

**MADE EASY**

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Test Centres: Delhi, Noida, Hyderabad, Bhopal, Jaipur, Lucknow, Bhubaneswar, Indore, Pune, Kolkata, Patna**ESE 2020: Prelims Exam**
CLASSROOM TEST SERIES**GENERAL STUDIES**
& **ENGG. APTITUDE****Test 5****Section A :** General Principles of Design, Drawing, Importance of Safety**Section B :** Basics of Energy and Environment**Section C :** Basics of Material Science

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|---------|---------|---------|---------|---------|
| 1. (c) | 11. (c) | 21. (c) | 31. (c) | 41. (c) |
| 2. (b) | 12. (b) | 22. (b) | 32. (b) | 42. (b) |
| 3. (c) | 13. (b) | 23. (c) | 33. (b) | 43. (d) |
| 4. (a) | 14. (d) | 24. (b) | 34. (c) | 44. (b) |
| 5. (c) | 15. (b) | 25. (b) | 35. (a) | 45. (c) |
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| 7. (b) | 17. (d) | 27. (c) | 37. (b) | 47. (b) |
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DETAILED EXPLANATIONS

1. (c)

Reverse engineering starts with the description of the process or the performing of the functions by the product. This exercise is carried out with the intention of identifying the underlying principles of the product and its subsystems. From the description of the process, it is possible to identify the subsystems and the constituent parts of the product under consideration. This gives the embodiment design of the product. From this, it is possible to identify the functions performed by the different subsystems. The process in carrying out reverse engineering can be summarized by the following:

- Description of the process.
- Breaking down the product into subsystems.
- Establishing the functions of the subsystems

2. (b)

Design for manufacturing (DFM) is based on minimizing the cost of production, including minimizing the time to market while maintaining a high standard of quality for the product. DFM provides guidance in the selection of materials and processes and generates piece-part and tooling-cost estimates at any stage of product design.

DFM would include:

1. An accurate cost estimator that reviews the cost of parts as they are being designed in a fast and accurate way;
2. A concurrent engineering implementation that provides quantitative cost information which allows the design team to make decisions based on real-time information and to shorten the product development time.
3. Provide supplier negotiations with unbiased details of cost drivers;
4. Competitive benchmarking that compares the designs with competitors' products to determine marketability and target cost.

3. (c)

Overall generated scores of flush hinge is better than butt hinge because (+) points are more for flush hinges.

4. (a)

Adaptive design:

- In which the designer's work will be concerned with the adaptation of existing designs.
- There are branches of manufacturing in which development has practically ceased, so that there is hardly anything left for the designer to do except making minor modifications, usually in the dimensions of the product.
- Design activity of this kind of demands requires no special knowledge or skill, and the problems presented are easily solved by a designer with ordinary technical training.
- One such example can be the elevator, which has remained the same technically and conceptually for some time now.
- Another example is a washing machine which varied only few parameters, such as its dimensions, materials, and detailed power specifications machine. This has been based on the same conceptual design for the last.

Statement (b) and statement (c) are related development design, new design respectively.

5. (c)

Statement 3 is related to the conceptual design.

Embodiment Design is a process where the structured development of the design concepts takes place. It is in this phase that decisions are made on strength, material selection, size, shape and spatial compatibility. Embodiment design is concerned with three major tasks:

- Product architecture
- Configuration design
- Parametric design.

7. (b)

The product design specification is the basic control and reference document that would include the outcomes of the product development exercise, and is the must to begin with and execute the design and manufacturing of any specific part or product. The quality function deployment tool provides the most crucial inputs in writing the product design specifications. Following are some of the important elements of a typical product design specification document. It is, however, not necessary that the product design specification document of any product will contain all these elements:

- In-use purposes and market requirements
- Functional Requirements
- Social, Political and Legal Requirements
- Corporate Constrains

9. (b)

Loads moved with any material handling equipment must not pass above any personnel.

