

Solved Paper 2019*

Instructions

- There are 150 questions in all. The number of questions in each part is as given below.

No. of Questions	
1-40	Part I Physics
41-80	Part II Chemistry
81-95	Part III a. English Proficiency
96-105	b. Logical Reasoning
106-150	Part IV Mathematics
- All questions are Multiple Choice Questions having four options out of which **only one** is correct.
- Each correct answer fetches 3 marks while incorrect answer has a penalty of 1 mark.
- Time allotted to complete this paper is 3 hrs.

PART I

Physics

- A radioactive sample of half-life 23.1 days is disintegrating continuously. The percentage decay of it in 15th to 16th days will be [Take, $e^{0.03} = 1.03$]

a. 5%	b. 1%
c. 2.9%	d. 3.5%
- Two separate soap bubbles of radii 3×10^{-3} m and 2×10^{-3} m respectively, formed of same liquid (surface tension = 6.5×10^{-2} N/m) come together to form a double bubble. The radius of interface of double bubble is

a. 6×10^{-3} m	b. 4×10^{-3} m
c. 1.5×10^{-3} m	d. 0.66×10^{-3} m
- An electron revolves in a circular orbit of radius r with angular speed ω . The magnetic field at the centre of electron orbit is

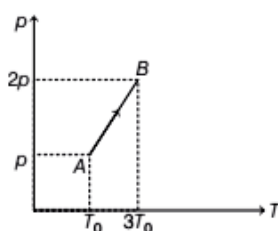
a. $\frac{\mu_0 e \omega}{\pi r}$	b. $\frac{\mu_0 e \omega}{4\pi r}$
c. $\frac{\mu_0 e^2 \omega}{4\pi r}$	d. $\frac{\mu_0 e \omega}{2\pi r}$
- A steel wire of cross-sectional area 4 cm^2 has elastic limit of $2.2 \times 10^8 \text{ N/m}^2$. The maximum upward acceleration that can be given to a 1000 kg elevator supported by this steel wire if the stress is to exceed one-fourth of the elastic limit is [Take, $g = 10 \text{ m/s}^2$]

a. 10 m/s^2	b. 9 m/s^2	c. 15 m/s^2	d. 12 m/s^2
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- An ideal monoatomic gas at 300 K expands adiabatically to twice its volume. The final temperature of gas is

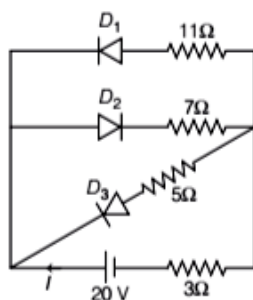
a. $300\sqrt{2}$	b. $300\sqrt{3}$	c. $300\left(\frac{1}{2}\right)^{2/3}$	d. $300(2)^{2/3}$
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- Two sound producing sources A and B are moving towards and away from a stationary observer with same speed respectively. If frequency of sound produced by both sources are equal as 400 Hz, then speed of sources (approximately) when observer detects 4 beats per second, is [Given, speed of sound = 340 m/s]

a. 1.7 m/s	b. 3.4 m/s	c. 2.4 m/s	d. 1 m/s
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7. Pressure *versus* temperature graph of an ideal gas is shown in the given figure. Density of gas at point A is ρ_0 , then density of gas at point B will be



- a. $2\rho_0$ b. $\frac{2}{3}\rho_0$ c. $\frac{3}{2}\rho_0$ d. $3\rho_0$
8. A rubber cord has a cross-sectional area 10^{-6} m^2 and total unstretched length 0.1 m. It is stretched to 0.125 m and then released to project a particle of mass 5.0 g. The velocity of projection is [Given, Young's modulus of rubber, $Y = 5 \times 10^8 \text{ N/m}^2$]
- a. 45 m/s b. 30 m/s
c. 25 m/s d. 15 m/s
9. A body is moving unidirectionally under the influence of a sources of constant power. The square of its displacement in time t is proportional to
- a. t^3 b. t^2
c. t d. \sqrt{t}
10. Two electrons are moving with speed of $5 \times 10^5 \text{ m/s}$ parallel to each other, then the electrostatic and magnetic force between them is
- a. 5×10^5 b. 2.5×10^4
c. 3.6×10^5 d. 4.4×10^3
11. In the following circuit diagram, the current through battery is



