Mechanical Engineering

1. The gear ratio of a simple manual transmission is changed by:

A) Sliding selected gears into mesh.

B) Using a torque converter.

C) Varying the fluid pressure.

D) Changing the belt and pulley combination.

Answer: A) Sliding selected gears into mesh.

Explanation: The driver moves the gearshift lever, which engages different pairs of gears to achieve different speed ratios between the engine and the wheels.

2. The universal joint, or U-joint, allows a rotating shaft to:

A) Transmit torque between shafts that are at an angle to each other.

B) Lengthen and shorten.

C) Connect and disconnect power.

D) Absorb torsional vibrations.

Answer: A) Transmit torque between shafts that are at an angle to each other.

Explanation: It is commonly used in the propeller shaft of rear-wheel-drive vehicles to accommodate the movement of the rear axle suspension.

3. The firing order in a typical four-cylinder inline engine is:

A) 1-2-3-4

B) 1-3-4-2

C) 1-4-3-2

D) 1-2-4-3

Answer: B) 1-3-4-2

Explanation: This firing order provides a better balance of forces and smoother operation compared to firing the cylinders in sequence.

4. A turbocharger is a type of supercharger that is driven by:

A) A belt connected to the engine's crankshaft.

B) An electric motor.

C) The engine's exhaust gases.

D) The intake manifold vacuum.

Answer: C) The engine's exhaust gases.

Explanation: It uses a turbine to extract energy from the exhaust stream to drive a compressor, which forces more air into the engine cylinders, boosting power and efficiency.

5. The Ackerman steering mechanism is designed so that during a turn, the inside wheel turns at a:

A) Smaller angle than the outside wheel.

B) Greater angle than the outside wheel.

C) The same angle as the outside wheel.

D) Negative angle.

Answer: B) Greater angle than the outside wheel.

Explanation: This geometry ensures that the axes of all four wheels intersect at a common point, allowing the wheels to roll without scrubbing or slipping.

6. The main function of lubricating oil in an engine is to:

A) Reduce friction and wear between moving parts.

B) Act as a coolant.

C) Clean the engine components.

D) All of the above.

Answer: D) All of the above.

Explanation: Lubricating oil performs multiple critical functions: it lubricates, cools, cleans by carrying away contaminants, and helps to seal the piston rings.

7. Break-even analysis is a method used to determine the point at which:

A) Total revenue equals total cost.

B) Profit is maximized.

C) Sales volume is maximized.

D) Costs are minimized.

Answer: A) Total revenue equals total cost.

Explanation: The break-even point is the level of sales at which the company has no profit and no loss. It is a crucial tool for financial planning and decision-making.

8. The ABC analysis in inventory control categorizes items based on their:

A) Annual consumption value.

B) Unit price.

C) Physical size.

D) Lead time.

Answer: A) Annual consumption value.

Explanation: 'A' items are high-value items that account for a large portion of the total cost, requiring tight control. 'B' items are moderate, and 'C' items are low-value items requiring simpler control.

9. The Gantt chart is a graphical tool used for:

A) Quality control

B) Project scheduling and planning.

C) Inventory management.

D) Financial forecasting.

Answer: B) Project scheduling and planning.

Explanation: It illustrates the start and finish dates of the terminal elements and summary elements of a project, showing the work breakdown structure and dependencies.

10. Just-In-Time (JIT) is a production strategy aimed at:

A) Increasing inventory levels to avoid stockouts.

B) Reducing inventory levels and associated carrying costs.

C) Maximizing the production batch size.

D) Focusing on inspection to ensure quality.

Answer: B) Reducing inventory levels and associated carrying costs.

Explanation: JIT aims to have materials and components arrive at the production line "just in time" to be used, thus minimizing waste associated with inventory.

11. Quality control is the process of:

A) Designing quality into a product.

B) Ensuring that products meet specified standards and requirements.

C) Improving the production process.

D) Reducing the cost of production.

Answer: B) Ensuring that products meet specified standards and requirements.

Explanation: It involves inspection, testing, and measurement to check if a product or service conforms to the set quality standards.

12. Ergonomics is the study of:

A) The economic aspects of manufacturing.

B) The efficiency of workers in their working environment.

C) The automation of industrial processes.

D) The marketing of industrial products.

