

Answer Key**Other (130 Questions)**

Q1. (A)	Q2. (B)	Q3. (A)	Q4. (C)	Q5. (C)
Q6. (B)	Q7. (B)	Q8. (D)	Q9. (C)	Q10. (B)
Q11. (B)	Q12. (C)	Q13. (C)	Q14. (A)	Q15. (A)
Q16. (D)	Q17. (C)	Q18. (B)	Q19. (A)	Q20. (B)
Q21. (C)	Q22. (A)	Q23. (B)	Q24. (B)	Q25. (A)
Q26. (B)	Q27. (D)	Q28. (D)	Q29. (B)	Q30. (A)
Q31. (A)	Q32. (D)	Q33. (C)	Q34. (B)	Q35. (A)
Q36. (C)	Q37. (D)	Q38. (D)	Q39. (D)	Q40. (A)
Q41. (D)	Q42. (B)	Q43. (D)	Q44. (B)	Q45. (A)
Q46. (C)	Q47. (B)	Q48. (A)	Q49. (A)	Q50. (A)
Q51. (D)	Q52. (B)	Q53. (D)	Q54. (D)	Q55. (D)
Q56. (D)	Q57. (B)	Q58. (C)	Q59. (A)	Q60. (C)
Q61. (B)	Q62. (A)	Q63. (A)	Q64. (D)	Q65. (C)
Q66. (C)	Q67. (A)	Q68. (D)	Q69. (D)	Q70. (A)
Q71. (D)	Q72. (A)	Q73. (B)	Q74. (A)	Q75. (B)
Q76. (B)	Q77. (B)	Q78. (B)	Q79. (A)	Q80. (A)
Q81. (A)	Q82. (D)	Q83. (B)	Q84. (D)	Q85. (C)
Q86. (C)	Q87. (A)	Q88. (D)	Q89. (D)	Q90. (D)
Q91. (C)	Q92. (B)	Q93. (C)	Q94. (D)	Q95. (A)
Q96. (C)	Q97. (B)	Q98. (D)	Q99. (B)	Q100.(D)
Q101.(A)	Q102.(B)	Q103.(D)	Q104.(D)	Q105.(C)

Q106.(A)

Q107.(C)

Q108.(A)

Q109.(B)

Q110.(D)

Q111.(A)

Q112.(C)

Q113.(B)

Q114.(C)

Q115.(A)

Q116.(D)

Q117.(A)

Q118.(A)

Q119.(D)

Q120.(B)

Q121.(B)

Q122.(B)

Q123.(C)

Q124.(A)

Q125.(D)

Q126.(C)

Q127.(D)

Q128.(C)

Q129.(D)

Q130.(C)

Solutions

Q1. Solution

Correct Answer: (A)

$$\frac{K_P A[100-\theta]}{l} = \frac{K_Q A[\theta]}{l}$$
$$\therefore \frac{K_P}{K_Q} = \frac{2}{3} = \frac{\theta}{100-\theta} \text{ or } \theta = 40^\circ C$$

Q2. Solution

Correct Answer: (B)

Given relation for internal energy is $U = U_0 + 2PV$.

For this cyclic process change in internal energy is given by

$$\Delta U = 2 \Delta (PV) = 2R \Delta T$$

$$\Rightarrow C_V = 2R$$

$$\Rightarrow C_p = 3R$$

Q3. Solution

Correct Answer: (A)

$$[P] = \left[\frac{a}{V^3} \right] \Rightarrow [ML^{-1}T^{-2}] = \frac{a}{[L^3]^3}$$
$$\Rightarrow a = [ML^8T^{-2}]$$
$$[V] = [b^2] \Rightarrow [L^3] = b^2 \Rightarrow b = [L^{3/2}]$$

Q4. Solution

Correct Answer: (C)

Given,

$$\frac{T_A}{T_B} = 1, \frac{L_A}{L_B} = \frac{80}{x}$$
$$\frac{D_A}{D_B} = \frac{2}{1}, \frac{d_A}{d_B} = \frac{0.81}{1}$$

Let μ_1 and μ_2 be the linear densities.

$$\therefore \frac{\mu_A}{\mu_B} = \left(\frac{D_A}{D_B} \right)^2 \times \frac{d_A}{d_B}$$

$$= \left(\frac{2}{1} \right)^2 \times 0.81$$

$$= 4 \times 0.81 = 3.24$$

$$\therefore \frac{v_1}{v_2} = \frac{L_B}{L_A} \times \sqrt{\frac{T_A}{T_B} \times \frac{\mu_B}{\mu_A}}$$

$$1 = \frac{x}{80} \times \sqrt{1 \times \frac{1}{3.24}}$$

$$\text{or } x = 144$$

Q5. Solution

Correct Answer: (C)

$$P = \frac{dK}{dt}$$

$$dK = P dt,$$

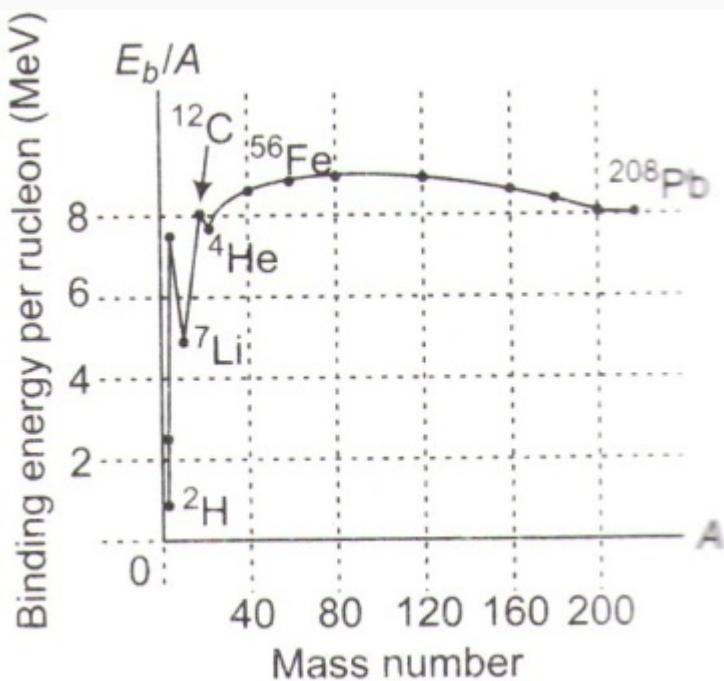
$$\frac{1}{2}mv^2 = \int_0^2 \frac{3}{2}t^2 dt$$

$$v = 2 \text{ m/s}$$

Q6. Solution

Correct Answer: (B)

In order to compare the stability of the nuclei of different atoms we determine the binding energy per nucleon. Higher the binding energy per nucleon, more stable is the nucleus. A graph between energy per nucleon and the mass number of nuclei is called the binding energy curve. It gives the following information that of two or more very light nuclei (nucleus of heavy hydrogen ${}_1H^2$ fuse into a relatively heavier nucleus (${}_2He^4$), then binding energy will increase showing that helium is stable.



Q7. Solution

Correct Answer: (B)

Since, we know,

$$\frac{I_{\max}}{I_{\min}} = \left(\frac{\frac{a_1}{a_2} + 1}{\frac{a_1}{a_2} - 1} \right)^2$$

$$\text{Given, } \frac{I_{\max}}{I_{\min}} = \frac{64}{1}$$

$$\Rightarrow \frac{64}{1} = \left(\frac{a_1 + a_2}{a_1 - a_2} \right)^2$$

$$\Rightarrow \frac{a_1 + a_2}{a_1 - a_2} = 8$$

$$\Rightarrow \frac{a_1}{a_2} = \frac{8+1}{8-1} = \frac{9}{7}$$

$$\therefore \frac{a_1}{a_2} = \frac{9}{7}$$

Q8. Solution

Correct Answer: (D)

From the graph Time period of wave $T = 8 \text{ s.}$ and Amplitude $A = 1 \text{ cm}$

$$\omega = \frac{2\pi}{T} = \frac{\pi}{4} \text{ rad s}^{-1}$$

$$\text{and } x = A \sin \omega t = \sin\left(\frac{\pi}{4}t\right)$$

acceleration at any time t is

$$a = -\omega^2 x = -\left(\frac{\pi}{4}\right)^2 \sin\left(\frac{\pi}{4}t\right)$$

Substituting $t = \frac{4}{3} \text{ s,}$ we get

$$a = -\left(\frac{\sqrt{3}}{32}\pi^2\right) \text{ cm s}^{-2}$$

Q9. Solution

Correct Answer: (C)

$$\frac{1}{V} = \frac{1}{f} + \frac{1}{u} = \frac{1}{8} - \frac{1}{14} = \frac{3}{56} \quad \text{When the}$$

$f = 8 \text{ cm, when the particle is at mean position, } u = -14 \text{ cm}$

$$\therefore V = \frac{56}{3} \approx 19 \text{ cm}$$

particle is at one of the extreme positions its distance from the lens is $14 + 1 = 15 \text{ cm} \therefore u = -15 \text{ cm}$ Again,

$$\frac{1}{V} = \frac{1}{f} + \frac{1}{u} = \frac{1}{8} - \frac{1}{15} = \frac{7}{120} \therefore v = \frac{120}{7} \approx 17 \text{ cm}$$

Q10. Solution

Correct Answer: (B)

$$\text{Maximum height } H = \frac{v^2 \sin^2 45^\circ}{2g} = \frac{v^2}{2g} \times \frac{1}{2} = \frac{v^2}{4g} \quad \text{Momentum of particle at the highest point}$$

$$p = mv \cos 45^\circ = mv/\sqrt{2} \quad \text{Angular momentum} = pH = \frac{mv}{\sqrt{2}} \times \frac{v^2}{4g} = \frac{mv^3}{4\sqrt{2}g}$$

Q11. Solution**Correct Answer: (B)**

For forward biased, majority charge carrier constitute current by diffusing to other side of junction. For reversed biased, minority charge carrier constitute small amount of leakage current by drifting due to externally applied electric field. ~

Q12. Solution**Correct Answer: (C)**

RMS speed is given by

$$v_{rms} = v = \sqrt{\frac{3RT}{M}}$$

New temperature $T' = 2T$

New molar mass $M' = \frac{M}{2}$

$$\therefore (v_{rms})_{\text{new}} = \sqrt{\frac{3R(2T)}{\left(\frac{M}{2}\right)}}$$