- a. 4 A b. 3 A
c. 1 A d. 2 A

12. A semicircular disc of mass M and radius R is free to rotate about its diameter. The moment of inertia of semicircular disc about a line perpendicular to its plane through centre is

a. $\frac{3}{4}MR^2$ b. $\frac{MR^2}{2}$ c. $\frac{MR^2}{3}$ d. $\frac{MR^2}{4}$

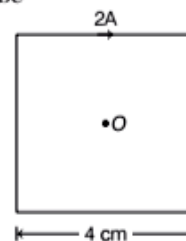
13. 12 eV energy is given to electron in third orbit of H-atom, then final energy of electron when it ionise from third orbit, is

a. 5.25 eV b. 10.49 eV
c. 12 eV d. 11.15 eV

14. In Young's double slit experiment, the distance between slits and screen is 2 m and distance between slits is 0.25 mm. A light of wavelength 800 nm is used to find fringes on the screen. If screen moves with a speed of 5 m/s, then first maxima will move with a speed of

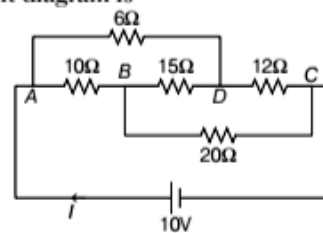
a. 16 mm/s b. 8 mm/s
c. 20 m/s d. 50 mm/s

15. The magnetic field at the point O in the following current carrying square loop at the centre will be



a. $12 \times 10^{-5} \text{ T}$ b. $4 \times 10^{-5} \text{ T}$
c. $4\sqrt{2} \times 10^{-5} \text{ T}$ d. $2\sqrt{2} \times 10^{-5} \text{ T}$

16. The value of current I as shown in the given circuit diagram is



a. 2 A b. 1.5 A c. 0.9 A d. 0.2 A

17. A semicircular wire of radius r rotates in uniform magnetic field B about its diameter with angular velocity ω . If the total resistance of the circuit is R , then the mean power generated per period of rotation is

a. $\frac{(\pi Br^2\omega)^2}{8R}$ b. $\frac{\pi Br\omega^2}{8R}$ c. $\frac{(\pi Br\omega)^2}{8R}$ d. Zero

18. A convex lens of focal length 25 cm produces images of the same magnification 2, when an object is kept at two positions x_1 and x_2 ($x_1 > x_2$) from the lens. The ratio of x_2 and x_1 is
 a. 2 : 1 b. 1 : 3 c. 1 : 2 d. 3 : 1

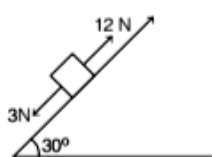
19. A particle x of mass m and initial velocity u collide with another particle y of mass $\frac{3m}{4}$ which is at rest. The collision is head on and perfectly elastic. The ratio of de-Broglie wavelengths λ_y and λ_x after the collision is
 a. 4 : 3 b. 2 : 32 c. 3 : 4 d. 3 : 32

20. The dimensional formula of $\sqrt{\frac{\mu_0}{\epsilon_0}}$ is
 a. $[ML^2T^{-3}A^2]$ b. $[M^0LT^{-1}A^0]$
 c. $[ML^2T^{-3}A^{-2}]$ d. $[M^{-1}L^{-2}T^3A^2]$

21. A body of mass m is moving in a straight line with momentum p . Starting at time $t = 0$, a force $F = at$, acts in the same direction on the moving particle during time interval of T . So that its momentum changes from p to $2p$. The value of T is

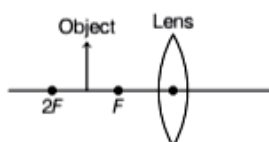
- a. $\sqrt{\frac{2p}{a}}$ b. $\frac{p}{a}$
 c. $2\sqrt{\frac{2p}{a}}$ d. $\frac{2p}{a}$

22. Unless a maximum force of 3 N is applied on a body kept on rough inclined plane of shown in the figure, then body remains stationary. Also when the maximum external force up the inclined plane that does not move the block is 12 N. The coefficient of static friction between the block and the plane is [Take, $g = 10 \text{ m/s}^2$]



- a. $\frac{\sqrt{3}}{5}$ b. $\frac{1}{\sqrt{3}}$ c. $\frac{3\sqrt{3}}{5}$ d. $\frac{5}{3\sqrt{3}}$

23. In the shown situation, if middle portion of the lens is painted black, then



- a. complete image of the object will form with low intensity
 b. complete image of the object will form with high intensity
 c. incomplete image of the object will form with low intensity
 d. incomplete image of the object will form with high intensity

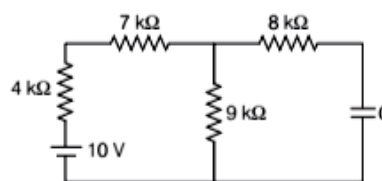
24. If sound travels in air with the speed of 340 m/s, then number of tones present in an open organ pipe of length 2 m and its maximum frequency 1200 Hz, are