Answer: B) The efficiency of workers in their working environment.

Explanation: Ergonomics (or human factors) aims to design systems, jobs, and products to fit the people who use them, improving performance, safety, and comfort.

13. Varignon's theorem states that the moment of a force about any point is equal to the:

A) Product of the force and the perpendicular distance.

B) Algebraic sum of the moments of its components about that point.

C) Vector product of the force and the position vector.

D) Sum of the forces in the system.

Answer: B) Algebraic sum of the moments of its components about that point.

Explanation: This theorem is often useful for calculating moments by resolving a force into components whose perpendicular distances are easier to determine.

14. Strain energy is the:

A) Energy stored in a body due to external loading.

B) Energy lost as heat during deformation.

C) Work done by external forces.

D) Force required to cause deformation.

Answer: A) Energy stored in a body due to external loading.

Explanation: When a body is deformed within its elastic limit, it stores potential energy, known as strain energy, which is released upon unloading.

15. The specific gravity of a fluid is the ratio of its density to the density of:

A) Air at standard conditions.

B) Water at 4°C.

C) Mercury at 0°C.

D) The same fluid at a reference temperature.

Answer: B) Water at 4°C.

Explanation: Specific gravity is a dimensionless quantity that provides a quick comparison of a fluid's density relative to the standard density of water.

16. The hydraulic ram is a pump that:

A) Requires an external power source like a motor.

B) Uses the energy of a large amount of water falling a small height to lift a small amount of water to a greater height.

C) Is a type of centrifugal pump.

D) Is used for pumping highly viscous fluids.

Answer: B) Uses the energy of a large amount of water falling a small height to lift a small amount of water to a greater height.

Explanation: It works on the principle of water hammer to achieve this pumping action without any external power.

17. The ideal gas law is given by the equation PV = mRT, where R is the:

A) Universal gas constant.

B) Specific gas constant.

C) Molar mass.

D) Specific heat.

Answer: B) Specific gas constant.

Explanation: The specific gas constant 'R' is different for each gas and is equal to the universal gas constant divided by the molar mass of the gas.

18. A throttling process in thermodynamics is a constant:

A) Enthalpy process.

B) Entropy process.

C) Pressure process.

D) Volume process.

Explanation: In a throttling process, such as flow through a partially opened valve or a porous plug, the enthalpy of the fluid remains constant ($h_1 = h_2$).

19. The purpose of a condenser in a steam power plant is to:

A) Convert steam into water at a pressure below atmospheric.

B) Increase the temperature of the steam.

C) Filter impurities from the steam.

D) Store excess steam.

Answer: A) Convert steam into water at a pressure below atmospheric.

Explanation: By creating a very low back pressure, the condenser significantly increases the pressure drop across the turbine, thereby increasing the work output and overall plant efficiency.

20. Creep is the time-dependent deformation of a material under:

A) A constant load and elevated temperature.

B) A cyclic load.

C) An impact load.

D) A constant load at room temperature.

Answer: A) A constant load and elevated temperature.

Explanation: Creep is a critical failure mechanism in high-temperature applications like turbine blades and boiler tubes.

21. A rivet is specified by its:

A) Shank diameter.

B) Head diameter.

C) Length.

D) Material type.

Answer: A) Shank diameter.

Explanation: The nominal diameter of the unheated rivet shank is the primary dimension used to specify its size.

22. The angle between the face of the cutting tool and the plane parallel to its base is known as the:

A) Rake angle.

B) Clearance angle.

C) Cutting edge angle.

D) Lip angle.

Answer: A) Rake angle.

Explanation: The back rake angle and side rake angle are crucial for controlling chip flow and cutting forces.

23. The purpose of a thermostat in an engine's cooling system is to:

A) Regulate the engine's operating temperature.

B) Drive the water pump.

C) Radiate heat to the atmosphere.

D) Measure the coolant temperature.

Answer: A) Regulate the engine's operating temperature.

Explanation: It controls the flow of coolant to the radiator, allowing the engine to warm up quickly and then maintaining it at its optimal operating temperature.

24. A worm and worm wheel drive is used to achieve:

A) Small speed reductions.

B) High speed reductions in a compact space.

C) A speed increase.

D) A right-angle drive with intersecting shafts.

Answer: B) High speed reductions in a compact space.