10. (d)

According to Heinrich, there are five factors in the sequence of events leading up to an accident. These factors can be summarized as follows:

1. **Ancestry and social environment.** Negative character traits that may lead people to behave in an unsafe manner can be inherited (ancestry) or acquired as a result of the social environment (for example, alcoholism).
2. **Fault of person.** Negative character traits, whether inherited or acquired, are why people behave in an unsafe manner and why hazardous conditions exist.
3. **Unsafe act/mechanical or physical hazard.** Unsafe acts committed by people and mechanical or physical hazards are the direct causes of accidents.
4. **Accident.** Typically, accidents that result in injury are caused by falling or being hit by moving objects.
5. **Injury.** Typical injuries resulting from accidents include lacerations and fractures.

11. (c)

Power ventilation providing fresh air to confined spaces must have make-up air to the blower supplied from a point where there are no other known harmful air contaminants and exhaust blowers should not discharge into employee work area. Exhaust blowers removing flammable gases must not discharge near sources of ignition.

12. (b)

Minimizing the amount of physical stress in the workplace requires continuous study of the ways in which people and technology interact. The insight learned from this study must then be used to improve the interaction. This is a description of the science of ergonomics.

Ergonomics is defined as follows:

Ergonomics is a multidisciplinary science that seeks to standards of the workplace and all of physiological aspects to the worker.

Ergonomics involves the following:

- Using special design and evaluation techniques to make tasks, objects, and environments more compatible with human abilities and limitations.
- Seeking to improve productivity and quality by reducing workplace stressors, reducing the risk of injuries and illnesses, and increasing efficiency.

13. (b)

The National Fire Protection Association (NFPA) has devised the NFPA 704 system for quick identification of hazards presented when substances burn. The NFPA's red, blue, yellow, and white diamond is used on product labels, shipping cartons, and buildings. Ratings within each category are 0 to 4, where 0 represents no hazard; 4, the most severe hazard level. The colors refer to a specific category of hazard:

- Red = Flammability
- Blue = Health
- Yellow = Reactivity
- White = Special information

14. (d)

In an industrial setting, people interact with machines that are designed to drill, cut, shear, punch, chip, staple, stitch, abrade, shape, stamp, and slit such materials as metals, composites, plastics, and elastomers. If an appropriate safeguard are not in place or if workers fail to follow safety precautions, these machines can apply the same procedures to humans. When this happens, the types of mechanical injuries that result are typically the result of cutting, tearing, shearing, crushing, breaking, straining, or puncturing.

15. (b)

The goal of the Occupational Safety and Health Administration (OSHA) Hazardous Waste Standard and other regulations is to (a) encourage companies to reduce the amount and toxicity of the hazardous substances that they use, (b) ensure that remaining hazardous materials are used safely, and (c) ensure that companies are prepared to respond promptly and appropriately when accidents occur.

16. (b)

$$\text{Representative fraction} = \frac{\text{Length of object in the drawing}}{\text{Actual length of object}}$$

$$2 = \frac{\text{Length of object in the drawing}}{\text{Actual length of object}}$$

So, Representative fraction (R.F) of 2 means that length of object in the drawing is double the actual length of the object.

- Diagonal scales are used to represent three successive units such as meter, decimeter and centimeter.
- A plain scale represents either two units or a unit and its subdivisions.

17. (d)

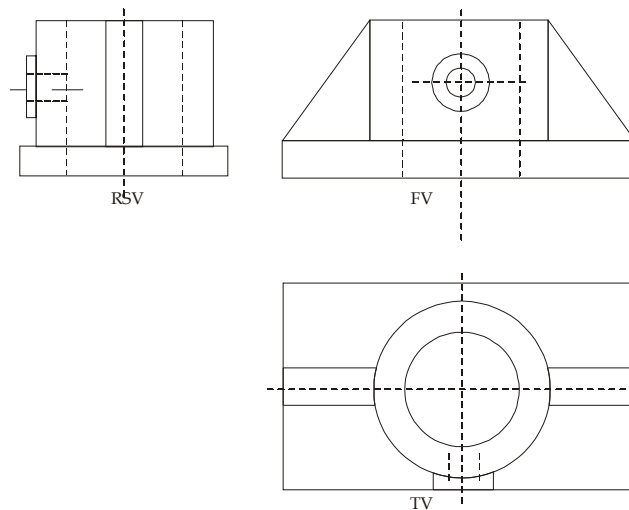
Epitrochoid is a curve generated by a point fixed to circle (within or outside its circumference, but in the same plane) rolling on the outside of another circle.