- a. 17 b. 11 c. 9 d. 14

25. A proton is revolving on a circular path of radius 2 mm with frequency 10 Hz. Magnetic dipole moment associated with proton is

- a. $2 \times 10^{-24} \text{ A-m}^2$ b. $4 \times 10^{-24} \text{ A-m}^2$
 c. $3 \times 10^{-20} \text{ A-m}^2$ d. $6 \times 10^{-20} \text{ A-m}^2$

26. When a capacitor is fully charged as shown in the following figure, then current drawn from the cell is



- a. 1 mA b. 0.5 mA c. 2 mA d. 5 mA

27. A charged capacitor of capacitance C is discharging through a resistor of resistance R . At what time the charge on the capacitor is equal to one half of its initial value?

- a. $\frac{RC}{2}$ b. $\frac{RC}{\log_e 2}$
 c. $RC \log_e 2$ d. $\frac{1}{RC} \log_e 2$

28. The escape velocity of the earth surface is v_e . A body is projected with velocity $3v_e$. With what constant velocity will it move in the inter planetary space?

- a. v_e b. $3v_e$ c. $\sqrt{2} v_e$ d. $2\sqrt{2} v_e$

29. The time period of a bob performing simple harmonic motion in water is 2s. If density of bob is $\frac{4}{3} \times 10^3 \text{ kg/m}^3$, then time period of bob performing simple harmonic motion in air will be

- a. 3s b. 4s c. 2s d. 1s

30. A uniform solid cylindrical roller of mass m is being pulled on horizontal surface with force F parallel to the surface applied at its centre. If the acceleration of the cylinder is a and it is rolling without slipping, then the value of F is
 a. $2ma$ b. $3ma$ c. $\frac{3ma}{2}$ d. $\frac{5ma}{2}$

31. A projectile is given an initial velocity of $(\hat{i} + \sqrt{3}\hat{j})$ m/s, where \hat{i} is along the ground and \hat{j} is along the vertical. Then, the equation of the path of projectile is [Take, $g = 10$ m/s²]

a. $y = \sqrt{3}x - 5x^2$ b. $y = \sqrt{3}x + 5x^2$
 c. $x = \sqrt{3}y + 5x^2$ d. $x^2 = y^2 + \sqrt{3}$

32. The force on a body of mass 1 kg is $(20\hat{i} + 10\hat{j})$ N. If it starts from rest, then the position of the body at time $t = 2$ s, is

a. $-20\hat{i} - 40\hat{j}$ b. $20\hat{i} - 40\hat{j}$
 c. $40\hat{i} - 20\hat{j}$ d. $40\hat{i} + 20\hat{j}$

33. A cylinder of mass 2 kg is released from rest from the top of an inclined plane of inclination 30° and length 1m. If the cylinder rolls without slipping, then its speed when it reaches the bottom, is [Take, $g = 10$ m/s²]

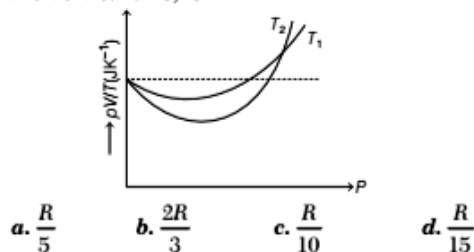
a. $\frac{20}{3}$ m/s b. $\sqrt{\frac{20}{3}}$ m/s c. $\frac{10}{3}$ m/s d. $\sqrt{\frac{10}{3}}$ m/s

34. Frequency of oscillation of a body is 5 Hz when a force F_1 is applied and 12 Hz when another force F_2 is applied. If both forces F_1 and F_2 are applied together, then frequency of oscillation of the body will be

a. 13 Hz b. 169 Hz c. 62 Hz d. 52 Hz

35. The figure shows the graph of $\frac{pV}{T}$ versus p for 2×10^{-4} kg of hydrogen gas at two different temperatures, where p , V and T represents pressure, volume and temperature respectively.

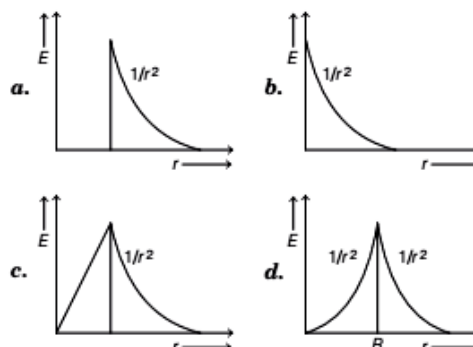
Then, the value of $\frac{pV}{T}$, where the curve meet on the vertical axis, is



36. An ammeter of resistance 1.5Ω can measure currents upto 1 A. The value of shunt resistance to measure current upto 4 A is

a. 0.5Ω b. 1Ω
 c. 1.5Ω d. 0.2Ω

37. In the following figures, which represents the variation of the electric field with distance from the centre of a uniformly charged non-conducting spheres of radius R ?