Explanation: Worm drives can easily achieve large reduction ratios (e.g., 60:1) in a single stage and are often self-locking.

25. In electro-discharge machining (EDM), material is removed by:

A) A high-velocity abrasive jet.

B) A series of rapidly recurring electrical discharges.

C) An electrochemical reaction.

D) A focused laser beam.

Answer: B) A series of rapidly recurring electrical discharges.

Explanation: EDM uses thermal energy from electric sparks to machine hard and electrically conductive materials into complex shapes.

26. The critical temperature of a material is the temperature above which:

A) It becomes a superconductor.

B) Its gaseous form cannot be liquefied, no matter how high the pressure.

C) It melts.

D) It becomes magnetic.

Answer: B) Its gaseous form cannot be liquefied, no matter how high the pressure.

Explanation: Above the critical temperature, the distinction between liquid and gas phases disappears, and the substance is in a supercritical fluid state.

27. A venturimeter is a device used to measure:

A) Velocity

B) Pressure

C) Flow rate or discharge

D) Viscosity

Answer: C) Flow rate or discharge

Explanation: It works on the principle of Bernoulli's equation by measuring the pressure difference between the inlet and a constricted throat section.

28. The process of adding specific impurities to a semiconductor to alter its electrical properties is called:

A) Doping

B) Annealing

C) Sintering

D) Alloying

Answer: A) Doping

Explanation: Doping with elements like phosphorus (for n-type) or boron (for p-type) is fundamental to creating semiconductor devices like diodes and transistors.

29. A strut is a structural member that is primarily subjected to:

A) A tensile load.

B) A compressive load.

C) A bending moment.

D) A torsional load.

Answer: B) A compressive load.

Explanation: While a column is a vertical member under compression, a strut can be oriented in any direction.

30. The center of pressure on a submerged plane surface is:

A) Always above the centroid of the area.

B) Always at the centroid of the area.

C) Always below the centroid of the area.

D) Sometimes above and sometimes below the centroid.

Answer: C) Always below the centroid of the area.

Explanation: Because pressure increases with depth, the resultant hydrostatic force acts at a point (the center of pressure) that is lower than the geometric center (centroid) of the surface.

31. The Mach cone is formed in supersonic flow because:

A) The fluid is compressible.

B) The object travels faster than the pressure waves it creates.

C) The fluid viscosity is high.

D) The flow is turbulent.

Answer: B) The object travels faster than the pressure waves it creates.

Explanation: The sound waves (pressure disturbances) emitted by the object cannot propagate upstream, and they coalesce to form a conical shock wave front.

32. A thermistor is a type of resistor whose resistance is strongly dependent on:

A) Pressure

B) Light

C) Temperature

D) Humidity

Answer: C) Temperature

Explanation: Thermistors are widely used as temperature sensors in a variety of applications due to their high sensitivity.

33. In a belt drive, the tension on the tight side (T_1) and the slack side (T_2) are related to the coefficient of friction (μ) and the angle of wrap (θ) by the equation:

A) $T_1/T_2 = \mu\theta$

B) $T_1/T_2 = e^{(\mu\theta)}$

C) $T_2/T_1 = e^{(\mu\theta)}$

D) $T_1 - T_2 = \mu\theta$

Answer: B) $T_1/T_2 = e^{(\mu\theta)}$

Explanation: This fundamental belt friction equation determines the maximum torque that can be transmitted by the drive.

34. The process of arranging manufacturing resources in the sequence of operations a product follows is known as a:

A) Process layout

B) Product layout

C) Fixed-position layout

D) Cellular layout

Answer: B) Product layout

Explanation: A product layout, or assembly line, is efficient for mass production of a standardized product.

35. A hydraulic coupling is a device that transmits rotating mechanical power through:

A) A solid mechanical connection.

B) A fluid medium.

C) A magnetic field.

D) A belt and pulley system.

Answer: B) A fluid medium.

Explanation: It consists of a pump (impeller) and a turbine in a sealed housing filled with fluid, providing a smooth transfer of power without a mechanical link.

36. The property of a liquid that offers resistance to the relative motion between its layers is called:

A) Density

B) Surface tension

C) Viscosity

D) Compressibility

Answer: C) Viscosity

Explanation: Viscosity is a measure of a fluid's internal friction or its resistance to flow.

