

(2) it is a mass production machine

(3) splines

(4) high degree of finish and close tolerance are achieved

Ans:3

46. Which of the following is not the angle measuring device?

(1) angle plate (2) sine bar

(3) bevel protector (4) angle gauge

Ans:1

Angle Measurement Instrument

Line standard Angular Measuring Devices

Protractors

Universal Bevel protractors

Face standard Angular Measuring Devices

Sine bar

Sine center

Measurement of Inclines

- Spirit level
- Clinometer

Angle comparators

- Auto collimators

Mechanical measurement and metrology
Prof. Naman M. Dave

https://www.slideshare.net/NamanDave/angular-measurements-59300107

……

https://www.fullyinstrumented.com/tools-to-measure-angles/

5 TYPES OF TOOLS TO MEASURE ANGLES

1. PROTRACTORS

The protractor allows you to measure an angle that is generated by two sides of an object. And therefore, you could do the measurement at any position you want as long as you get the angle. This type of angle measuring tool can be digital and non-digital.

Bevel Protractor

This model comes with at least two arms and a hinge to give flexibility, speed, and accuracy in measuring an angle. By using this model, you could measure whether it is an external or an internal angle. Moreover, you could get a more accurate angle measurement with this model since the arms stick directly to the

surface.

The digital model of this model is also available to choose from. As you have to stick the arms, you could get the angle reading easily. You don't need to see the scale perpendicularly, you could read the screen at any position.

2. ANGLE GAUGE

An angle gauge lets you measure the surface angle easily against the horizontal axis in which using a protractor can be impossible to do. Simply put the angle gauge on the surface you want to measure its angle, and then it will display the reading.

The model can be digital and mechanical. Both of them have different advantages and you could consider which one is more suitable for you.

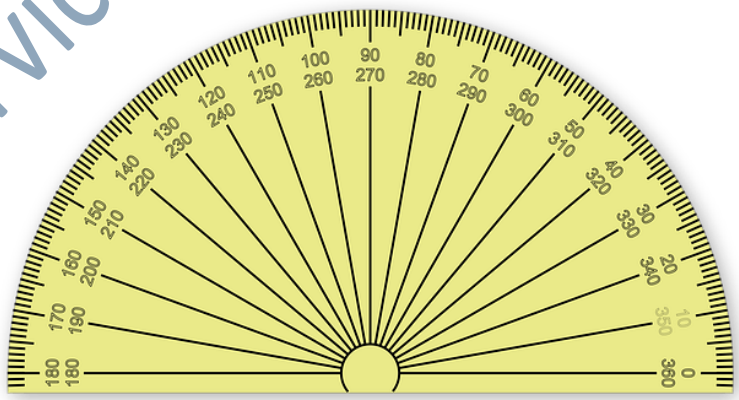
3. MULTIPLE ANGLE MEASURING RULER

Though this tool cannot exactly measure the angle, however, it's very helpful to simplify job in accordance with angle measurement. Instead of measuring each angle and measure the length of the sides one by one, a multi-angle measuring ruler functions to copy the multiple angles of an object easily. Moreover, it duplicates the dimension as well so you don't need to measure the side length again.