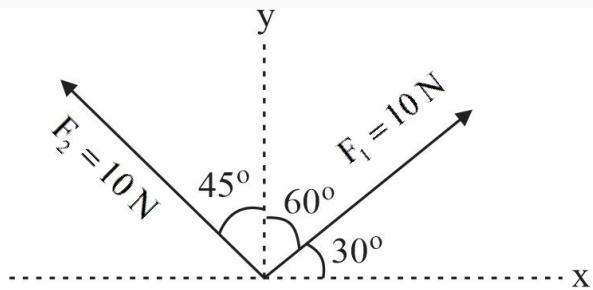
$$(v_{rms})_{\text{new}} = 2v \sim$$

Q13. Solution**Correct Answer: (C)**

Escape velocity from a planet. $v_e = \sqrt{\frac{2GM}{R}} = \sqrt{\frac{2GM}{R^2}R} = \sqrt{2gR}$ According due to gravity

$$g = \frac{GM}{R^2} = \frac{G \cdot \frac{4}{3}\pi R^3 \cdot \rho}{R^2} = \frac{4}{3}G\pi R\rho \therefore \text{Radius } R = \frac{3g}{4\pi G\rho} \text{ From Eqs. (i) and (ii), we get}$$

$$v_e = \sqrt{2g \cdot \frac{3g}{4\pi G\rho}} = \sqrt{\frac{3}{2} \frac{g^2}{\pi G\rho}} \text{ Thus, } v_e \propto \frac{g}{\sqrt{\rho}} \therefore \frac{v_n}{v_{r_2}} = \frac{g_1}{\sqrt{\rho_1}} \times \frac{\sqrt{\rho_2}}{g_2} = \frac{5}{2} \times \frac{1}{\sqrt{2}} \text{ (given, } \frac{g_1}{g_2} = \frac{5}{2} \text{ and } \frac{Q}{\rho_2} = 2 : 1) = \frac{5}{2\sqrt{2}},$$

Q14. Solution**Correct Answer: (A)**

After resolving forces in xy - direction, we get

Along x direction, net force;

$$F_x = 10[\cos 30^\circ + (-\cos 45^\circ)] = 10\left(\frac{\sqrt{3}}{2} - \frac{1}{\sqrt{2}}\right) = 1.59 \text{ N}$$

Along y direction, net force;

$$F_y = 10(\sin 30^\circ + 10 \sin 45^\circ)$$

$$F_y = 10\left(\frac{1}{2} + \frac{1}{\sqrt{2}}\right)$$

$$= 12.07 \text{ N}$$

Thus forces in x and y direction are 1.59 N and 12.07 N respectively. ^

Q15. Solution**Correct Answer: (A)**

In a cyclotron, a charged particle: Moves in a semicircular path inside the dees (D_1 and D_2) under a uniform magnetic field. The magnetic field only changes the direction of the particle, not its speed. The particle is accelerated (i.e., gains speed/kinetic energy) only when it crosses the gap between D_1 and D_2 , where an alternating electric field is applied .

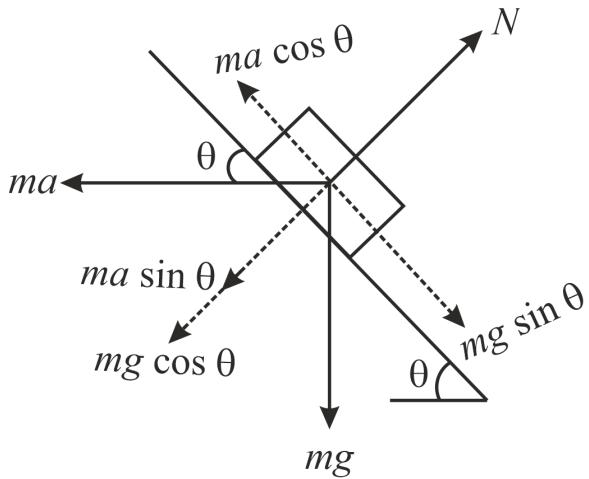
Q16. Solution

Correct Answer: (D)

In non-inertial frame of wedge

Using pseudo force,

Free body diagram is given as



Normal reaction is balanced by $mg \cos(\theta)$

Where m is mass of the body,

g is the acceleration due to gravity

a is the acceleration produced by external force..

$$ma \cos \theta = mg \sin \theta$$

$$a = \frac{g \sin(\theta)}{\cos(\theta)}$$

$$a = g \tan \theta$$

,

Q17. Solution

Correct Answer: (C)

$$B = \frac{\mu_0}{4\pi} \frac{M}{d^3}$$

$$20 \times 10^{-6} = \frac{10^{-7} \times M}{8 \times 10^{-3}}$$

$$M = \frac{1.6 \times 10^{-7}}{10^{-7}} = 1.6 \text{ A m}^2 \wedge$$

Q18. Solution

Correct Answer: (B)

$$\Delta h = \frac{2S \cos \theta}{\rho g} = \frac{2S}{R \rho g}$$

$$\Rightarrow R = \frac{2S}{\Delta h \rho g} \wedge$$

Q19. Solution

Correct Answer: (A)

Per unit volume energy stored

$$= \frac{1}{2} \times Y \times (\text{strain})^2 = \frac{1}{2} \times Y \times \left(\frac{l}{L}\right)^2$$

given $l = L \times 1\%$

$$\text{or } l = \frac{L}{100}$$

$$\text{Thus per unit volume energy stored } = \frac{1}{2} \times 2 \times 10^{10} \times \left(\frac{L}{100L}\right)^2$$

$$= 10^6 \text{ J m}^{-3} !$$

Q20. Solution

Correct Answer: (B)

Let t_1, t_2 and t_3 be the time taken by the particles to cover the distance $2x$, $4x$ and $6x$ respectively. Let v be the velocity of the particle at B ie, maximum velocity. The particle moves with uniform acceleration from A to B.

For motion from A to B.

$$\text{Average velocity} = \frac{0+v}{2} = \frac{v}{2}$$

$$\text{Time taken, } t_1 = \frac{2x}{v/2}$$

$$\text{Particle moves with uniform retardation from C TO D, } V_{\text{avg}} = \frac{0+v}{2} = v/2$$

$$\text{Time taken, } t_3 = \frac{6x}{(v/2)}$$

$$\text{Total time} = t_1 + t_2 + t_3$$

$$t = \frac{2x}{v/2} + \frac{4x}{v} + \frac{6x}{v/2} = \frac{20x}{v}$$

$$\text{Average Velocity over } = \frac{6x+2x+4x}{20x/v} = \frac{3}{5}v$$

$$\text{Required Ratio} = \frac{\text{AverageSpeed}}{v} = \frac{3}{5},$$

Q21. Solution

Correct Answer: (C)

$$\frac{2\pi r}{4} = 628$$

$$r = \frac{628(2)}{3.14} = 400 \text{ m}$$

$$\text{Centripetal Force, } F = \frac{mv^2}{r}$$

$$F = \frac{1000(16)^2}{400}$$

$$F = 640 \text{ N}$$

Q22. Solution

Correct Answer: (A)

Electromagnetic wave equation

$$E = E_0 \cos(kw - \omega t) \dots(i)$$

Speed of electromagnetic wave $v = \frac{\omega}{k}$

Given, equation

$$\mathbf{E} = 40 \cos(kz - 6 \times 10^8 t) \mathbf{i} \dots(ii)$$

Comparing Eqs. (i) and (ii), we get

$$\omega = 6 \times 10^8$$

and $E_0 = 40\mathbf{i}$

$$\text{Here, wave factor } k = \frac{\omega}{v} = \frac{6 \times 10^8}{3 \times 10^8} = 2 \text{ m}^{-1}$$

Q23. Solution

Correct Answer: (B)

From Einstein's photoelectric equation the maximum kinetic energy of photoelectrons emitted from the metal surface is given by

$$E_k = h\nu_1 - W$$

Where W is the work function of the metal.

$$\text{Given, } W = h\nu \text{ and } \nu_1 = 4\nu$$

$$\therefore E_k = 4h\nu - h\nu = 3h\nu$$

Q24. Solution

Correct Answer: (B)

Apply the concept of Lenz's law.

Q25. Solution

Correct Answer: (A)

$$E = \frac{40-10}{0.3} = 100 \text{ V m}^{-1}$$

(near the plate the electric field has to be uniform

\therefore it is almost due to the plate).

For conducting plate

$$E = \frac{\sigma}{\epsilon_0} \Rightarrow \sigma = \epsilon_0 E$$

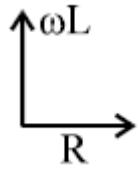
$$\begin{aligned} \text{Therefore } \sigma &= 8.85 \times 10^{-12} \times 100 \\ &= 8.85 \times 10^{-10} \text{ C m}^{-2} \end{aligned}$$

Q26. Solution**Correct Answer: (B)**

For DC LR circuit, time constant is given by,

$$\tau = L/R$$

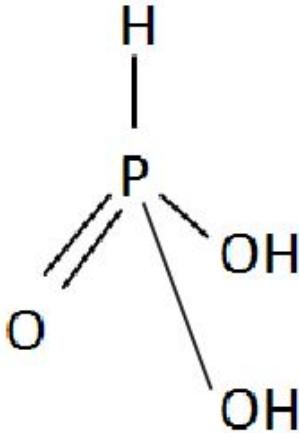
For AC LR circuit, power factor is given by,



$$\cos \phi = \frac{R}{\sqrt{R^2 + \omega^2 L^2}} = \frac{1}{\sqrt{1 + \omega^2 \frac{L^2}{R^2}}} = \frac{1}{\sqrt{1 + \omega^2 \tau^2}}$$

Q27. Solution**Correct Answer: (D)**

The structure of H_3PO_3 is



Since it contains two -OH groups, it is diabasic. Also it contains H atom directly attached to P, hence, it is reducing.

Q28. Solution**Correct Answer: (D)**

No constant force will act towards a fixed point so path won't be circular.

No force will act towards a fixed point called focus so path won't be parabolic.

No force will act towards a fixed point called foci so path won't be parabolic.

Force will act from a fixed point so path will be rectangular hyperbola.

Q29. Solution

Correct Answer: (B)

From figure $\left(\frac{R}{\sqrt{2}}, \frac{R}{\sqrt{2}}\right)$ is the coordinate of the rod only in absence of the ring,

When the ring is also introduced then $r_{cm} = \frac{m_{chord} r_{chord} + m_{ring} r_{ring}}{m_{chord} + m_{ring}}$

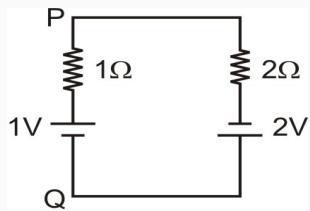
Hence coordinate of the center of mass of system $r_{cm} = \frac{m_{chord} r_{chord}}{m_{chord} + m_{ring}}$

Hence the value of coordinate will decrease and will not be $\left(\frac{R}{\sqrt{2}}, \frac{R}{\sqrt{2}}\right)$, hence the answer is B

Q30. Solution

Correct Answer: (A)

Two batteries of emf 1 V are combined, and two resistance also combine in series



$$E_{net} = \frac{E_1 r_2 - E_2 r_1}{r_1 + r_2} = \frac{2 - 2}{2 + 1} = 0$$

Q31. Solution

Correct Answer: (A)

For First order reaction $t_{1/2} = \frac{0.693}{k_1} \Rightarrow k_1 = \frac{0.693}{40} \text{ s}^{-1}$ (i) For Zero order reaction

$t_{1/2} = \frac{[C]_0}{2k_0} \Rightarrow k_0 = \frac{1.386}{2 \times 20} \text{ mol/dm}^3/\text{s}$ (ii) Using (i) and (ii)

$$\frac{k_1}{k_0} = \frac{0.693/40}{1.386/2 \times 20} = \frac{0.693}{1.386} = 0.5 \text{ mol}^{-1} - \text{dm}^3$$

Q32. Solution

Correct Answer: (D)

The primary precursors of photochemical smog are NO_2 and hydrocarbons. The secondary precursors are ozone and PAN (peroxyacetyl nitrates).