37. The clearance volume in a reciprocating engine is the volume:

A) Swept by the piston.

B) Of the cylinder when the piston is at the bottom dead center.

C) Above the piston when it is at the top dead center.

D) Displaced by the piston during one stroke.

Answer: C) Above the piston when it is at the top dead center.

Explanation: The clearance volume is the small volume remaining in the cylinder at the end of the compression stroke, and it is a key factor in determining the compression ratio.

38. The process of coating a base metal with a more corrosion-resistant metal is called:

A) Cladding

B) Nitriding

C) Carburizing

D) Cyaniding

Answer: A) Cladding

Explanation: Cladding involves bonding a layer of a different metal to the surface, such as bonding a layer of stainless steel to carbon steel for corrosion protection.

39. A ball bearing is a type of:

A) Journal bearing

B) Rolling contact bearing

C) Thrust bearing

D) Sliding contact bearing

Answer: B) Rolling contact bearing

Explanation: It uses balls to maintain the separation between the moving parts, replacing sliding friction with much lower rolling friction.

40. In PERT analysis, the optimistic, most likely, and pessimistic time estimates are used to calculate the:

A) Expected time and variance of an activity.

B) Critical path.

C) Project cost.

D) Resource allocation.

Answer: A) Expected time and variance of an activity.

Explanation: PERT (Program Evaluation and Review Technique) uses a probabilistic approach to time estimates to account for uncertainty in activity durations.

41. The process of increasing the pressure of a fluid at the expense of its kinetic energy is called:

A) Diffusion

B) Expansion

C) Nozzling

D) Throttling

Answer: A) Diffusion

Explanation: A diffuser is a device with an increasing cross-sectional area that slows down a fluid,

thereby increasing its static pressure.

42. A reciprocating compressor is best suited for:

A) High discharge and low pressure.

B) Low discharge and high pressure.

C) High discharge and high pressure.

D) Low discharge and low pressure.

Answer: B) Low discharge and high pressure.

Explanation: As a positive displacement machine, it can generate very high pressures but has a lower

flow rate compared to centrifugal compressors.

43. The ratio of the velocity of an object to the velocity of sound in the surrounding medium is called the:

A) Reynolds number

B) Mach number

C) Froude number

D) Weber number

Answer: B) Mach number

Explanation: Mach number is a critical parameter in gas dynamics, defining the flow regime: subsonic (M<1), sonic (M=1), or supersonic (M>1).

44. Intercooling in a multi-stage compressor is done to:

A) Increase the work of compression.

B) Decrease the volumetric efficiency.

C) Reduce the work of compression.

D) Cool the delivered air.

Answer: C) Reduce the work of compression.

Explanation: By cooling the gas between stages, its volume is reduced, which means less work is required to compress it to the final pressure, thereby improving overall efficiency.

45. A gas turbine works on the:

A) Otto cycle

B) Carnot cycle

C) Rankine cycle

D) Brayton cycle

Answer: D) Brayton cycle

Explanation: The Brayton cycle is the ideal thermodynamic cycle for a gas turbine, consisting of isentropic compression, constant pressure heat addition, isentropic expansion, and constant pressure heat rejection.

46. Surging in a centrifugal compressor is a phenomenon of:

A) Steady and stable flow.

B) Unstable, periodic reversal of flow.

C) Maximum efficiency operation.

D) Choked flow.

Answer: B) Unstable, periodic reversal of flow.

Explanation: Surging occurs at low flow rates and can cause severe vibrations and damage to the compressor.

47. A kinematic pair is a joint of two links that permits:

A) No relative motion.

B) Only rotational motion.

C) Relative motion between them.

D) Only sliding motion.

Answer: C) Relative motion between them.

Explanation: Kinematic pairs are the building blocks of mechanisms, and the nature of the allowed relative motion (e.g., sliding, turning) defines the type of pair.

48. The number of degrees of freedom of a planar mechanism is given by Grubler's criterion as:

A) $n = 3(l-1) - 2j - h$

B) $n = 2(l-1) - 3j - h$

C) $n = 3l - 2j - 4$

D) $n = l - j - 1$

Answer: A) $n = 3(l-1) - 2j - h$

Explanation: This equation, also known as the Kutzbach criterion, calculates the mobility (degrees of freedom) of a planar linkage based on the number of links (l), lower pairs (j), and higher pairs (h).