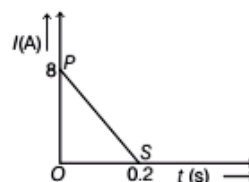
38. A carbon resistor of $(56 \pm 5.6) \text{ k}\Omega$ is to be marked with rings of different colours for its identification. The colour code sequence will be

a. green, blue, orange, silver
 b. blue, yellow, orange, silver
 c. green, red, orange, silver
 d. red, green, blue, gold

39. Two monochromatic light waves are travelling with same frequency and constant phase different. If both waves interfere, then

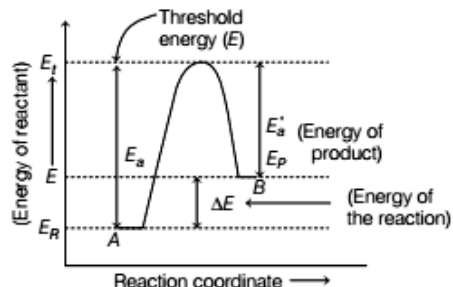
a. there is a gain of energy
 b. there is a loss of energy
 c. the energy is redistributed and the distribution remains constant in time
 d. the energy is redistributed and the distribution changes with time

40. In a coil of resistance 50Ω , the induced current developed by changing magnetic flux through it, is shown in figure as a function of time. The magnitude of change in flux through the coil is



a. 10 Wb b. 20 Wb
 c. 32 Wb d. 40 Wb

67. For a reverse reaction, $A \rightleftharpoons B$, which one of the following statement is wrong from the given energy profile diagram?



- a. Activation energy of forward reaction is greater than backward reaction
 b. The forward reaction is endothermic
 c. The threshold energy is less than that of activation energy
 d. The energy of activation of forward reaction is equal to the sum of heat of reaction and the energy of activation of backward reaction
68. Which of the following reactants is used for the preparation of ethyl benzene, where anhyd. AlCl_3 is a catalyst?
 a. $\text{CH}_3\text{CH}_2\text{OH} + \text{C}_6\text{H}_6$
 b. $\text{CH}_3-\text{CH}=\text{CH}_2 + \text{C}_6\text{H}_6$
 c. $\text{H}_2\text{C}=\text{CH}_2 + \text{C}_6\text{H}_6$
 d. $\text{CH}_3-\text{CH}_3 + \text{C}_6\text{H}_6$
69. Given pH of a solution 'A' is '3' and it is mixed with another solution 'B' having pH '2'. If both solutions are mixed, the resultant pH of the solution will be
 a. 3.2 b. 1.9 c. 3.4 d. 3.5
70. In Freundlich adsorption isotherm, the value of $1/n$ is
 a. between 0 and 1 in all cases
 b. between 2 and 4 in all cases
 c. always 1 in case of physical adsorption
 d. always 1 in use of chemical adsorption
71. Spin only magnetic moment of Mn^{4+} ion is nearly
 a. 3 BM b. 6 BM c. 4 BM d. 5 BM
72. 0.45 g acid of molecular mass 90 was neutralise by 20 mL of 0.5 N KOH. The basicity of the acid is
 a. 2 b. 4 c. 1 d. 3
73. 4 moles of A are mixed with 4 moles of B. At equilibrium for the reaction $A + B \rightleftharpoons C + D$, 2 moles of C and D are formed, the equilibrium constant for the reaction will be,
 a. 1 b. 1/2
 c. 4 d. 1/4
74. What time (in s) is required for depositing all the silver present in 125 mL of 1 M AgNO_3 solution by passing a current of 241.25 A (Given $1F = 96500 \text{ C}$)
 a. 10 b. 50
 c. 100 d. 1000
75. In a homonuclear molecule, which of the following set of orbitals is degenerated?
 a. $\sigma 1s$ and $\sigma 2s$
 b. $\pi 2p_x$ and $\pi 2p_y$
 c. $\pi^* 2p_x$ and $\sigma^* 2p_z$
 d. $\sigma 2p_x$ and $\sigma^* 2p_z$
76. If the photon of wavelength 150 pm strikes an atom and one of its inner bond electron is ejected out with a velocity of $1.5 \times 10^7 \text{ m/s}$, what is the energy with which it is bond to the nucleus?
 a. $1.2 \times 10^2 \text{ eV}$
 b. $215 \times 10^3 \text{ eV}$
 c. $7.6 \times 10^3 \text{ eV}$
 d. $8.12 \times 10^3 \text{ eV}$
77. Identify compound (C) in the following reaction
 $\text{C}_7\text{H}_8 \xrightarrow{3\text{Cl}_2/\Delta} (\text{A}) \xrightarrow{\text{Br}_2/\text{Fe}} (\text{B}) \xrightarrow{\text{Zn}/\text{HCl}} (\text{C})$
 a. *o*-bromotoluene
 b. *m*-bromotoluene
 c. *p*-bromotoluene
 d. 3-bromo, 2, 4, 6-trichlorotoluene
78. In a compound C, H and N are present in 9 : 1 : 3.5 by weight. If molecular weight of compound is 108, the molecular formula of compound is
 a. $\text{C}_2\text{H}_6\text{N}_2$ b. $\text{C}_3\text{H}_4\text{N}$
 c. $\text{C}_6\text{H}_8\text{N}_2$ d. $\text{C}_9\text{H}_{12}\text{N}_3$
79. Which of the following compounds contain all the carbon atoms in the same hybridisation state
 a. $\text{H}-\text{C}\equiv\text{C}-\text{C}\equiv\text{C}-\text{H}$
 b. $\text{CH}_3-\text{C}\equiv\text{C}-\text{CH}_3$
 c. $\text{CH}_2=\text{C}=\text{CH}_2$
 d. $\text{CH}_2=\text{CH}-\text{C}\equiv\text{CH}$
80. The final step for extraction of copper from copper pyrite in bessemer converter involves the reaction
 a. $\text{Cu}_2\text{S} + 2\text{Cu}_2\text{O} \longrightarrow 6\text{Cu} + \text{SO}_2$
 b. $4\text{Cu}_2\text{O} + \text{FeS} \longrightarrow 8\text{Cu} + \text{FeSO}_4$
 c. $2\text{Cu}_2\text{O} + \text{FeS} \longrightarrow 4\text{Cu} + \text{Fe} + \text{SO}_2$
 d. $\text{Cu}_2\text{S} + 2\text{FeO} \longrightarrow 2\text{Cu} + \text{Fe} + \text{SO}_2$