Q33. Solution

Correct Answer: (C)

Distance between successive wave fringes is a wavelength λ .

So path difference from XY to P is 3λ

Time taken : $\frac{3\lambda}{c}$

Q34. Solution**Correct Answer: (B)**

Let two oxide be



As per question

$$\frac{2a}{16x} = \frac{25}{4} \text{ and } \frac{2a}{16y} = \frac{25}{6}$$

$$x = \frac{a}{50}, y = \frac{3a}{100} \text{ where } a = \text{atomic mass of Metal}$$

As x and y to be an integer,

If we take $a = 50$, then $x = 1, y = 1.5$ (not possible)

If we take $a = 100$ then $x = 2, y = 3$ (possible)

\therefore Minimum Atomic Mass = 100u

Q35. Solution**Correct Answer: (A)**

Dettol is a mixture of chloroxylenol and terpineol.

Q36. Solution**Correct Answer: (C)**

The shortest wavelength in hydrogen spectrum of Lyman series is given by formula

$$\frac{1}{\lambda} = \frac{R_H}{n^2} = \frac{R_H}{1^2} = \frac{109678}{1}$$

$$\lambda = 9.117 \times 10^{-6} \text{ cm}$$

$$= 911.7 \times 10^{-10} \text{ m} = 911.7 \text{ Å}$$

Q37. Solution**Correct Answer: (D)**

The electrical resistance of metals depends upon temperature. Electrical resistance decreases with decrease in temperature and becomes zero near the absolute temperature. Material in this state is said to possess super conductivity.

Q38. Solution**Correct Answer: (D)**

State functions are the functions which depend on initial and final states of a system. Internal energy is a state function and as all the graphs represent cyclic processes, the change in internal energy is zero for all the graphs.

Q39. Solution**Correct Answer: (D)**

When a non-volatile solute is added to a volatile solvent, the solute covers up some of the surface of solvent. Thus, less surface area is available for vaporisation of solvent and hence, vapour pressure decreases. As the amount of non-volatile solute increases, vapour pressure decreases accordingly. \therefore The order of concentration of X is $0.01 < 0.10 < 0.25$ \therefore The order of vapour pressure is $p_3 > p_1 > p_2$

Q40. Solution**Correct Answer: (A)**

physical adsorption involves the weak attractive interaction i.e. weak Vanderwaal's force of attraction between the adsorbent and adsorbate

Q41. Solution**Correct Answer: (D)**

All the statements except (d) are correct. The correct statement is π -electrons are referred to as mobile electrons.

Q42. Solution**Correct Answer: (B)**

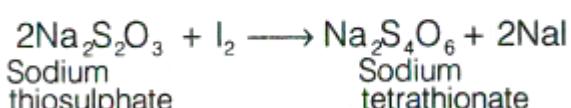
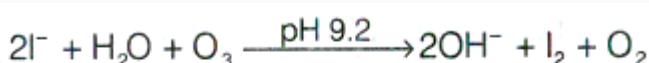
Vulcanization is a process of heating natural rubber with sulphur. This brings about linking of polymer chains at various points of backbone through S – S linkage. This provides strength to the rubber.

Q43. Solution**Correct Answer: (D)**

$$\begin{aligned}E_{\text{cell}}^{\circ} &= E_{\text{Cathode}}^{\circ} - E_{\text{Anode}}^{\circ} \\E_{\text{cell}}^{\circ} &= E_{\text{Cu}^{+2}/\text{Cu}}^{\circ} - E_{\text{Zn}^{+2}/\text{Zn}}^{\circ} \\&= 0.34 - (-0.76) \\&= 1.10 \text{ V}\end{aligned}$$

Q44. Solution**Correct Answer: (B)**

When ozone is treated with excess of KI solution buffered with borate buffer (pH 9.2), I₂ is liberated quantitatively which is titrated against a standard solution of Na₂ S₂O₃ using starch as an indicator and the amount of O₃ can thus be calculated. The reaction involved are



Q45. Solution**Correct Answer: (A)**

The most appropriate opposite word of the given word is meagre.

Massive: very big.

Meagre: too small in amount.

Heavy: weighing a lot.

Light: something that produces light.

Short: not measuring much from one end to the other.

Hence, this is a correct answer.

Q46. Solution**Correct Answer: (C)**

The suitable meaning of these idioms is as follow-

Smell a rat- To have reason to suspect to smell a rat. phrase. If you smell a rat, you begin to suspect or realize that something is wrong in a particular situation, for example that someone is trying to deceive you or harm you.

Q47. Solution**Correct Answer: (B)**

A sentence has a noun or pronoun component called the subject, and a verb part called the predicate. The subject is missing from the sentence so first the subject 'I' should be included. Since an experience is being related to the tense of the verb here so 'find' cannot be used, thus the option (d) is eliminated. Whatever phrase follows the subject Taj Mahal will act as the adjective attached to the verb 'found', the remaining expression will then become only supportive or additional information. That is in option (b) 'I found the Taj Mahal truly impressive' is the chief part of the sentence and 'in the moonlight' is additional information, without which also the sentence makes sense. In option (c) I found the Taj Mahal in the moonlight will be the chief sentence which is not the appropriate usage.

Q48. Solution

Correct Answer: (A)

The idiom "Die hard" is used when someone takes a long time to disappear, and is not given up easily on something.

For example:

Not even cricket game diehard supporters can pretend that this was a great game.

Among the given options, the most appropriate option is "Unwilling to change".

Therefore, the answer is option (1).

Q49. Solution

Correct Answer: (A)

Correct Answer: If you had worked hard, you would have certainly got the scholarship.

Conditional sentences are statements discussing known factors or hypothetical situations and their consequences.

It is used to refer to a time that is in the past, and a situation that is contrary to reality or refer to an unreal past condition and its probable past result.

This conditional sentence falls under 'Type III-Impossible Condition'. This type is also called 'unfulfilled condition of the past'. It relates to the past. The action is over now. The verb in the 'if' clause is in the past perfect tense and the verb in the main clause is in the perfect conditional. Here, 'had worked hard' is in the past perfect tense and it refers to the past activity and an unreal past condition and its probable past result, so it is the suitable option.

The other options are incorrect as 'been worked hard', 'work hard', and 'have worked hard' when used in the given blank, will form a grammatically inappropriate sentence.

Q50. Solution

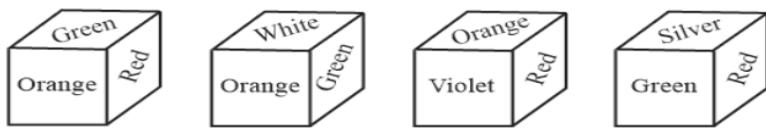
Correct Answer: (A)

The passage says that animals "acquire carotenoids either directly (from the plants and algae that produce them) or indirectly (by eating insects)." A Correct. The passage indicates that the phrase acquire directly signifies in this context acquisition from the ultimate source of carotenoids, so the phrase acquire ... indirectly signifies an acquisition that is not from the ultimate source. This implies that insects do not produce their own carotenoids, but derive them by consuming plants, algae, or other insects. B This may well be true of some insects, but no information in the passage implies it. C No information in the passage implies that carotenoid levels in insect tissue remain constant over time. D The passage contains no information that relates to the immune system of any insect species.

Q51. Solution

Correct Answer: (D)

The given question is:



We can see that four positions of a die are given. From the given four positions of the die, faces adjacent to the face having Green colour are Orange, Red, White, Silver. We can observe that Violet is not given on any face adjacent to Green.

Therefore, we can conclude that the Violet is opposite to Green.

Hence, this is the correct answer.

Q52. Solution

Correct Answer: (B)

(X) → Sucrose on hydrolysis gives glucose and fructose. i.e. Sucrose → glucose + fructose (Y) → Lactose on hydrolysis gives D-glucose and D-galactose. i.e. Lactose → D-glucose + D-galactose (Z) → Maltose on hydrolysis gives 2 units of glucose. i.e. Maltose → glucose + glucose Thus, correct option is (b).

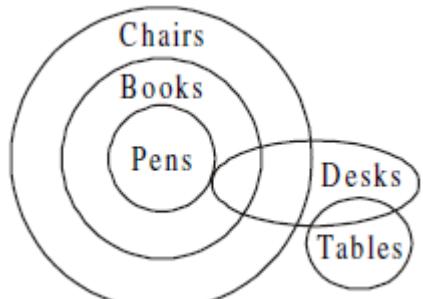
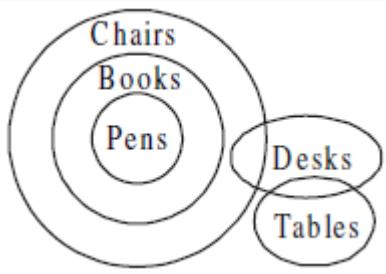
Q53. Solution

Correct Answer: (D)

A simple application of Wurtz reaction.

Q54. Solution

Correct Answer: (D)



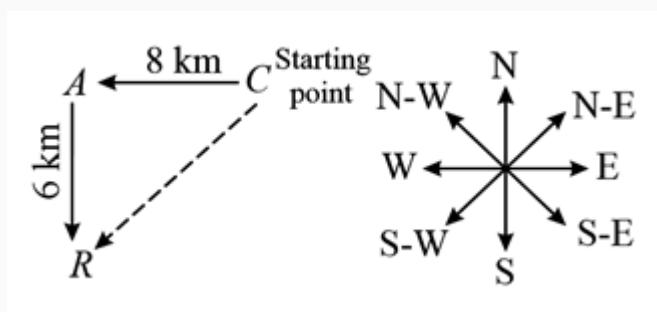
OR

Conclusions: I. False II. False III. True IV. True So, Only III and IV follow.

Q55. Solution

Correct Answer: (D)

Make a diagram according to question,



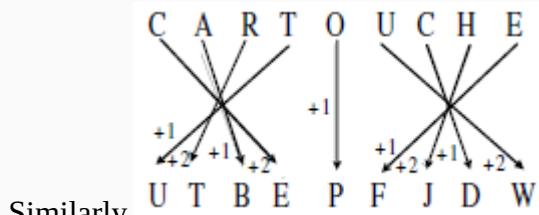
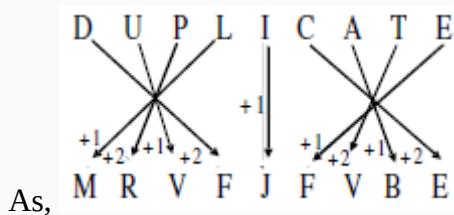
Using Pythagoras theorem,

$$BC = \sqrt{8^2 + 6^2} = 10$$

Thus required answer is 10 km, South-West

Q56. Solution

Correct Answer: (D)



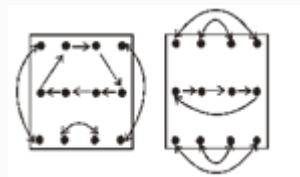
Q57. Solution

Correct Answer: (B)

$$\begin{aligned} \therefore P(V - b) &= RT \\ \therefore PV - Pb &= RT \\ PV &= RT + Pb \\ \text{For 1 mol van der Waal's gas } (P + \frac{a}{V^2})(v - b) &= RT \text{ At high pressure } P + \frac{a}{V^2} \approx P \\ z &= \frac{PV}{RT} = \frac{RT}{RT} + \frac{Pb}{RT} \\ \therefore z &= 1 + \frac{Pb}{RT} \end{aligned}$$

Q58. Solution

Correct Answer: (C)



From the logical pattern explained in the above figures, we can obtain the required answer.