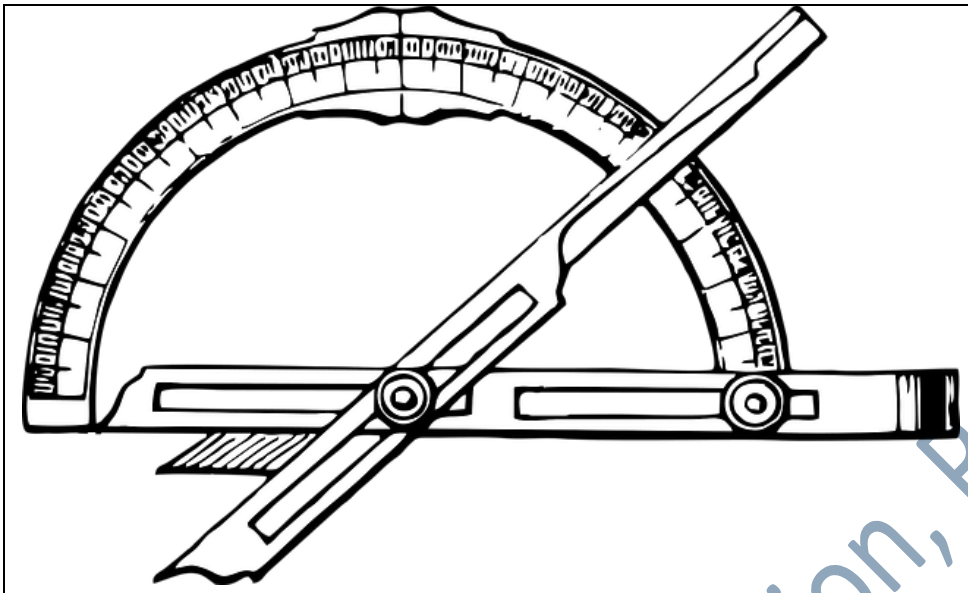
4. TRY SQUARE

Similar to the multi-angle measuring ruler, a try square doesn't show the reading of the degree of an angle. However, it's designed such a go/no-go gauge. If an angle is not 90° shaped, then it can be detected by this tool.

The advantage given by the try square is the speed. You could easily determine an angle whether it's a 90 angle or not.



Half-disk protractor



over, it can be a ruler. Instead of carrying the ruler, this tool provides two functions at the same time.

5. SINE BAR

A sine bar doesn't show directly the reading of angle. By the support of the gauge block as the height adjustment, a sine bar will shape a triangle. The accuracy of gauge block and sine bar is highly determinable to the accuracy of the angle measurement.

47. Centering can be done most accurately on A

(1) four jaw chuck (2) three jaw chuck

(3) collect chuck (4) Magnetic chuck

Ans:1

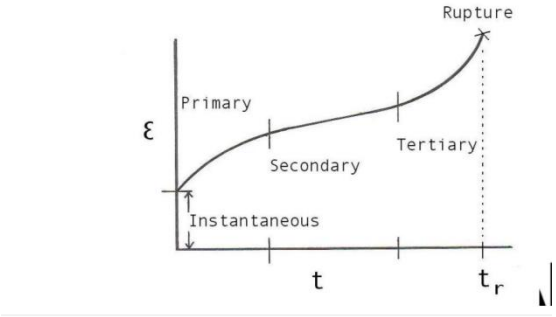
48. In the tensile test, the phenomenon of slow extension of the material, i.e., stress increasing with the time at the constant load is called:

(1) creep (2) yielding (3) breaking (4) plasticity

Ans:2

Creep. • It is a time- dependent deformation under a certain applied load. • Generally occurs at high temperature (thermal creep), but can also happen at room temperature in certain materials (e.g. lead or glass), albeit much slower.

Classical Creep Curve • The rate of deformation is called the creep rate. It is the slope of the line in a Creep Strain vs. Time curve.



Creep Stages
• Primary Creep: starts at a rapid rate and slows with time.
• Secondary Creep: has a relatively uniform rate.
• Tertiary Creep: has an accelerated creep rate and terminates when the material breaks or ruptures. It is associated with both necking and formation of grain boundary voids.

https://www.iit.edu/sites/default/files/2021-02/materialscreep.pdf

49. A head of the matchstick contains:

(1) white phosphorus (2) red phosphorus

(3) sodium (4) black phosphorus

Ans:

The head of safety matches are made of **an oxidizing agent such as potassium chlorate, mixed with sulfur, fillers and glass powder**. The side of the box contains red phosphorus, binder and powdered glass.