PART III

a. English Proficiency

Directions (Q. Nos 81-83) *In the following questions, the sentences may or may not be grammatically correct. Find out which part of a sentence has an error and mark that part. If there is no error mark part 'd' as your answer.*

81. Many a man **a.** / have come to India from Bangladesh **b.** / to live here permanently. **c.** / No error **d.**
82. How long it takes **a.** / to travel from Chennai to Trichy **b.** / by train? **c.** / No error **d.**
83. One should respect **a.** / the religions of others **b.** / as much as his own. **c.** / No error **d.**

Directions (Q. Nos. 84 and 85) *Fill in the blanks with suitable preposition from the alternatives given under each sentence.*

84. The master assured her success in the examination.
a. of **b.** in **c.** for **d.** with
85. Why do we always have to submit his authority?
a. under **b.** with **c.** for **d.** to

Directions (Q. Nos. 86-88) *Select the word or the phrase that is closest to the opposite in meaning of the italicised or phrase.*

86. The officer made an *audacious* remark.
a. Mute **b.** Visible **c.** Cultivated **d.** Timid
87. They put forward *cogent* arguments for their membership.
a. Logical **b.** Weighty **c.** Dissuasive **d.** Persuasive
88. His administration was *tainted* by scandal
a. Construct **b.** Clear **c.** Purify **d.** Repair

Directions (Q. Nos. 89 and 90) *Choose the word nearest in meaning to the underlined word.*

89. Her mother is vivacious and elegant.
a. Imaginary **b.** Lively **c.** Perceptible **d.** Languid
90. Sporadic fighting broke out in the office.
a. Timely **b.** Scattered **c.** Frequent **d.** Irrelevant

Directions (Q. Nos. 91-95) *Read the passage given below and answer the questions that follow.*

Radically changing monsoon patterns, reduction in the winter rice harvest and a quantum increase in respiratory diseases-all part of the environmental doomsday scenario which is reportedly playing out in South Asia. According to a United Nations Environment Programme report, a deadly 3-km deep blanket of pollution comprising a fearsome cocktail of ash, acids, aerosols and other particles has enveloped this region.

For India, already struggling to cope with a drought, the implications of this are devastating and further crop failure will amount to a life and death question for many Indians. The increase in premature deaths will have adverse social and economic consequences and a rise in **morbidities** will place an unbearable burden on our crumbling health system. And there is no one to blame but ourselves.