Q59. Solution**Correct Answer: (A)**

Logic: Look for the number that represents its respective word in the given Matrix, first take the number from the column and then from the row.

So,

$$C \rightarrow 44$$

$$A \rightarrow 62$$

$$L \rightarrow 65$$

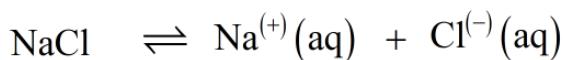
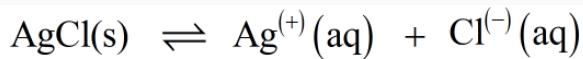
$$M \rightarrow 51$$

Therefore, the number set 44, 62, 65, 51 represents 'CALM'.

Q60. Solution**Correct Answer: (C)**

We can see in the given figure that after adding column 1 and column 2 the result will place in column 3.

Now, if we place option C in the blank space then this logic is satisfied because if we add the last row of column 1 and column 2 then we get the right answer which is option C.

Q61. Solution**Correct Answer: (B)**

$$\therefore K_{sp(AgCl)} = S(S + 0.1)$$

$$\therefore S \ll 0.1$$

$$\therefore S + 0.1 \approx 0.1$$

$$\therefore 1.6 \times 10^{-10} = S \times 0.1$$

$$\therefore S = 1.6 \times 10^{-9}\text{ M}$$

Q62. Solution**Correct Answer: (A)**

The pair of words given in the question depicts a certain relation. The first one of them is of higher intensity than the second word. For example, Stare means to continuously see someone or a particular object whereas glance means to take a slight look at someone.

The pair 'Gulp: Sip' has also the same kind of relationship as the word 'gulp' means to intake a large quantity of a liquid inside the mouth whereas the word 'sip' means to intake a very light quantity of the liquid. The other pair of words have the opposite relationship between them.

Hence, Gulp: Sip is the answer.

Q63. Solution**Correct Answer: (A)**

Here, we have to find the odd one out among the four of them. So, as we can analyse that:

$$F \xrightarrow{-4} BJ \xrightarrow{+2} L$$

Both increment and decrement are taking place, but in other options only increment is taking place as shown below:

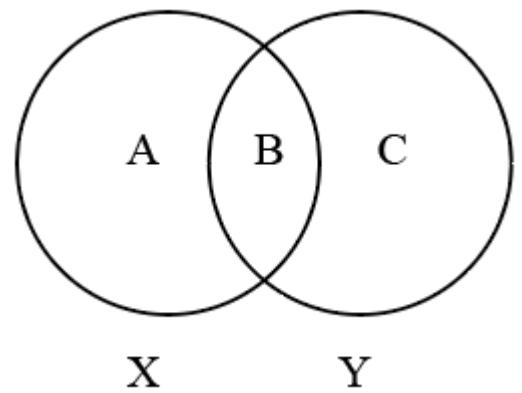
$$\begin{aligned} D &\xrightarrow{+7} KR \xrightarrow{+5} W \\ K &\xrightarrow{+3} NX \xrightarrow{+1} Y \\ C &\xrightarrow{+11} NP \xrightarrow{+3} T \end{aligned}$$

So, *FBJL* is the correct option.

Q64. Solution**Correct Answer: (D)**

III>II>I

Adjacent functional group appear to weaken C – H Bonds, hence making free radical more stable
(All the three are molecules - not radicals. We have assumed them as radicals)

Q65. Solution**Correct Answer: (C)**

The number of people who read only magazine $X = A$ The number of people who read only magazine $Y = C$

$$3A = B + C$$

$$3C = B + A$$

The number of people who read both the magazines = B $3A - C = 3C - A$ Now, if we substitute $A = C$ in

$$\Rightarrow 4A = 4C$$

$$\Rightarrow A = C$$

the first two equations, we get $B = 2A = 2C = A + C$ Hence, the number of people who read both the magazines are twice the number of people who read only magazine X . Also, the number of people who either read only one magazine or both magazines = $B + (A + C) = B + B = 2B$ Hence, the total number of persons who read either one magazine or both the magazines is twice the number of persons who read both the magazines. Thus, both conclusions are true.

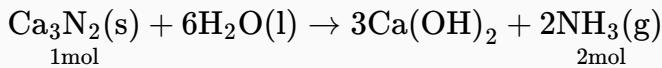
Q66. Solution**Correct Answer: (C)**

$$\begin{aligned}
 & \left(\frac{a}{a+x}\right)^{\frac{1}{2}} + \left(\frac{a}{a-x}\right)^{\frac{1}{2}} \\
 &= \frac{1}{(1+\frac{x}{a})^{\frac{1}{2}}} + \frac{1}{(1-\frac{x}{a})^{\frac{1}{2}}} \\
 &= \left(1 + \frac{x}{a}\right)^{-\frac{1}{2}} + \left(1 + \left(-\frac{x}{a}\right)\right)^{-\frac{1}{2}} \\
 &= \left(1 + \left(-\frac{1}{2}\right) \left(\frac{x}{a}\right) + \frac{(-\frac{1}{2})(-\frac{3}{2})}{1.2} \left(\frac{x}{a}\right)^2\right) + \left(1 + \left(-\frac{1}{2}\right) \left(-\frac{x}{a}\right) + \frac{(-\frac{1}{2})(-\frac{3}{2})}{1.2} \left(-\frac{x}{a}\right)^2\right)
 \end{aligned}$$

(Neglecting $\left(\frac{x}{a}\right)^3$ and higher powers)

$$= \left(1 - \frac{x}{2a} + \frac{3x^2}{8a^2}\right) + \left(1 + \frac{x}{2a} + \frac{3x^2}{8a^2}\right) = 2 + \frac{3x^2}{4a^2}$$

$$\therefore k = \frac{3}{4}.$$

Q67. Solution**Correct Answer: (A)**

One mole of calcium nitride on the reaction with an excess of water gives two moles of ammonia and three moles of calcium hydroxide.

Q68. Solution**Correct Answer: (D)**

Let

$$\Delta = \begin{vmatrix} 1 + a^2 - b^2 & 2ab & -2b \\ 2ab & 1 - a^2 + b^2 & 2a \\ 2b & -2a & 1 - a^2 - b^2 \end{vmatrix}$$

Apply $C_1 \rightarrow C_1 - bC_3$ and $C_2 \rightarrow aC_3 + C_2$

$$\begin{aligned} & \begin{vmatrix} 1 + a^2 - b^2 + 2b^2 & 2ab - 2ab & -2b \\ 2ab - 2ab & 1 - a^2 + b^2 + 2a^2 & 2a \\ 2b - b + a^2b + b^3 & -2a + a - a^3 - ab^2 & 1 - a^2 - b^2 \\ (1 + a^2 + b^2) & 0 & -2b \end{vmatrix} \\ &= \begin{vmatrix} 0 & (1 + a^2 + b^2) & 2a \\ b(1 + a^2 + b^2) & -a(1 + a^2 + b^2) & (1 - a^2 - b^2) \\ 1 & 0 & -2b \end{vmatrix} \\ &= (1 + a^2 + b^2)^2 \begin{vmatrix} 0 & 1 & 2a \\ b & -a & (1 - a^2 - b^2) \end{vmatrix} \\ &= (1 + a^2 + b^2)^2 \{(1 - a^2 - b^2 + 2a^2) + 2b^2\} \\ &= (1 + a^2 + b^2)^2 (1 + a^2 + b^2) = (1 + a^2 + b^2)^3 \end{aligned}$$

Q69. Solution**Correct Answer: (D)**

We have, $f(x) = \begin{cases} 0, & x \text{ is irrational} \\ \sin|x|, & x \text{ is rational} \end{cases}$ If $f(x)$ is continuous, then $\sin|x| = 0 \Rightarrow x = k\pi$, where k is an integer.

Q70. Solution**Correct Answer: (A)**

$$I = \int_{\frac{\pi}{6}}^{\frac{\pi}{4}} e^{-x} (\cosec x + \cot x \cosec x) dx.$$

Put $-x = t \Rightarrow dx = -dt$

$$= - \int_{-\frac{\pi}{6}}^{-\frac{\pi}{4}} e^t (-\cosec(t) + \cot(t) \cdot \cosec(t)) dt$$

$$= e^t \cosec t \Big|_{-\frac{\pi}{6}}^{-\frac{\pi}{4}} = -\sqrt{2}e^{\frac{-\pi}{4}} + 2e^{\frac{-\pi}{6}}$$

$$= 2e^{\frac{-\pi}{6}} - \sqrt{2}e^{\frac{-\pi}{4}}$$

$$\Rightarrow a + b = 2 - \sqrt{2}.$$

Q71. Solution**Correct Answer: (D)**

Given equation $16x^2 - 3y^2 - 32x + 12y - 44 = 0$

$$\Rightarrow 16(x^2 - 2x) - 3(y^2 - 4y) = 44$$

$$\Rightarrow \frac{(x-1)^2}{3} - \frac{(y-2)^2}{16} = 1$$

The equation represents a hyperbola with eccentricity given

$$e = \sqrt{1 + \left(\frac{4}{\sqrt{3}}\right)^2}$$

$$= \sqrt{\frac{19}{3}}$$

Q72. Solution**Correct Answer: (A)**

$$\int \frac{\cos x - \sin x}{7 - 9 \sin 2x} dx$$

$$= \int \frac{\cos x - \sin x}{7 - 9[(\sin x + \cos x)^2 - 1]} dx$$

Put, $\sin x + \cos x = t \Rightarrow (\cos x - \sin x)dx = dt$

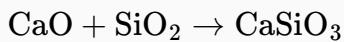
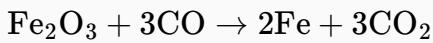
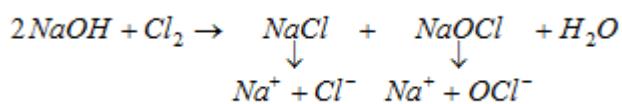
$$\Rightarrow I = \int \frac{dt}{7 - 9(t^2 - 1)} = \int \frac{dt}{4^2 - (3t)^2}$$

$$= \frac{1}{24} \cdot \frac{1}{3} \ln\left(\frac{4+3t}{4-3t}\right) + c$$

$$= \frac{1}{24} \log \frac{4+3(\sin x + \cos x)}{4-3(\sin x + \cos x)} + c, \text{ where } c \text{ is the constant of integration.}$$

Q73. Solution**Correct Answer: (B)**

Reaction occurs in blast furnace:

**Q74. Solution****Correct Answer: (A)**

Q75. Solution**Correct Answer: (B)**

No of G.I in $[\text{PdClFBrI}]^{2-}$ is 3.