Epicycloid is the curve generated by a point on the circumference of a circle, which rolls without slipping along another circle outside it.

18. (a)

- Scale tool enlarges or reduces selected objects, keeping the proportions same after scaling.
- Chamfer tool bevels the edges of the object whereas fillet tool rounds and fillets the edges of the object.

19. (a)



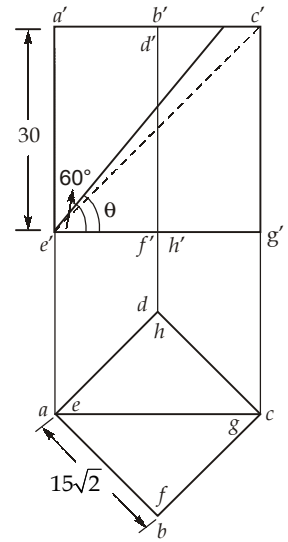
20. (c)

- Parallel line method: This method is used to develop prism and cylinder.
- Radial line method : This method is used to develop pyramid and cone.
- Triangulation method: This method is used to develop solids having different surfaces.
- Approximate method: This method is employed for double curved surfaces like spheres, as it is theoretically impossible to develop these surface.

21. (c)

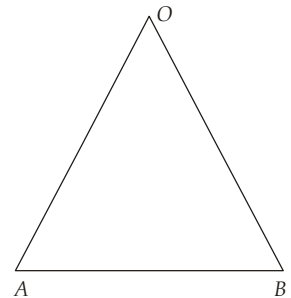
$$\begin{aligned}
 ab &= bc = 15\sqrt{2} \text{ mm} \\
 ac &= \sqrt{ab^2 + bc^2} \\
 &= \sqrt{(15\sqrt{2})^2 + (15\sqrt{2})^2} \\
 &= 15\sqrt{2} \times \sqrt{1+1} \\
 ac &= 15\sqrt{2} \times \sqrt{2} = 30 \text{ mm} \\
 e'g' &= ac = 30 \text{ mm} \\
 c'g' &= 30 \text{ mm} \\
 \tan\theta &= \frac{c'g'}{e'g'} = \frac{30}{30} = 1 \\
 \theta &= \tan^{-1}1 = 45^\circ
 \end{aligned}$$

Since, $\theta < 60^\circ$, cutting plane will not cut vertical edge $c'g'$.
 So, number of vertical edges cut by section plane is 3.

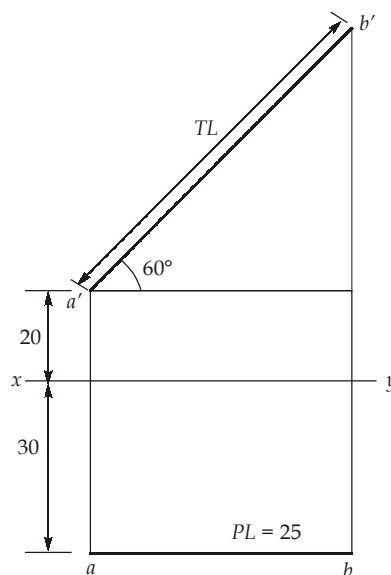


22. (b)

Slant edge = 50 mm
 Edge of base = 50 mm
 Hence, slant face OAB is an equilateral triangle
 $\angle AOB = 60^\circ$
 Hence development shown $\angle AOA = 60 \times 4 = 240^\circ$



23. (c)



Plan length, $PL = 25$ mm

$$\cos 60^\circ = \frac{PL}{TL} = \frac{25}{TL}$$

$$TL = \frac{25}{\cos 60^\circ} = \frac{25}{\frac{1}{2}}$$

True length, $TL = 50$ mm

24. (b)

Point C lies in fourth quadrant. Since it is 40 mm below HP, front view c' is 40 mm below xy . Since point C is 50 mm in front of VP, top view c is 50 mm below xy .