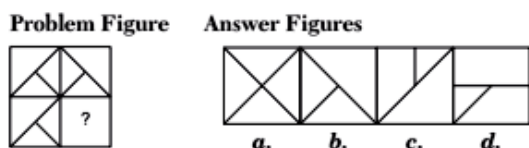
Both official and corporate India has always been **allergic** to any mention of clean technology. Most mechanical two wheelers roll off the assembly line without proper pollution control system.

Little effort is made for R & D on simple technologies, which could make a difference to people's lives and the environment. However, while there is no denying that South Asia must clean up its act, skeptics might question the timing of the haze report.

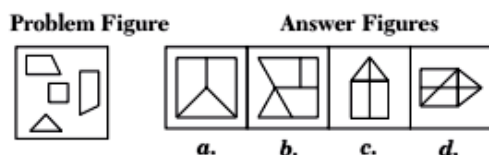
91. Both official and corporate India is allergic to
a. failure of monsoon
b. poverty and inequality
c. slowdown in industrial production
d. mention of clean technology
92. Which, according to the passage, is a life and death question to many Indians?
a. Increase in respiratory diseases
b. Use of clean technology
c. Thick blanket of pollution over the region
d. Failure in crops
93. Choose the word which is similar in meaning to the word 'profligacy' as used in the passage.
a. Wastefulness **b.** Conservation
c. Upliftment **d.** Criticalness
94. According to the passage, India cannot tolerate any further
a. crop failure
b. deterioration of healthcare system
c. increase in respiratory diseases
d. proliferation of nuclear devices
95. What could be the reason behind timing of the haze report just before the Johannesburg meet, as indicated in the passage?
a. United Nations is working hand-in-glove with US
b. Organises the forthcoming meet to teach a lesson to the US
c. Drawing attentions of the world towards devastating effects of environment degradation
d. US wants to use it as a handle against the developing countries in the forthcoming meet

b. Logical Reasoning

96. 'College' is related to 'Student' in the same way as 'Hospital' is related to
- a. Doctor b. Nurse
c. Medicine d. Patient
97. Choose the odd one.
- a. 27 b. 35
c. 18 d. 9
98. Complete the series by replacing question mark "?"
- 1, 2, 2, 4, 3, 8, 7, 10, ?
- a. 9 b. 8
c. 11 d. 13
99. Mohan is taller than Shyam but shorter than Ramesh. Ramesh is taller than Rajat but shorter than Gautam. If Shyam is taller than Rajat, then who is the shortest among all?
- a. Gautam
b. Rajat
c. Shyam
d. Ramesh
100. In the following question, complete the missing segment by selecting the appropriate figure from the given alternatives, (a), (b), (c) and (d).

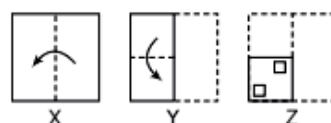


101. In the question given below, find out which of the figures can be formed from the pieces given in the problem figure.

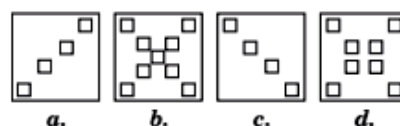


102. In the following question, a set of three figures (X), (Y) and (Z) have been given, showing a sequence in which paper is folded and finally cut from a particular section. These figures are followed by a set of answer figures marked a., b., c. and d. showing the design which the paper actually acquires when it is unfolded. You need to select the answer figure which is closest to the unfolded piece of paper.

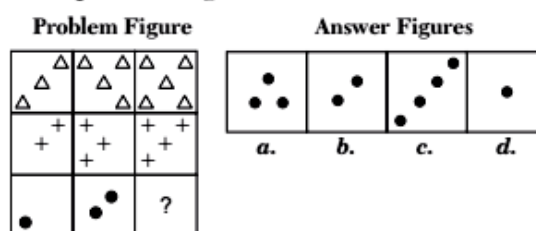
Problem Figures



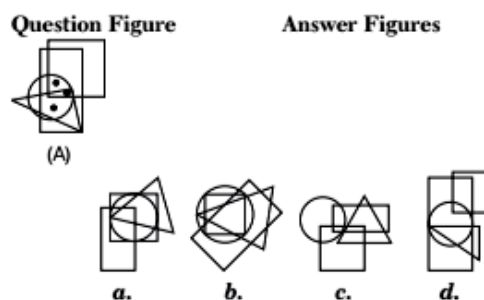
Answer Figures



103. Which of the answer figure a, b, c or d completes the figures matrix?



104. In the following question, some dots are placed in the figure marked as (A). The figure is followed by four alternatives marked as (a), (b), (c) and (d). One out of these four options contains region(s) common to the circle, square, triangle, similar to that marked by the dot in figure (A). Choose the correct option.