Hence $n = 3$

$$\text{So } [\text{Fe}(\text{CN})_6]^{n-6} = [\text{Fe}(\text{CN})_6]^{-3}$$

$$\text{Fe}^{3+} = 3\text{d}^5 4\text{s}^0$$

As $\bar{\text{CN}}$ is a strong field ligand. So, according to crystal field theory the configuration is as follows

$$\text{Fe}^{3+} = t_{2g}^{2,2,1}, e_g^{0,0}$$

1	1	1
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$$n = 1$$

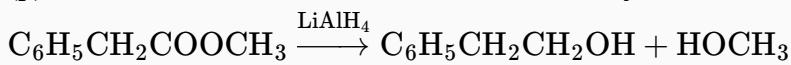
$$\text{Magnetic moment} = \sqrt{n(n+2)} = \sqrt{1(1+2)} = \sqrt{3} = 1.73 \text{ B.M.}$$

$$\text{CFSE} = -0.4\Delta_0 \times nt_{2g} + 0.6\Delta_0 \times n_{eg}$$

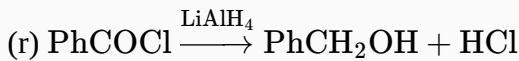
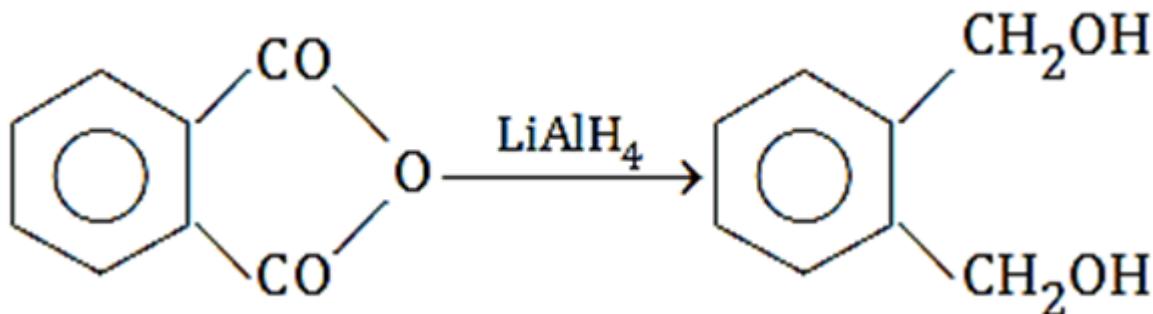
$$\text{CFSE} - 0.4\Delta_0 \times 5 = -2.0\Delta_0$$

Q76. Solution**Correct Answer: (B)**

(p) Esters on reduction form alcohols 1° is always obtained from acid portion of the esters.



(q) Anhydrides on reduction form two equivalents of $-\text{CH}_2\text{OH}$.

**Q77. Solution****Correct Answer: (B)**

Secondary alcohols on dehydrogenation with Cu at 573 K give ketones.

Q78. Solution

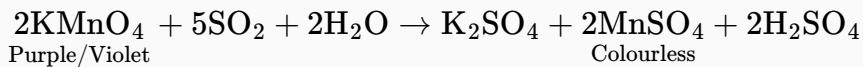
Correct Answer: (B)

MO for the fluorine molecule, the 14 valence electrons of the fluorine atoms fill 4 bonding and 3 anti-bonding orbital thus bond order is 1 . Bond order = $\frac{\text{bonding electrons} - \text{anti} - \text{bonding electrons}}{2}$ In the same way O_2^{2-} has $2 \times (6) + 2 = 14e^-$ So, bond order is 1 .

Q79. Solution

Correct Answer: (A)

SO_2 being a reducing agent can reduce and decolourise KMnO_4 into Mn^{2+} as follows



Q80. Solution

Correct Answer: (A)

The correct order of ionic radii is $\text{Cr}^{3+} > \text{Mn}^{3+} > \text{Fe}^{3+} > \text{Sc}^{3+}$

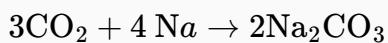
Q81. Solution

Correct Answer: (A)

In the manufacture of hydrogen from water gas ($\text{CO} + \text{H}_2$)



CO is oxidized to CO_2 with steam in the presence of a catalyst followed by absorption of CO_2 in alkali.



Q82. Solution

Correct Answer: (D)

The correct answer for the above question is "scanty".

The word copious means there is more of something. So the opposite of this would be to be less or insufficient in quantity. Among the options given the word scanty is the one that means small or less.

Therefore, the correct answer is "scanty".

Q83. Solution

Correct Answer: (B)

$$\Delta n_g = (\text{No. Moles of products} - \text{No. of moles of reactant}) = 1$$

$$\Delta n_g = 1$$

$$K_p = [K_c]^{\Delta n_g} R T$$

Q84. Solution**Correct Answer: (D)**

Option (a) is incorrect as passage doesn't state that the UK government is set to fund the research, but it is still arranging for them. Option (b) is incorrect as the extent of damage realisation is not the gist of the passage but working on gathering funds and doing more research is. Option(c) is incomplete as it doesn't mention other charities and that Dementia is one of the big diseases and not the 'only single biggest threat'. Option (d) is the answer as passage states that Dementia is one of the greatest threats to the health and wealth of the UK and in light of this fact, the government and charities are making more funds available for research.

Hence, option (d) best summarises the passage.

Q85. Solution**Correct Answer: (C)**

The correct sentence will be "neither the employees nor the manager comes on time".

When the subjects are joined by 'or', 'nor', etc, they are considered as different persons and the verb agrees with the nearer subject. This is known as the proximity rule. Here, the 'manager' is the nearer singular, third-person subject. So, the verb must agree with the person and number of the subject. So, it will be the singular verb, 'comes'.

Q86. Solution**Correct Answer: (C)**

The passage states that carotenoids are used by the immune system and for detoxification processes that help maintain health. Males that are more susceptible to disease and parasites, i.e., males that lack high genetic resistance to such things, must use up the carotenoids they accumulate to boost their immune systems. The passage suggests that consequently male animals perceived by females of the species as having used up their carotenoids would be perceived as having relatively low genetic resistance to disease and parasites. A Even if an animal has efficient detoxification processes, the passage suggests that carotenoids would be used up in such processes. Thus, having relatively less bright coloration (and therefore less carotenoids) would not necessarily indicate inefficient detoxification processes. B The information in the passage suggests that having low genetic resistance to parasite infections is consistent with having immunity to at least some parasite infections, because carotenoids can be used to boost immunity. But this comes at the cost of lacking bright coloration. C Correct. The passage indicates that a male's having relatively bright coloration could indicate relatively high genetic resistance to disease, and having relatively less bright coloration could indicate relatively low genetic resistance, because the carotenoids that create bright coloration would have been used to boost immunity or aid detoxification processes.

Q87. Solution**Correct Answer: (A)**

As per the question,

Working hours in minutes:

$$\text{On Monday} = 4 \times 60 + \frac{1}{2} \times 60 = 270$$

$$\text{On Tuesday} = 190$$

$$\text{On Wednesday} = 230$$

$$\text{On Friday} = 220$$

So, total time in minutes

$$= 270 + 190 + 230 + 220 = 910$$

$$\text{And, total time in hours} = \frac{910}{60} = \frac{91}{6} = 15\frac{1}{6}$$

Now, total earning in Rupees:

$$= 15\frac{1}{6} \times 42 = \frac{91}{6} \times 42 = 91 \times 7 = 637$$

Hence, the correct answer is 637.

Q88. Solution**Correct Answer: (D)**

Due to share value changes the maximum loss is 10 for the month of June. Hence the answer is (d).

Q89. Solution**Correct Answer: (D)**

If P draws black card from box I and if Q also draws black card, then both may lose.

Q90. Solution**Correct Answer: (D)**

According to the situation, poverty is an inescapable (one cannot escape from it) part of social milieu (environment) and it is difficult to eliminate it. Pallbearers of society are the supporters of poverty.

Hence, option D is correct.

Q91. Solution**Correct Answer: (C)**

Symbol represent here:-

>	+
<	-
+	+
-	=
×	>
=	<

Now, check the options,

$$\begin{aligned} \text{option 1)} & 14 + 7 > 3 = 6 + 3 > 2 \\ & \Rightarrow 14 \div 7 + 3 = 6 \div 3 + 2 \\ & \Rightarrow 2 + 3 = 2 + 2 \\ & \Rightarrow 5 \neq 4 \end{aligned}$$

$$\text{option 2)} 6 + 3 > 8 = 4 + 2 < 1$$

$$\Rightarrow 6 \div 3 + 8 = 4 \div 2 - 1$$

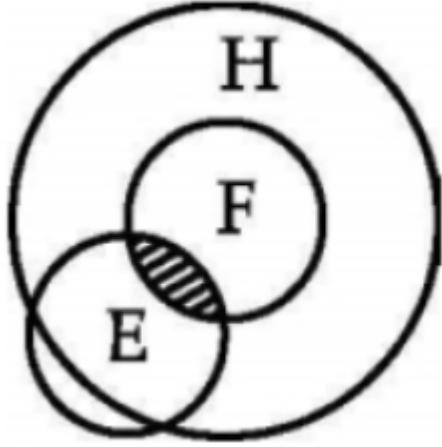
$$\Rightarrow 2 + 8 = 2 - 1$$

$$\Rightarrow 10 = 1 \text{ (does not follow)}$$

$$\text{option 3)} 9 < 6 + 3 = 7 > 4 \Rightarrow 9 - 6 + 3 < 7 + 4 \Rightarrow 9 - 2 < 7 + 4 \Rightarrow 7 < 11 \text{ Follow.}$$

Q92. Solution**Correct Answer: (B)**

F-Mohan's family members E- Employed members H - Honest members



Here, shaded area denotes the employed members of Mohan's family members, who are honest.

Q93. Solution**Correct Answer: (C)**

Here we have given the following letter series,

U, T, R, O, K, ?

The given series is based on the following pattern,

The letter in the series will move backwards in increasing order of

1, 2, 3, 4, and 5 letters.

$U - 1 = T$,

$T - 2 = R$,

$R - 3 = O$,

$O - 4 = K$,

$K - 5 = F$

Hence, the correct answer is F.

Q94. Solution**Correct Answer: (D)**

In the given circle in the figure, the central number in each quadrant is obtained by squaring the addition product of peripheral numbers of the same quadrant as follows -

In the first quadrant,

$$(3 + 4)^2 = 49$$

In the second quadrant,

$$(5 + 1)^2 = 36$$

In the fourth quadrant,

$$(7 + 5)^2 = 144$$

And thus, in the third quadrant,

$$(2 + 8)^2 = 100$$

So, the missing number is 100.

Q95. Solution**Correct Answer: (A)**

The given date and day is
6 th March 2012 is Sunday.

Here, we have to calculate the day on 6 th March 2016.

