


MADE EASY

India's Best Institute for IES, GATE & PSUs

Test Centres: Delhi, Hyderabad, Bhopal, Jaipur, Lucknow, Bhubaneswar, Pune, Kolkata, Patna

ESE 2023 : Prelims Exam | **GS & ENGINEERING**
CLASSROOM TEST SERIES | **APTITUDE**
Test 3
Section A : Basics of Energy and Environment [All Topics]

Section B : Basics of Material Science [All Topics]

Section C : Engineering Mathematics + Reasoning & Aptitude [All Topics]

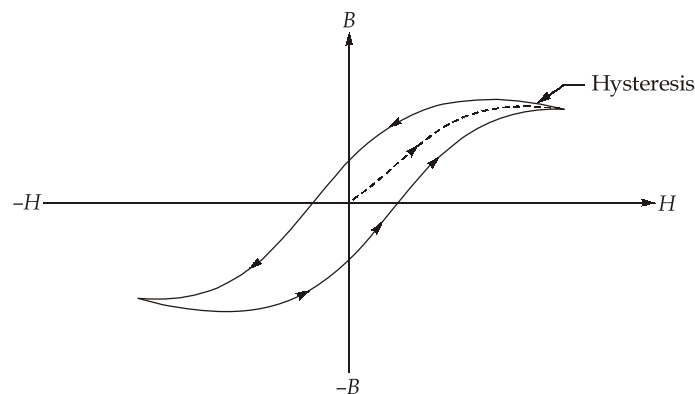
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|---------|---------|---------|---------|----------|
| 1. (d) | 11. (c) | 21. (a) | 31. (d) | 41. (a) |
| 2. (b) | 12. (c) | 22. (a) | 32. (d) | 42. (d) |
| 3. (c) | 13. (b) | 23. (a) | 33. (b) | 43. (b)* |
| 4. (b) | 14. (b) | 24. (c) | 34. (b) | 44. (a) |
| 5. (a) | 15. (c) | 25. (d) | 35. (a) | 45. (c) |
| 6. (b) | 16. (b) | 26. (b) | 36. (b) | 46. (b) |
| 7. (a) | 17. (d) | 27. (c) | 37. (b) | 47. (c) |
| 8. (c) | 18. (d) | 28. (b) | 38. (c) | 48. (d) |
| 9. (d) | 19. (a) | 29. (b) | 39. (c) | 49. (b) |
| 10. (d) | 20. (d) | 30. (d) | 40. (a) | 50. (b) |

Q.43* : Marks to all

DETAILED EXPLANATIONS

3. (c)
Aphotic zone is an area of inky darkness, which occupies the great bulk of the ocean.
4. (b)
In the pond ecosystem, the pyramid is upright.
5. (a)
 - Aggregation refers to the increase in population of the species which has become established in the area.
 - Ecesis is the initial establishment of a plant community. It is also called colonization.
6. (b)
 - As of 2022, India has a total of 75 Ramsar Wetland sites.
 - Montreux Record is a register of wetland sites on the List of Ramsar wetlands of international importance where changes in ecological character have occurred, are occurring, or are likely to occur as a result of technological developments, pollution or other human interference.
7. (a)
 - The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity is an international agreement which aims at sharing the benefits arising from the utilization of genetic resources in a fair and equitable way.
 - Aichi Biodiversity Targets are a set of twenty time-bound targets for addressing the biodiversity challenges.
8. (c)
Oil spills result in hypothermia which causes fatalities in birds and animals.
11. (c)
India has not done any change in its goal of creating an additional carbon sink of 2.5 to 3 billion tonnes of CO₂ equivalent through additional forest and tree cover by 2030.
15. (c)
India Cooling Action Plan (ICAP) aims to reduce cooling demand across sectors by 20% to 25% by 2037-38.
16. (b)
Shale gas consists of 70 to 90 percent Methane gas.
24. (c)
An ecotone may appear on ground as gradual blending of two communities across a broad area.
25. (d)
The process of protecting an endangered plant or animal in its natural habitat is commonly known as In-situ conservation.