105. How many triangles are there in the given figure?



- a. 28 b. 24
c. 25 d. 26

- 106.** If the length of the major axis of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is three times the length of minor axis, its eccentricity is
 a. $1/3$ b. $1/\sqrt{3}$ c. $\sqrt{2/3}$ d. $2\sqrt{2}/3$
- 107.** $\sum_{m=1}^n \tan^{-1}\left(\frac{2m}{m^4 + m^2 + 2}\right)$ is equal to
 a. $\tan^{-1}\left(\frac{n^2 + n}{n^2 + n + 2}\right)$ b. $\tan^{-1}\left(\frac{n^2 - n}{n^2 - n + 2}\right)$
 c. $\tan^{-1}\left(\frac{n^2 + n + 2}{n^2 + n}\right)$ d. None of these
- 108.** Let $(2x^2 + 3x + 4)^{10} = \sum_{r=0}^{20} a_r x^r$, then the value of $\frac{a_8}{a_{12}}$, is
 a. 2 b. 4 c. 8 d. 16
- 109.** Let ABC be an acute-angled triangle and let D be the mid-point of BC . If $AB = AD$, then $\frac{\tan B}{\tan C}$ equal
 a. $\sqrt{2}$ b. $\sqrt{3}$ c. 2 d. 3
- 110.** Suppose the limit $L = \lim_{n \rightarrow \infty} \sqrt[n]{\int_0^1 \frac{1}{(1+x^2)^n} dx}$ exists and is larger than $\frac{1}{2}$, then
 a. $\frac{1}{2} < L < 2$ b. $2 < L < 3$
 c. $3 < L < 4$ d. $L \geq 4$
- 111.** In the real number system, the equation $\sqrt{x+3} - 4\sqrt{x-1} + \sqrt{x+8} - 6\sqrt{x-1} = 1$ has
 a. No solution
 b. Exactly two distinct solution
 c. Exactly four distinct solution
 d. Infinitely many solution
- 112.** If system of equation $ax + y + z = a$, $x + by + z = b$ and $x + y + cz = c$ is inconsistent, then which of the following is correct?
 a. $abc - a - b - c + 2 = 0$
 b. $abc - a - b - c + 3 = 0, a = 1$
 c. $abc - a - b - c + 3 = 0$
 d. $abc - a - b - c + 2 = 0, a \neq 1, b \neq 1, c \neq 1$
- 113.** A die is thrown 7 times. What is the probability that an even number turns up at least 4 times?
 a. $\frac{1}{2}$ b. $\frac{31}{64}$
 c. $\frac{51}{128}$ d. $\frac{35}{128}$
- 114.** The equation of plane containing line $x - y = 1$, $z = 1$ and parallel to $\frac{x}{2} - \frac{z}{3} = 1, y = 3$ is
 a. $3x + 3y - 2z = 1$ b. $3x - 3y - 2z = 1$
 c. $3x + 3y + 2z = 1$ d. $3x + 3y + 2z = -1$
- 115.** If $(1+x+x^2)^{20} = \sum_{r=0}^{40} a_r \cdot x^r$, then $\sum_{r=0}^{39} (-1)^r \cdot a_r \cdot a_{r+1}$ is equal to
 a. 79 b. $2^{39} \cdot {}^{78}C_{39}$
 c. $3^{39} \cdot {}^{78}C_{39}$ d. 0
- 116.** The value of $\lim_{x \rightarrow \frac{3\pi}{4}} \frac{4\sin^2 x \cos x - \cos x + \sin x}{\sin x + \cos x}$ is equal to
 a. -1 b. 0
 c. 1 d. None of these
- 117.** If \mathbf{a} , \mathbf{b} and \mathbf{c} are non-coplanar vectors such that $\mathbf{b} \times \mathbf{c} = \mathbf{a}$; $\mathbf{c} \times \mathbf{a} = \mathbf{b}$ and $\mathbf{a} \times \mathbf{b} = \mathbf{c}$, then which of the following is not TRUE?
 a. $|\mathbf{a}| - |\mathbf{b}| = 0$ b. $|\mathbf{a}| = |\mathbf{b}| = |\mathbf{c}| = 2$
 c. $[\mathbf{a} \ \mathbf{b} \ \mathbf{c}] = 1$ d. $|\mathbf{a}| |\mathbf{b}| |\mathbf{c}| = 1$
- 118.** The value of λ for which the loci $arg z = \frac{\pi}{6}$ and $|z - 2\sqrt{3}i| = \lambda$ on the argand plane touch each other is
 a. 3 b. 4 c. 5 d. 6
- 119.** The angle between the lines whose direction cosine satisfy the equations $l + m + n = 0$ and $l^2 = m^2 + n^2$ is
 a. $\frac{\pi}{3}$ b. $\frac{\pi}{4}$ c. $\frac{\pi}{6}$ d. $\frac{\pi}{2}$
- 120.** The locus of the foot of perpendicular drawn from the centre of the ellipse $x^2 + 3y^2 = 6$ on any tangent to it is
 a. $(x^2 - y^2)^2 = 6x^2 + 2y^2$ b. $(x^2 - y^2)^2 = 6x^2 - 2y^2$
 c. $(x^2 + y^2)^2 = 6x^2 + 2y^2$ d. $(x^2 + y^2)^2 = 6x^2 - 2y^2$