50. If a solution contains a known quantity of solute in a known volume of solvent then it is called:

(1) normal solution (2) standard solution

(3) molar solution (4) ideal solution

Ans:1

Normality (N) is another way to quantify solution concentration. It is similar to molarity but uses the **gram-equivalent weight** of a solute in its expression of solute amount in a liter (L) of solution, rather than the **gram molecular weight (GMW)** expressed in molarity. A 1N solution contains 1 gram-equivalent weight of solute per liter of solution.

https://www.labce.com/spg931723_what_is_a_normal_solution.aspx

Molarity

The most common unit of concentration is *molarity*, which is also the most useful for calculations involving the stoichiometry of reactions in solution. The molarity

(M) is defined as the number of moles of solute present in exactly 1 L of solution. It is, equivalently, the number of millimoles of solute present in exactly 1 mL of solution:

$$molarity = \frac{moles\ of\ solute}{liters\ of\ solution} = \frac{mmoles\ of\ solute}{milliliters\ of\ solution}$$

The units of molarity are therefore moles per liter of solution (mol/L), abbreviated as M. An aqueous solution that contains 1 mol (342 g) of sucrose in enough water to give a final volume of 1.00 L has a sucrose concentration of 1.00 mol/L or 1.00 M. In chemical notation, square brackets around the name or formula of the solute represent the molar concentration of a solute. Therefore,

$$[\text{sucrose}] = 1.00\ \text{M} \qquad (4.5.2)$$

is read as "the concentration of sucrose is 1.00 molar." The relationships between volume, molarity, and moles may be expressed as either

The units of molarity are therefore moles per liter of solution (mol/L), abbreviated as MM.

https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_-_The_Central_Science_(Brown_et_al.)/04._Reactions_in_Aqueous_Solution/4.5%3A_Concentration_of_Solutions

Standard solution

In analytical chemistry, a **standard solution** is a solution containing a precisely known concentration of an element or a substance. A known mass of solute is dissolved to make a specific volume. It is prepared using a standard substance, such as a primary standard. Standard solutions are used to determine the concentrations of other substances, such as solutions in titration. The concentrations of standard solutions are normally expressed in units of moles per litre (mol/L, often abbreviated to M for molarity), moles per cubic decimetre (mol/dm^3), kilomoles per cubic metre (kmol/m^3) or in terms related to those used in particular titrations (such as titres

https://en.wikipedia.org/wiki/Standard_solution#:~:text=In%20analytical%20chemistry%2C%20a%20standard,such%20as%20a%20primary%20standard.

Molar solution

A molar solution is defined as an aqueous solution that contains 1 mole (gram-molecular weight) of a compound dissolved in 1 liter of a solution. In other words, the solution has a concentration of 1 mol/L or a molarity of 1 (1M). Physicists and chemists typically use this parameter to express concentrations of various substances.

https://www.corrosionpedia.com/definition/790/molar-solution

Ideal solution

In chemistry, an **ideal solution** or **ideal mixture** is a solution that exhibits thermodynamic properties analogous to those of a mixture of ideal gases

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

Normal solution: A solution made by dissolving 1 g-equivalent weight of a substance in sufficient distilled water to make 1 L of solution.

A solution consists of two components: solute (the dissolved material) and solvent (the liquid in which the solute is dissolved). The amount of solute in a given amount of solution or solvent is known as the concentration. The two most common ways of expressing concentration are molarity and molality.

MOLARITY

The molar concentration (M) of a solution is defined as the number of moles of ***solute*** (n) per liter of ***solution*** (i.e, the volume, $V_{solution}$):

M=nVsolution M=nVsolution

The units of molarity are mol/L, often abbreviated as ***M***.

For example, the number of moles of NaCl in 0.123L of a 1.00M solution of NaCl can be calculated as follows:

0.123 L of solution×1.00 mole1.00 L of solution=0.123 moles NaCl0.123 L of solution×1.00 mole1.00 L of solution=0.123 moles NaCl

MOLALITY

The molal concentration (m) of a solution is defined as the number of moles of ***solute*** (n) per kilogram of ***solvent*** (i.e., the mass of the solvent, $m_{solvent}$).

The units of molality are mol/kg, or ***m***.

https://courses.lumenlearning.com/boundless-chemistry/chapter/solution-concentration/