25. (b)

All levels of management must be involved in the loss control program. The frontline supervisor is the key to a successful program. Supervisors have the most control over the variables that affect both the prevention and the proper control of emergencies. Supervisors have broad knowledge of the products, materials, machines, equipment, processes, buildings, storage, and day-to-day hazards of the work. They should be given the responsibility for all the fire hazards and equipment in their areas. Each building or area should be assigned to a specific person who clearly understands that he or she is responsible for the building and accountable for all aspects of the fire plan. This includes fire inspections and items on the inspection checklist, tools, and equipment being used by the employees.

26. (a)

Advantages associated with nuclear energy:

- Production of nuclear power is continuous.
- Non-polluting type of energy resource.
- Cost of nuclear fuel is less compared to energy generation.
- Less amount of fuel offers more energy.

Problems/Disadvantages associated with nuclear energy:

- There is difficulty in the management of nuclear waste, which may result in environmental contamination.
- Risk of accidental leakage of nuclear radiation can lead to catastrophe disasters.
- Nuclear power plants have a limited life.
- Construction and maintenance cost of nuclear power plants are very high.

27. (c)

- Alpha-diversity (α -diversity) refers to the diversity within a particular area or ecosystem and is usually expressed by the number of species in that ecosystem. It is expressed by number of species per unit area. It is a local measure.
- Among these, the tropical rainforest has highest density of species, i.e. having highest Alpha-diversity.

29. (d)
- A fuel cell is an electrochemical cell that converts the chemical energy of a fuel (often hydrogen) and an oxidizing agent (often oxygen) into electricity through a pair of redox reactions.
 - The energy efficiency of a fuel cell is generally between 40–60%; however, if waste heat is captured in a cogeneration scheme, efficiencies of up to 85% can be obtained.
 - High initial cost is one of the disadvantages of fuel cells.
30. (c)
- Homeostasis in an ecosystem is a state of equilibrium, or a balance of the organisms, i.e. the populations of species in the ecosystem which are relatively stable.
31. (c)
- A carbon credit is a generic term for any tradable certificate or permit representing the right to emit one tonne of carbon dioxide or the equivalent amount of a different Greenhouse gas (tCO₂e).
 - The carbon credits can also be traded on exchanges like Carbon Trade Exchange, which is like a stock exchange for carbon credits.
 - The Kyoto Protocol provides for three mechanisms that enable countries or operators in developed countries to acquire greenhouse gas reduction credits.
 - ◆ Under Joint Implementation (JI), a developed country with relatively high costs of domestic Greenhouse reduction would set up a project in another developed country.
 - ◆ Under the Clean Development Mechanism (CDM), a developed country can sponsor a Greenhouse gas reduction project in a developing country where the cost of Greenhouse gas reduction project activities is usually much lower, but the atmospheric effect is globally equivalent.
 - ◆ Under International Emissions Trading (IET), countries can trade in the international carbon credit market to cover their shortfall in assigned amount units.
32. (b)
- In a terrestrial ecosystem, a much larger fraction of energy flows through the Detritus Food Chain than the Grazing Food Chain.
 - The Grazing Food Chain begins with producers like green plants, while the Detritus Food Chain begins with dead organic matter.
 - The Detritus Food Chain is made up of decomposers which are heterotrophic organisms, mainly fungi, and bacteria. They meet their energy and nutrient requirements by degrading dead organic matter or detritus.
33. (b)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES):**
- CITES is an International agreement to regulate worldwide commercial trade in wild animal and plant species. It also restricts trade in items made from such plants and animals, such as food, clothing, medicine and souvenirs.
 - It was signed in the year 1973. It is administered by the United Nations Environment Programme (UNEP).