We know,

The extra days in an ordinary year = 1 day

The extra days in a leap year = 2 day

Firstly, we check that 2012 is a leap year or not.

A leap year has 366 days. A leap year is divisible by 400 for a century year or except century year it is divisible by 4.

Formula for leap year = $\frac{\text{Year}}{4}$ or $\frac{\text{Century Year}}{400}$

2012 is not a century year. So, it is divisible by 4.

$$\frac{2012}{4} = 503$$

2012 is completely divisible by 4.

As, 2012 is a leap year and the next leap year is 2016.

That means 2013, 2014 and 2015 is an ordinary year.

Therefore,

3 ordinary year and 1 leap year present between 2012 and 2016

$$3 \text{ ordinary year} + 1 \text{ leap year} = 3 + 2 = 5 \text{ days}$$

Therefore,

$$\text{Sunday} + 5 \text{ days} = \text{Friday}$$

So, on 6th March 2016 is Friday.

Hence, this is the correct answer.

Q96. Solution**Correct Answer: (C)**

According to the information given in the question, following relationship can be deduced;

Sirius is a star system.

Proxima Centauri is a star system.

Alpha Centauri is a star system.

Deimos is a satellite.

So, Deimos is odd word from the given alternatives.

Hence, the correct option is (C).

Q97. Solution**Correct Answer: (B)**

$$\text{Since, } f(x) = 3x^4 + 4x^3 - 12x^2 + 12$$

$$f'(x) = 12x^3 + 12x^2 - 24x$$

$$= 12x(x-1)(x+2)$$

From above it is clear that $f'(x)$ increasing in $(-2, 0)$ and in $(1, \infty)$

Q98. Solution**Correct Answer: (D)**

Given circles are $x^2 + y^2 - 2x + 8y + 13 = 0$ and $x^2 + y^2 - 4x + 6y + 11 = 0$

Here, $C_1 = (1, -4)$, $C_2 = (2, -3)$

$$\Rightarrow r_1 = \sqrt{1 + 16 - 13} = 2$$

$$\text{And } r_2 = \sqrt{4 + 9 - 11} = \sqrt{2}$$

$$\text{Now, } d = C_1C_2 = \sqrt{(2-1)^2 + (-3+4)^2} = \sqrt{2}$$

$$\therefore \cos \theta = \frac{d^2 - r_1^2 - r_2^2}{2r_1r_2} = \frac{|2-4-2|}{2 \times 2 \times \sqrt{2}} = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \theta = 45^\circ$$

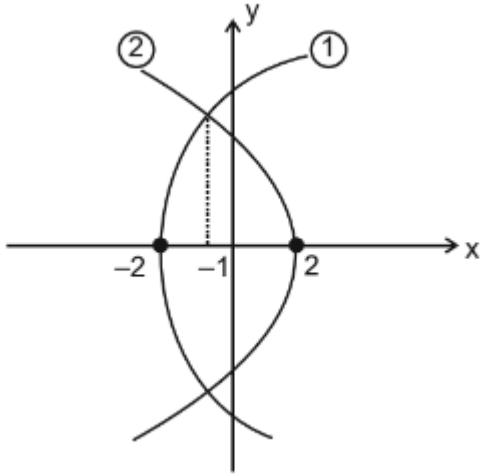
Q99. Solution**Correct Answer: (B)**

$$y^2 = -8(x - 2)$$

$$y^2 = 24(x + 2) \cdots (2)$$

Solving (1) and (2) $\Rightarrow x = -1$

$$\text{Area} = 2 \left[\int_{-2}^{-1} 2\sqrt{6}\sqrt{x+2}dx + \int_{-1}^2 2\sqrt{2}\sqrt{2-x}dx \right] = \frac{32}{3}\sqrt{6} \text{ sq. unit}$$

**Q100. Solution****Correct Answer: (D)**

$$\text{Given: } a = \cos \alpha + i \sin \alpha \quad b = \cos \beta + i \sin \beta$$

$$\text{and } c = \cos \gamma + i \sin \gamma$$

$$\text{Now, } \frac{b}{c} = \frac{\cos \beta + i \sin \beta}{\cos \gamma + i \sin \gamma} \times \frac{\cos \gamma - i \sin \gamma}{\cos \gamma - i \sin \gamma}$$

$$\cos \beta \cdot \cos \gamma + \sin \beta \cdot \sin \gamma + i$$

$$[\sin \beta \cdot \cos \gamma - \sin \gamma \cdot \cos \beta]$$

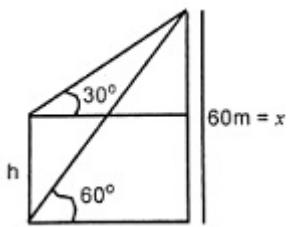
$$\Rightarrow \frac{b}{c} = \cos(\beta - \gamma) + i \sin(\beta - \gamma)$$

$$\text{Similarly, } \frac{c}{a} = \cos(\gamma - \alpha) + i \sin(\gamma - \alpha) \text{ and } \frac{a}{b} = \cos(\alpha - \beta) + i \sin(\alpha - \beta)$$

$$\text{On adding Eqs. (i), (ii) and (iii), we get } \cos(\beta - \gamma) + \cos(\gamma - \alpha) + \cos(\alpha - \beta) + i [\sin(\beta - \gamma) + \sin(\gamma - \alpha) + \sin(\alpha - \beta)] = 1$$

$$[\because \frac{b}{c} + \frac{c}{a} + \frac{a}{b} = 1]$$

$$\text{On equating real parts, we get } \cos(\beta - \gamma) + \cos(\gamma - \alpha) + \cos(\alpha - \beta) = 1$$

Q101. Solution**Correct Answer: (A)**

$$\alpha = 60^\circ$$

$$\beta = 30^\circ$$

$$h = \frac{x(\cot \beta - \cot \alpha)}{\cot \beta}$$

$$= \frac{60\left(\sqrt{3} - \frac{1}{\sqrt{3}}\right)}{\sqrt{3}}$$

$$= \frac{60(2)}{3} = 40 \text{ m}$$

Hence 40 is correct choice.

Q102. Solution**Correct Answer: (B)**

The feasible region for an LPP is shown shaded in the figure. Let $Z = 3x - 4y$ be the objective function.
Minimum of Z occurs at $(0, 8)$

Q103. Solution**Correct Answer: (D)**

Equation of two parabola are $y^2 = 3x$ and $x^2 = 3y$.

Let equation of tangent to $y^2 = 3x$ is $y = mx + \frac{3}{4m}$ is also tangent to $x^2 = 3y$

$$\Rightarrow x^2 = 3mx + \frac{9}{4m}$$

$\Rightarrow 4mx^2 - 12m^2x - 9 = 0$ have equal roots

$$\Rightarrow D = 0$$

$$\Rightarrow 144m^4 = 4(4m)(-9)$$

$$\Rightarrow m^4 + m = 0 \Rightarrow m = -1$$

Hence, common tangent is $y = -x - \frac{3}{4}$

$$\Rightarrow 4(x + y) + 3 = 0$$

Q104. Solution**Correct Answer: (D)**

Number of pairs of numbers having difference $|1| = 99$.

Number of pairs of numbers having difference $|2| = 98$.

Number of pairs of numbers having difference $|3| = 97$.

Number of pairs of numbers having difference $|4| = 96$.

\therefore Total numbers = 390.

Required numbers

$$= {}^{100}C_2 - 390$$

$$= 4560$$

$$= {}^{96}C_2.$$

Q105. Solution**Correct Answer: (C)**Equation of the plane passing through $(2, 1, 0)$, $(4, 1, 1)$ and $(5, 0, 1)$ is

$$\begin{matrix} x - 2 & y - 1 & z - 0 \\ 4 - 2 & 1 - 1 & 1 - 0 \\ 5 - 2 & 0 - 1 & 1 - 0 \end{matrix} = 0 \quad R'(x, y, z)$$

$$\Rightarrow x + y - 2z = 3$$

$$x + y - 2z = 3$$

$$\frac{x - 2}{1} = \frac{y - 1}{1} = \frac{z - 6}{-2} = \frac{-2[2 + 1 - 2(6) - 3]}{1 + 1 + 4}$$

is image of $R(2, 1, 6)$ w.r.t. to plane

$$\Rightarrow \frac{x - 2}{1} = \frac{y - 1}{1} = \frac{z - 6}{-2} = 4$$

$$\Rightarrow x = 6, y = 5, z = -2$$

$$\therefore R'(x, y, z) \equiv (6, 5, -2)$$

Q106. Solution**Correct Answer: (A)**Since, $\frac{1}{a}$, $\frac{1}{b}$ and $\frac{1}{c}$ are in AP .

$$\therefore \frac{1}{a} + \frac{1}{c} = \frac{2}{b} \dots (i)$$

$$\text{Now, } \left(\frac{1}{a} + \frac{1}{b} - \frac{1}{c}\right)\left(\frac{1}{b} + \frac{1}{c} - \frac{1}{a}\right)$$

$$= \left\{ \frac{1}{a} + \frac{1}{b} - \left(\frac{2}{b} - \frac{1}{a}\right) \right\} \left\{ \frac{1}{b} + \frac{1}{c} - \left(\frac{2}{b} - \frac{1}{c}\right) \right\}$$

[from equation (i)]

$$= \left(\frac{2}{a} - \frac{1}{b}\right)\left(\frac{2}{c} - \frac{1}{b}\right)$$

$$= \frac{4}{ac} - \frac{2}{b}\left(\frac{1}{a} + \frac{1}{c}\right) + \frac{1}{b^2}$$

$$= \frac{4}{ac} - \frac{2}{b}\left(\frac{2}{b}\right) + \frac{1}{b^2}$$

$$= \frac{4}{ac} - \frac{3}{b^2}$$

Q107. Solution**Correct Answer: (C)**Given, $\sigma = 9$ Let a student obtains x marks out of 75. Then, his marks out of 100 are $\frac{100}{75}x = \frac{4}{3}x$ Each observation is multiply by $\frac{4}{3}$

$$\therefore \text{New } SD, \sigma = \frac{4}{3} \times 9 = 12$$

Hence, variance is $\sigma^2 = 144$

Q108. Solution**Correct Answer: (A)**

$$\begin{aligned}
 4x^2 + 9y^2 &= 36 \\
 \Rightarrow 4\lambda^2 + 9(\lambda - 2)^2 &< 36 \\
 \Rightarrow 4\lambda^2 + 9\lambda^2 + 36 - 36\lambda &< 36 \\
 \text{The point } (\lambda, \lambda - 2) \text{ lies inside the ellipse} \quad \Rightarrow 13\lambda^2 - 36\lambda &< 0 \\
 \Rightarrow \lambda(13\lambda - 36) &< 0 \\
 \Rightarrow 0 < \lambda < \frac{36}{13} \\
 (\lambda - 2)^2 - \lambda > 0
 \end{aligned}$$

$$\begin{aligned}
 \text{outside the parabola } y^2 = x \quad \Rightarrow \lambda^2 - 4\lambda + 4 - \lambda > 0 \Rightarrow \lambda^2 - 5\lambda + 4 > 0 \\
 \Rightarrow \lambda^2 - 4\lambda - \lambda + 4 > 0 \Rightarrow (\lambda - 4)(\lambda - 1) > 0 \\
 \Rightarrow \lambda \in (-\infty, 1) \cup (4, \infty)
 \end{aligned}$$

conclude that $0 < \lambda < 1$ The point $(\lambda, \lambda - 2)$ also lies**Q109. Solution****Correct Answer: (B)**