26. (b)
Impingement corrosion or Erosion corrosion refers to the combined effect of mechanical abrasion and chemical corrosion. It occurs in pumps and turbines. It is caused by sustained impact of fluid or solid particles in a high velocity flow against a surface.
27. (c)
Creep is a high temperature constant load phenomena. Polycrystalline materials with fine grains are more prone to creep.
28. (b)
Graphene layer is highly impermeable and even helium gas cannot pass through it.
29. (b)
Magnalium is an alloy of aluminium with Mg(1-5.5%), Cu(0-2.5%), Mn(0.2-0.6%). It is highly ductile. It has good machinability. It can be welded but has poor castability.
30. (d)
 BaTiO_3 is one of the most important ceramic material that is photoelectric, pyroelectric, ferroelectric and piezoelectric and shows photorefractive effect. It has perovskite structure and is used in manufacturing of transducers and fuel cells.
31. (d)
Case hardening is done to improve the surface hardness keeping the core soft and ductile.
32. (d)
Hall effect has the following applications:
- To determine the type of semiconductor.
 - To determine the carrier concentration.
 - To calculate the mobility of carriers.
 - Hall voltage is used in Gauss meter to measure the strength of magnetic field.
33. (b)
The Silicon Carbide is expensive and not easy to manufacture.
34. (b)
The hysteresis is lagging of the flux density B with respect to the magnetising force H .



35. (a)

Here,

$$\text{Coercivity, } H = 5 \times 10^3 \text{ A/m}$$

$$\text{Length, } l = 10 \text{ cm}$$

$$\text{Total turns, } N = 500$$

$$\text{Turns per meter } N = \frac{500}{0.1} = 5000 \text{ turns/m}$$

Now,

$$H = Ni$$

$$5 \times 10^3 = 5000 \times i$$

$$i = 1 \text{ Amp}$$

36. (b)

The transducers used in microphones are made of piezoelectric materials.

37. (b)

$$\text{The internal field, } E_i = E + \frac{vP}{\epsilon}$$

For three-dimensional case

$$v \approx \frac{1}{3}$$

So,

$$E_i = E + \frac{P}{3\epsilon_0}$$

38. (c)

Composite materials are multiphase materials that exhibit proportion of properties of matrix phase and dispersed phase. Both provide different characteristic properties to the composite based on orientation, concentration and size.

39. (c)

$$\text{Given matrix } A = \begin{bmatrix} 1 & 3 & 5 \\ 2 & -1 & 4 \\ -2 & 8 & 2 \end{bmatrix}$$

Applying $R_2 \rightarrow R_2 - 2R_1$ and $R_3 \rightarrow R_3 + 2R_1$

$$A \approx \begin{bmatrix} 1 & 3 & 5 \\ 0 & -7 & -6 \\ 0 & 14 & 12 \end{bmatrix}$$

Applying $R_3 \rightarrow R_3 + 2R_2$

$$A \approx \begin{bmatrix} 1 & 3 & 5 \\ 0 & -7 & -6 \\ 0 & 0 & 0 \end{bmatrix}$$

This is the row Echelon form of A. Since the number of non-zero rows in the Echelon form is 2, the rank of the matrix is 2.

40. (a)

Substituting $y = e^{mx}$, we obtain the characteristic equation as

$$\begin{aligned} m^3 - 2m^2 - 5m + 6 &= 0 \\ (m - 1)(m + 2)(m - 3) &= 0 \end{aligned}$$

The roots of this equation are $m = 1, -2, 3$ since the roots are real and distinct, the general solution of the equation is given by

$$y(x) = Ae^x + Be^{-2x} + Ce^{3x}$$

41. (a)

By linearity principle,

$$\begin{aligned} L^{-1}\left[\frac{2s+5}{s^2+25}\right] &= L^{-1}\left[\frac{2s}{s^2+25}\right] + L^{-1}\left[\frac{s}{s^2+25}\right] \\ &= 2\cos 5t + \sin 5t \end{aligned}$$

42. (d)

Since there is replacement,

$$\text{Probability of selecting any coupon} = \frac{1}{15}$$

$$\text{Probability of selecting coupon numbered less or equal to 9} = \frac{9}{15}$$

$$\begin{aligned} \text{Probability of selecting 7 coupons} &= \frac{9}{15} \times \frac{9}{15} \times \dots 7 \text{ times} \\ &= \left(\frac{9}{15}\right)^7 = \left(\frac{3}{5}\right)^7 \end{aligned}$$