- CITES is legally binding on state parties to the convention, which are obliged to adopt their own domestic legislation to implement its goals.
34. (c)
- The major pollutants released from automobiles, locomotives, aircraft, etc. include Carbon Monoxide (CO), Unburnt hydrocarbons, nitrogen dioxide and suspended particulate matter emissions.
 - In metropolitan cities, vehicular exhausts account for most of the CO, hydrocarbons, oxides, and suspended particulate matter emissions.
35. (a)
- Boreal or coniferous forests are the forests growing in high-latitude environments where freezing temperatures occur for 6 to 8 months and in which trees are capable of reaching a minimum height of 5 m and a canopy cover of 10%.
 - The forests are characterised by cold climate with high rainfall and evergreen plant species like spruce, fir and pine trees, etc. and by animals like lynx, bear, red fox, porcupine, etc.
36. (b)
- Kigali Amendment amends the Montreal Protocol which aims to phase out Hydrofluorocarbons (HFCs), a family of potent greenhouse gases by the late 2040s.
 - Under Kigali Amendment, all 197 countries, including India have agreed to a timeline to reduce the use of HFCs by roughly 85% of their baselines.
 - The Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer entered into force on 1 January 2019, following ratification by 65 countries.
- The UN Environment Programme (UNEP) announced the entry into force, and noted that it will help reduce the production and consumption of hydrofluorocarbons (HFCs), the potent Greenhouse gases (GHGs), and thus to avoid global warming by up to 0.4°C this century.
39. (b)
- The atomic bonding in this group of materials is metallic and thus nondirectional in nature.
40. (b)
- For FCC structure, the number of atoms per unit cell is 4.
- ∴ $n = 4$
- and $A_{cu} = 64 \text{ g/mol}$
- Avogadro's number, $N_A = 6.023 \times 10^{23} \text{ atoms/mol}$
- Theoretical density, $\rho = \frac{nA_{cu}}{V_c N_A}$
- $$= \frac{4 \times 64}{4.8 \times 10^{-23} \times 6.023 \times 10^{23}}$$
- $$\rho = 8.86 \text{ g/cm}^3$$

41. (c)

In some materials, which have well defined fatigue limit (σ_e), it has been observed that the application of stress cycles at stresses below σ_e strengthens the materials.

If these cycles are applied to a material in series of increasing stress starting from just below σ_e (eg one million cycle at each level), the materials have been found to withstand stresses higher than σ_e without failure. This process of repeated cycling at successively higher levels by which the fatigue properties of materials are improved is called understressing.

42. (b)

Ceramic (Clay based)	Application
• Stoneware	Roof tiles, glazed pipes
• Porcelain	Scientific and electrical items
• China clay	Tableware
• Earthenware	Drainage pipes, water filters, bricks, wall tiles

43. (d)

- Wrought iron cannot flow like cast iron and hence not suitable for casting process.
- Wrought iron does not have carbon content. Hence hardening by heating and quenching is not possible.

44. (b)

Overaging in Precipitation hardening:

- With increase in time, the strength or hardness increases, reaches a maximum and finally diminishes.
- The reduction in strength and hardness that occur after long time period is known as overaging.

46. (b)

Positive ion and negative ion have lowest mobility almost immobile and mobility of e^- is greater than that of hole.

47. (b)

Diamagnetic materials possess only induced dipole, in absence of magnetic field there is no dipoles and dipole moment is zero.

48. (c)

Statement (II) is wrong as at lower temperature transformation rate is faster.

49. (a)

Application of an electric field causes relative displacement of these charges, leading to the creating of dipoles and hence polarization.

50. (a)

Both are correct and Statement (II) is the reason for statement (I). Glazing is always done to make surface smooth and absorbent because if surface will not be smooth moisture will be collected from atmosphere on surface discontinuities and results in electrical breakdown.

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