Given $f'(x) = f(x) + \int_0^1 f(x)dx \dots (1)$

Differentiating we get,

$$f''(x) = f'(x) + 0 \Rightarrow \frac{f''(x)}{f'(x)} = 1$$

On integrating $\int \frac{f''(x)}{f'(x)} dx = \int dx$

$$\Rightarrow \ln f'(x) = x + c \Rightarrow f'(x) = e^{x+c} = ke^x$$

where $k = e^c$, a constant

Again integrate

$$\int f'(x)dx = \int ke^x + D \Rightarrow f(x) = ke^x + D \dots (2)$$

Put $x = 0$ in (1), $f(0) = ke^0 + D \Rightarrow k + D = 1$

(given $f(0) = 1$) $\dots (3)$

Also from (1), $f'(x) = f(x) + \int_0^1 f(x)dx$

$$\Rightarrow ke^x = ke^x + D + \int_0^1 (ke^x + D)dx$$

$$\Rightarrow [ke^x + Dx]_0^1 + D = 0 \Rightarrow [ke + D - k] + D = 0$$

$$\Rightarrow k(e - 1) + 2D = 0$$

Solving (3) and (4), we get

$$k = \frac{2}{3-e} \text{ and } D = \frac{1-e}{3-e}$$

$$\therefore f(x) = \frac{2e^x}{3-e} + \frac{1-e}{3-e}$$

Q110. Solution**Correct Answer: (D)**

Hint :

$$f \left[\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix} \right] = 4 = f \left[\begin{pmatrix} 4 & 0 \\ 0 & 1 \end{pmatrix} \right]$$

 \Rightarrow not one-oneAs $0 \in \mathbb{R}$ but S does not contain any singular matrix so, f is not onto**Q111. Solution****Correct Answer: (A)**Given, for $x, y \in N$ $f(x+y) = f(x) \cdot f(y)$ Then, function will be of the form $f(x) = a^x$, where

$$\therefore f(1) = 3$$

 $a \in N$ $[\because a \neq 1] \Rightarrow f(1) = a^1 = 3 \therefore$ Function is $f(x) = 3^x$. Now, $\sum_{x=1}^n f(x) = 120$

$$\Rightarrow a = 3$$

$$\Rightarrow \sum_{x=1}^n 3^x = 120 \Rightarrow 3 + 3^2 + 3^3 + \dots + 3^n = 120 \Rightarrow \frac{3(3^n - 1)}{3-1} = 120 \Rightarrow 3^n = 1 + \frac{120 \times 2}{3} \Rightarrow 3^n = 81 = 3^4 \text{ So, } n = 4$$

Q112. Solution**Correct Answer: (C)**

Given,

$$x^2 + y^2 = t - \frac{1}{t} \dots (i)$$

and

$$x^4 + y^4 = t^2 + \frac{1}{t^2} \Rightarrow x^4 + y^4 = \left(t - \frac{1}{t}\right)^2 + 2$$

Since

$$[(a+b)^2 = a^2 + b^2 + 2ab]$$

$$\Rightarrow x^4 + y^4 = (x^2 + y^2)^2 + 2 \Rightarrow x^4 + y^4 = x^4 + y^4 + 2x^2y^2 + 2$$

$$\therefore x^2y^2 = -1$$

On differentiation w.r.t. x :

$$\Rightarrow x^2 \cdot 2y \frac{dy}{dx} + y^2 \cdot 2x = 0$$

$$\Rightarrow x^3y \frac{dy}{dx} = -x^2y^2 \Rightarrow x^3y \frac{dy}{dx} = -(-1) \Rightarrow x^3y \frac{dy}{dx} = 1$$

Q113. Solution**Correct Answer: (B)**

On rearranging the given equation, we reduce the equation in the form.

$$\frac{x^2 dx}{1+x^3} = \frac{y^2 dy}{1+y^3}$$

Integrating both side, using method of substitution

let $(1 + x^3) = t$, on differentiating both sides we get $3x^2 = \frac{dt}{dx} \Rightarrow x^2 dx = \frac{dt}{3}$

$$\text{Now, } \int \frac{x^2 dx}{1+x^3} = \frac{1}{3} \int \frac{dt}{t} = \frac{1}{3} \ln t$$

Doing similarly for right-hand side we obtain, $\frac{1}{3} \ln(1 + x^3) = \frac{1}{3} \ln(1 + y^3) + \frac{\ln C}{3}$

$$\ln(1 + x^3) = \ln(c(1 + y^3))$$

$$(1 + x^3) = (c(1 + y^3))$$

Q114. Solution**Correct Answer: (C)**

Required Probability = P(red, red) + P(black, red)

$$= \frac{4}{(4+6)} \times \frac{6}{(4+6+2)} + \frac{6}{6+4} \times \frac{4}{6+4+2} \\ = \frac{24+24}{10 \times 12} = \frac{48}{10 \times 12} = \frac{2}{5}$$

Q115. Solution**Correct Answer: (A)**

If we fix 1 at one's place then number of words formed is $3!$.

Similarly, if we fix 2 at one's place then the number of words formed is $3!$ and so on.

Required sum = $3!(1 + 2 + 3 + 4) = 6(10) = 60$.

Q116. Solution**Correct Answer: (D)**

Let α and 2α be the roots of (1), then

$$(a^2 - 5a + 3)\alpha^2 + (3a - 1)\alpha + 2 = 0 \quad \dots (2)$$

$$\text{And } (a^2 - 5a + 3)(4\alpha^2) + (3a - 1)(2\alpha) + 2 = 0 \quad \dots (3)$$

Multiplying (2) by 4 and subtracting it from (3) we get

$$(3a - 1)(2\alpha) + 6 = 0$$

Clearly $a \neq \frac{1}{3}$ therefore,

Putting this value in (2) we get

$$(a^2 - 5a + 3)(9) - (3a - 1)^2(3) + 2(3a - 1)^2 = 0$$

$$\Rightarrow 9a^2 - 45a + 27 - (9a^2 - 6a + 1) = 0 \Rightarrow -39a + 26 = 0$$

$$\Rightarrow a = \frac{2}{3}$$

For $a = \frac{2}{3}$ the equation becomes $x^2 + 9x + 18 = 0$ whose roots are $-3, -6$

Q117. Solution**Correct Answer: (A)**

$$M = |\overrightarrow{OP}|$$

$$\begin{aligned} M &= \sqrt{(\hat{a} \sin t + \hat{b} \cos t)^2} \\ &= \sqrt{(\hat{a} \sin t)^2 + (\hat{b} \cos t)^2 + 2(\hat{a} \sin t) \cdot (\hat{b} \cos t)} \\ &= \sqrt{\sin^2 t + \cos^2 t + \hat{a} \cdot \hat{b}(2 \sin t \cos t)} \\ &= \sqrt{1 + \hat{a} \cdot \hat{b}(\sin 2t)} \end{aligned}$$

Maximum value of $\sin 2t = 1$

$$\therefore 2t = \sin^{-1}(1)$$

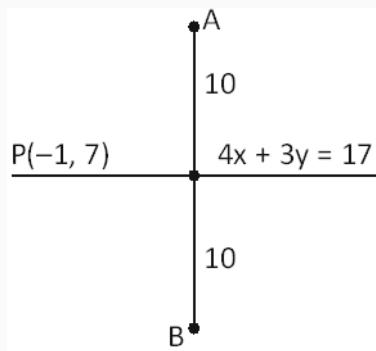
$$\therefore t = \frac{\pi}{4}$$

$$\begin{aligned} \therefore M &= \sqrt{1 + \hat{a} \cdot \hat{b}(1)} \\ &= (1 + \hat{a} \cdot \hat{b})^{\frac{1}{2}} \end{aligned}$$

$$\text{Now, } \hat{u} = \frac{\overline{OP}}{|\overline{OP}|}$$

$$\begin{aligned} &= \frac{\hat{a} \sin t + \hat{b} \cos t}{|\hat{a} \sin t + \hat{b} \cos t|} \\ &= \frac{\hat{a} \left(\frac{1}{\sqrt{2}} \right) + \hat{b} \left(\frac{1}{\sqrt{2}} \right)}{\hat{a} \left(\frac{1}{\sqrt{2}} \right) + \hat{b} \left(\frac{1}{\sqrt{2}} \right)} \end{aligned}$$

Unit vector of OP is $\hat{u} = \frac{\hat{a} + \hat{b}}{|(\hat{a} + \hat{b})|}$

Q118. Solution**Correct Answer: (A)**

There are two points A & B which are at a distance of 10 units from P and farthest (10 unit distance) from the line $4x + 3y = 17$.

The slope of $AB = \frac{3}{4}$ {Because the slope of $4x + 3y = 17$ is $-\frac{4}{3}$ }

Let, line AB makes an angle θ with x -axis then $\tan \theta = \frac{3}{4} \Rightarrow \cos \theta = \frac{4}{5}$ & $\sin \theta = \frac{3}{5}$
 $\Rightarrow A$ or $B = (10 \cos \theta - 1, 10 \sin \theta + 7)$ or

$\Rightarrow A$ or $B = (-10 \cos \theta - 1, -10 \sin \theta + 7)$.

$\Rightarrow A$ or $B = (7, 13)$ or $(-9, 1)$.