43. (b)

$$\begin{aligned} \nabla \times \vec{F} &= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ (x+2y+az) & (bx-3y-z) & (4x+cy+2z) \end{vmatrix} \\ &= (c+1)\hat{i} - (4-a)\hat{j} + (b-2)\hat{k} \end{aligned}$$

As \vec{F} is irrotational, $\nabla \times \vec{F} = 0$

$$\text{i.e. } (c+1)\hat{i} - (4-a)\hat{j} + (b-2)\hat{k} = 0\hat{i} - 0\hat{j} + 0\hat{k}$$

$$\Rightarrow a = 4, b = 2 \text{ and } c = -1$$

44. (a)

$f(x)$ is a probability density function, we have

$$\int_0^4 f(x) dx = 1$$

Note that $f(x)$ is a continuous function, we have

$$\int_0^2 ax dx + \int_2^4 a(4-x) dx = 1$$

$$2a + 2a = 1$$

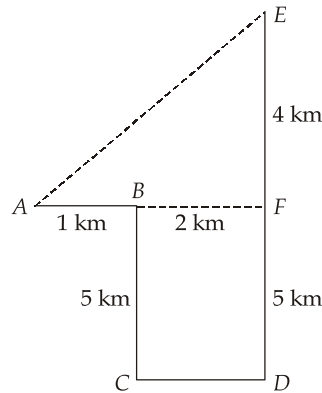
$$a = \frac{1}{4}$$

$$\begin{aligned} P(x > 2.5) &= \int_{2.5}^4 \frac{1}{4}(4-x) dx \\ &= \frac{1}{4} \left[4x - \frac{x^2}{2} \right]_{2.5}^4 = \frac{9}{32} \end{aligned}$$

45. (c)

The movements of the man are as shown in figure,

(A to B, B to C, C to D, D to E)



$$AB = 1 \text{ km}, CD = BF = 2 \text{ km}$$

$$AF = 3 \text{ km}, EF = 4 \text{ km}$$

$$AE = \sqrt{AF^2 + EF^2} = \sqrt{3^2 + 4^2} = 5 \text{ km}$$

46. (b)

$$(A \cap B) = P(A) \times P(B) = 0.15 \times P(B)$$

$$P(A \cup B) = 0.15 + P(B) - 0.15 \times P(B)$$

$$0.45 = 0.15 + P(B) - 0.15P(B)$$

$$0.85P(B) = 0.30$$

$$P(B) = \frac{0.30}{0.85} = \frac{6}{17}$$

47. (c)

$$\frac{a+b}{2} = 25$$

$$a+b = 50$$

Also,

$$\sqrt{ab} = 7$$

$$ab = 49$$

Here, $a = 1$ and $b = 49$ or vice versa.

48. (d)

$$\begin{aligned}\sqrt{x^{-1}y} \cdot \sqrt{y^{-1}z} \cdot \sqrt{z^{-1}x} &= \sqrt{\frac{y}{x}} \cdot \sqrt{\frac{z}{y}} \cdot \sqrt{\frac{x}{z}} \\ &= 1\end{aligned}$$

49. (b)

Let the length of the train be x m.

\therefore Total distance covered by the train = $(x + 150)$ m

Speed of the train = 60 km/hr

$$= 60 \times \frac{5}{18} = \frac{50}{3} \text{ m/sec}$$

Since,

Distance = Speed \times Time

$$\therefore x + 150 = \frac{50}{3} \times 18 = 300$$

or

$$x = 300 - 150 = 150 \text{ m}$$

\therefore Length of the train = 150 m

50. (b)

Let 'A' be the cost of an apple, 'B' be the cost of each banana and 'C' be the cost of each cheeku,

We can form 2 equations as:

$$2A + 5B + 8C = 63 \quad \dots(i)$$

$$5A + 9B + 13C = 119 \quad \dots(ii)$$

Multiply equation (i) by 4 and equation (ii) by 3

$$8A + 20B + 32C = 252 \quad \dots(iii)$$

$$15A + 27B + 39C = 357 \quad \dots(iv)$$

Subtracting (iii) from (iv), we get

$$7A + 7B + 7C = 105$$

which gives

$$A + B + C = 15$$

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