49. A cam and follower is a mechanism that converts:

A) Rotary motion into rotary motion.

B) Rotary motion into reciprocating or oscillating motion.

C) Reciprocating motion into rotary motion.

D) Oscillating motion into linear motion.

Answer: B) Rotary motion into reciprocating or oscillating motion.

Explanation: Cams are used extensively in IC engines (for valve timing) and automated machinery to produce complex, precisely timed motions.

50. The gear train in which the axes of the first and last gears are co-axial is called a:

A) Simple gear train

B) Compound gear train

C) Reverted gear train

D) Epicyclic gear train

Answer: C) Reverted gear train

Explanation: This arrangement is commonly used in machine tool gearboxes and clocks where the input and output shafts need to be aligned.

51. A governor is used in an engine to regulate the:

A) Torque

B) Power

C) Mean speed

D) Fuel consumption

Answer: C) Mean speed

Explanation: It automatically controls the supply of fuel to the engine to maintain a constant mean speed despite variations in load.

52. Interference in gears can be avoided by:

A) Using a smaller pressure angle.

B) Using fewer teeth.

C) Using stub teeth or undercutting.

D) Increasing the module.

Answer: C) Using stub teeth or undercutting.

Explanation: Interference occurs when the tip of a tooth on one gear digs into the root of the mating tooth. Modifying the tooth profile can prevent this.

53. The function of a flywheel is to:

A) Regulate the mean speed of an engine.

B) Reduce the fluctuations of speed during a cycle.

C) Transmit power.

D) Store energy for long periods.

Answer: B) Reduce the fluctuations of speed during a cycle.

Explanation: It stores energy during the power stroke and releases it during other strokes, thus keeping the speed variations within permissible limits.

54. The mode of heat transfer that does not require a medium is:

A) Conduction

B) Convection

C) Radiation

D) Advection

Answer: C) Radiation

Explanation: Thermal radiation is the transfer of energy via electromagnetic waves and can occur through a vacuum, which is how the sun's energy reaches Earth.

55. Fourier's law of heat conduction relates the heat transfer rate to the:

A) Temperature difference and thermal conductivity.

B) Temperature gradient and thermal conductivity.

C) Convection coefficient and surface area.

D) Emissivity of the surface.

Answer: B) The temperature gradient and thermal conductivity.

Explanation: The law states that the rate of heat flux is directly proportional to the temperature gradient (change in temperature per unit length).

56. In a heat exchanger, if the hot and cold fluids flow in the same direction, it is called a:

A) Parallel-flow heat exchanger.

B) Counter-flow heat exchanger.

C) Cross-flow heat exchanger.

D) Regenerative heat exchanger.

Answer: A) Parallel-flow heat exchanger.

Explanation: In this configuration, both fluids enter at one end and flow in the same direction to the other end.

57. The unit of thermal conductivity is:

A) W/m^2K

B) W/mK

C) W/K

D) J/kgK

Answer: B) W/mK

Explanation: Thermal conductivity (k) is a material property that indicates its ability to conduct heat.

58. The working fluid in a vapor compression refrigeration system is called a:

A) Coolant

B) Lubricant

C) Refrigerant

D) Absorbent

Answer: C) Refrigerant

Explanation: Refrigerants (like R-134a or ammonia) are fluids that undergo a phase change from liquid to gas (and back) to move heat from one location to another.

59. The component of a refrigeration system where the refrigerant rejects heat is the:

A) Evaporator

B) Compressor

C) Condenser

D) Expansion valve

Answer: C) Condenser

Explanation: In the condenser, the high-pressure, high-temperature refrigerant vapor from the compressor is cooled and condensed back into a liquid, releasing heat to the surroundings.

60. Relative humidity is defined as the ratio of:

A) The mass of water vapor to the mass of dry air.

B) The actual mass of water vapor to the mass of water vapor in saturated air.

C) The volume of water vapor to the volume of dry air.

D) The partial pressure of dry air to the total pressure.

Answer: B) The actual mass of water vapor to the mass of water vapor in saturated air.

Explanation: It is a measure of the amount of moisture in the air compared to the maximum amount it could hold at that same temperature.