Q119. Solution

Correct Answer: (D)

$$\begin{aligned}
 A &= \begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix} & = & \begin{bmatrix} x^2 + 1 & x \\ x & 1 \end{bmatrix} \begin{bmatrix} x^2 + 1 & x \\ x & 1 \end{bmatrix} \\
 A^2 &= \begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} x^2 + 1 & x \\ x & 1 \end{bmatrix} & = & \begin{bmatrix} (x^2 + 1)^2 + x^2 & x(x^2 + 1 + 1) \\ x(x^2 + 1 + 1) & (x^2 + 1) \end{bmatrix} \\
 \therefore A^4 &= A^2 \cdot A^2 & \therefore A^4 &= [a_{ij}] \text{ and } a_{11} = 109 \\
 && a_{11} &= 109 \\
 && \Rightarrow \Rightarrow (x^2 + 1)^2 + x^2 &= 109
 \end{aligned}$$

$$\begin{aligned}
 (x^2 + 1)^2 + x^2 &= 100 + 9 \\
 &= (10)^2 + 3^2 = (3^2 + 1)^2 + 3^2
 \end{aligned}$$

Comparing we get, $x^2 = 9 \Rightarrow x = 3$ $a_{12} = x(x^2 + 2) = 3(9 + 2) = 33$ $a_{21} = x(x^2 + 2) = 3(9 + 2) = 33$
 $a_{22} = x^2 + 1 = 9 + 1 = 10$

$$\begin{aligned}
 \therefore A^4 &= \begin{bmatrix} 109 & 33 \\ 33 & 10 \end{bmatrix} \\
 \therefore A^4 &= 1 \neq 0
 \end{aligned}$$

$$\begin{aligned}
 \text{If } A = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \text{ and } ad - bc \neq 0, \text{ then} & \quad A^{-1} = \frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix} \\
 & \therefore (A^4)^{-1} = \begin{bmatrix} 10 & -33 \\ -33 & 109 \end{bmatrix}
 \end{aligned}$$

Q120. Solution

Correct Answer: (B)

$$\begin{aligned}
 \text{Given, } {}^{n+1}C_{n-2} - {}^{n+1}C_{n-1} &\leq 50 \\
 \Rightarrow \frac{(n-1)!}{3!(n-2)!} - \frac{(n+1)!}{2!(n-2)!} &\leq 50 \Rightarrow \frac{(n+1)!}{3!} \left[\frac{1}{(n-2)!} - \frac{3}{(n-1)!} \right] \leq 50 \Rightarrow (n+1)! \left(\frac{n-1-3}{(n-1)!} \right) \leq 300 \text{ For} \\
 n = 8, \text{ it satisfy to the above inequality. But } n = 1 \text{ it does not satisfy the above inequality.}
 \end{aligned}$$

Q121. Solution**Correct Answer: (B)**

Let given series is

$$S = \cot^{-1} 2 + \cot^{-1} 8 + \cot^{-1} 18 + \cot^{-1} 32 + \dots$$

$$S = \cot^{-1} 2(1)^2 + \cot^{-1} 2(2)^2 + \cot^{-1} 2(3)^2 + \cot^{-1} 2(4)^2 + \dots$$

$$\text{Let } T_n = \cot^{-1}(2n^2)$$

$$\Rightarrow T_n = \tan^{-1} \frac{1}{2n^2}$$

$$= \tan^{-1} \left[\frac{(2n+1) - (2n-1)}{1 + (2n+1)(2n-1)} \right]$$

$$= \tan^{-1}(2n+1) - \tan^{-1}(2n-1)$$

$$\therefore T_1 = \tan^{-1} 3 - \tan^{-1} 1$$

$$T_2 = \tan^{-1} 5 - \tan^{-1} 3$$

$$T_3 = \tan^{-1} 7 - \tan^{-1} 5 \dots \text{and so on.}$$

$$\therefore S_n = \tan^{-1}(2n+1) - \tan^{-1} 1$$

$$\therefore \lim_{n \rightarrow \infty} S_n = \tan^{-1} \infty - \frac{\pi}{4}$$

$$= \pi/2 - \pi/4 = \pi/4$$

$$\text{Hence, } \lim_{n \rightarrow \infty} S_n = \frac{\pi}{4}$$

Q122. Solution**Correct Answer: (B)**

$$\lim_{x \rightarrow -\infty} \frac{2x-1}{\sqrt{x^2+2x+1}} = \lim_{y \rightarrow \infty} \frac{-2-\frac{1}{y}}{\sqrt{1-\frac{2}{y}+\frac{1}{y^2}}}$$

[put $x = -y \therefore x \rightarrow -\infty \text{ ie, } y \rightarrow \infty$]

$$= -\frac{2}{1} = -2$$

Q123. Solution**Correct Answer: (C)**

$$\begin{array}{ccc} 1 & 4a & a \end{array}$$

For non-trivial solution, We have, $\begin{array}{ccc} 1 & 3b & b \end{array} = 0$

$$\begin{array}{ccc} 1 & 2c & c \end{array}$$

$$\Rightarrow 1(3bc - 2bc) - (4ac - 2ac) + 1(4ab - 3ab) = 0$$

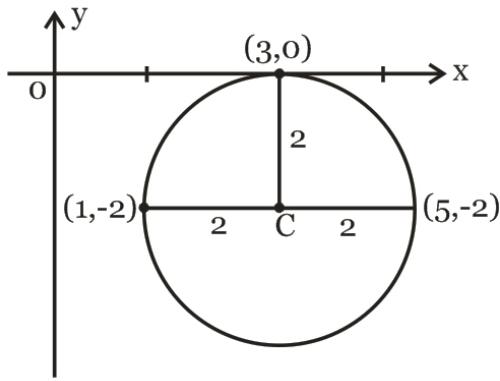
$$\Rightarrow bc - 2ac + ab = 0$$

$$\Rightarrow bc + ab = 2ac$$

$$\Rightarrow b(a+c) = 2ac$$

$$\Rightarrow b = \frac{2ac}{a+c}$$

$\Rightarrow a, b, c$ are in HP

Q124. Solution**Correct Answer: (A)**

Alternatively : Equation of circle is

$$(x - 3)^2 + (y + 2)^2 = r^2$$

Passes through $(1, - 2)$

$$\therefore r = 2$$

$$\therefore \text{Equation of the circle is } (x - 3)^2 + (y + 2)^2 = 4$$

Q125. Solution**Correct Answer: (D)**Inverse for $\neg p \Rightarrow q$ is $\neg(\neg p) \Rightarrow \neg q$ i.e., $p \Rightarrow \neg q$

Truth table for the inverse is given by:

p	q	$\neg q$	$p \Rightarrow \neg q$
T	F	T	T
T	T	F	F
F	F	T	T
F	T	F	T

Q126. Solution**Correct Answer: (C)**

$$\begin{aligned}
 t_r &= \frac{1}{(r+1)\sqrt{r+r\sqrt{r+1}}} \\
 &= \frac{1}{\sqrt{r(r+1)}\{\sqrt{r+1}+\sqrt{r}\}} \times \frac{(\sqrt{r+1}-\sqrt{r})}{(\sqrt{r+1}-\sqrt{r})} \\
 &= \frac{\sqrt{r+1}-\sqrt{r}}{\sqrt{r(r+1)}} = \frac{1}{\sqrt{r}} - \frac{1}{\sqrt{r+1}} \\
 P &= \sum_{r=1}^{99} t_r = 1 - \frac{1}{\sqrt{100}} = \frac{9}{10}
 \end{aligned}$$

Q127. Solution**Correct Answer: (D)**

We have, $\rho = \{(x, y) \in N \times N : 2x + y = 41\}$

For reflexive,

$$x\rho x \Rightarrow 2x + x = 41$$

$$\Rightarrow 3x = 41$$

$$\Rightarrow x = \frac{41}{3} \notin N$$

So, ρ is not reflexive.

For symmetric,

$$x\rho y \Rightarrow 2x + y = 41$$

$$\text{and } y\rho x \Rightarrow 2y + x = 41$$

$$\Rightarrow x\rho y \neq y\rho x$$

So, ρ is not symmetric.

For transitive,

$$x\rho y \Rightarrow 2x + y = 41$$

$$\text{and } y\rho z \Rightarrow 2y + z = 41$$

$$\Rightarrow x\rho z$$

$\Rightarrow \rho$ is not transitive.

Q128. Solution**Correct Answer: (C)**

Given, distribution is

x	0	1	2	3
$P(x)$	$1/3$	$1/2$	0	$1/6$

$$\therefore \text{Mean, } m = \sum_{i=1}^4 p_i x_i$$

$$= 0 \times \frac{1}{3} + 1 \times \frac{1}{2} + 2 \times 0 + 3 \times \frac{1}{6}$$

$$= 0 + \frac{1}{2} + 0 + \frac{1}{2} = 1$$

$$\text{Variance, } \sigma^2 = \sum_{i=1}^4 p_i (x_i - m)^2$$

$$= \frac{1}{3}(0 - 1)^2 + \frac{1}{2}(1 - 1)^2 + 0(2 - 1)^2 + \frac{1}{6}(3 - 1)^2$$

$$= \frac{1}{3} + 0 + 0 + \frac{2}{3} = 1$$

$$\therefore m = \sigma^2 = 1$$

Q129. Solution**Correct Answer: (D)**

$$\text{Given, } 3lm - 4ln + mn = 0 \quad \dots\dots\text{(i)}$$

$$\text{and } l + 2m + 3n = 0 \quad \dots\dots\text{(ii)}$$

From Eq. (ii), $l = -(2m + 3n)$ putting in Eq. (i)

$$-3(2m + 3n)m + 4(2m + 3n)n + mn = 0$$

$$\Rightarrow -6m^2 + 12n^2 = 0$$

$$\Rightarrow m = \pm\sqrt{2}n$$

$$\text{Now, } m = \sqrt{2}n$$

$$\Rightarrow l = -\left(2\sqrt{2}n + 3n\right) = -\left(2\sqrt{2} + 3\right)n$$

$$\therefore l : m : n = -\left(3 + 2\sqrt{2}\right)n : \sqrt{2}n : n$$

$$= -\left(3 + 2\sqrt{2}\right) : \sqrt{2} : 1$$

$$\text{Also, } m = -\sqrt{2}n \Rightarrow l = -\left(-2\sqrt{2} + 3\right)n$$

$$\therefore l : m : n = -\left(3 - 2\sqrt{2}\right)n : -\sqrt{2} : n$$

$$= -\left(3 - 2\sqrt{2}\right) : -\sqrt{2} : 1$$

$$= \cos \theta$$

$$= \frac{\left(3+2\sqrt{2}\right)\left(3-2\sqrt{2}\right)+\left(\sqrt{2}\right)\left(-\sqrt{2}\right)+1\cdot 1}{\sqrt{\left(3+2\sqrt{2}\right)^2+\left(\sqrt{2}\right)^2+1^2} \sqrt{\left(3-2\sqrt{2}\right)^2+\left(-\sqrt{2}\right)^2+1^2}}$$

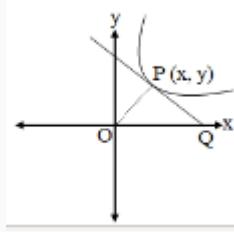
$$= 0$$

$$\Rightarrow \theta = \frac{\pi}{2}$$

Q130. Solution

Correct Answer: (C)

$$(Y-y) = \frac{dy}{dx} (X-x)$$



Thus meet x axis at $\left(x - y \frac{dy}{dx}, 0 \right)$

$$OP=OQ \sqrt{x^2 + y^2} = x - y \frac{dy}{dx}$$

$$-\frac{ydx + xdy}{\sqrt{x^2 + y^2}} = dy$$

$$\frac{ydx - xdy}{y^2 \sqrt{1+x^2/y^2}} = \frac{-1}{y} dy$$

$$\frac{1}{\sqrt{1+\left(\frac{x}{y}\right)^2}} d\left(\frac{x}{y}\right) = -\frac{1}{y} dy$$

$$\log \left\{ \frac{x}{y} + \sqrt{1 + \left(\frac{x}{y}\right)^2} \right\} = -\log y + \log k$$

$$\frac{x}{y} + \sqrt{1 + \frac{x^2}{y^2}} = \frac{k}{y}$$

$$x + \sqrt{x^2 + y^2} = k$$

passes through (1,0)

$$k=2$$

$$x^2 + y^2 = (2-x)^2$$

$$y^2 = 4 - 4x$$

$$y^2 = -4(x-1)$$

vertex (1, 0)

tangent at vertex

$$x=1 \Rightarrow a=1$$