- 121.** If f and g are differentiable function in $[0, 1]$ satisfying $f(0) = 2 = g(1)$, $g(0) = 0$ and $f(1) = 6$, then for some $c \in (0, 1)$
- a. $2f'(c) = g(c)$ b. $2f'(c) = 3g'(c)$
 c. $f'(c) = g'(c)$ d. $f'(c) = 2g'(c)$
- 122.** The integral $\int \left(1 + x - \frac{1}{x}\right) e^{x + \frac{1}{x}} dx$ is equal to
- a. $(x-1)e^{x + \frac{1}{x}} + C$ b. $xe^{x + \frac{1}{x}} + C$
 c. $(x+1)e^{x + \frac{1}{x}} + C$ d. $-xe^{x + \frac{1}{x}} + C$
- 123.** If the coefficient of x^3 and x^4 in the expansion of $(1 + ax + bx^2)(1 - 2x)^{18}$ in powers of x are both zero, then (a, b) is equal to
- a. $\left(16, \frac{251}{3}\right)$ b. $\left(14, \frac{251}{3}\right)$
 c. $\left(14, \frac{272}{3}\right)$ d. $\left(16, \frac{272}{3}\right)$
- 124.** An equation of plane parallel to plane $x - 2y + 2z - 5 = 0$ and at a unit distance from the origin is
- a. $x - 2y + 2z = 3$ b. $x - 2y + 2z + 1 = 0$
 c. $x - 2y + 2z - 1 = 0$ d. $x - 2y + 2z + 5 = 0$
- 125.** Three numbers are chosen at random without replacement from $\{1, 2, 3, \dots, 8\}$. The probability that their minimum is 3, given that their maximum is 6, is
- a. $\frac{3}{8}$ b. $\frac{1}{5}$ c. $\frac{1}{4}$ d. $\frac{2}{5}$
- 126.** The number of real numbers λ for which the equality $\frac{\sin(\lambda\alpha)}{\sin\alpha} - \frac{\cos(\lambda\alpha)}{\cos\alpha} = \lambda - 1$, holds for all real α which are not integral multiple of $\pi/2$ is
- a. 1 b. 2
 c. 3 d. ∞
- 127.** Suppose a parabola $y = ax^2 + bx + c$ has two x intercepts, one positive and one negative, and its vertex is $(2, -2)$, then which of the following is true?
- a. $ab > 0$ b. $bc > 0$
 c. $ac > 0$ d. $a + b + c > 0$
- 128.** The larger of two angles made with the X -axis of a straight line drawn through $(1, 2)$ so that it intersects the line $x + y = 4$ at a point distant $\sqrt{6}/3$ from the point $(1, 2)$ is
- a. 60° b. 75°
 c. 105° d. None of these
- 129.** The point $([P+1], [P])$ (where, $[x]$ is the greatest integer function) lying inside the region bounded by the circle $x^2 + y^2 - 2x - 15 = 0$ and $x^2 + y^2 - 2x - 7 = 0$, then
- a. $P \in [-1, 2] - \{0, 1\}$
 b. $P \in [-1, 0) \cup (0, 1) \cup (1, 2]$
 c. $P \in (-1, 2)$
 d. None of the above
- 130.** Solution of the equation $\frac{dy}{dx} = e^{x-y}(e^x - e^y)$ is
- a. $e^y = e^x - 1 + ce^{-e^x}$ b. $e^{y-x} = -1 + ce^{-e^x}$
 c. $e^x + e^y = ce^{-e^x}$ d. None of these
- 131.** Area bounded by two branches of the curve $(y-x)^2 = x^3$ and $x = 1$ is
- a. $\frac{5}{4}$ sq unit b. $\frac{3}{2}$ sq unit
 c. $\frac{1}{4}$ sq unit d. $\frac{4}{5}$ sq unit
- 132.** The least value of the function $f(x) = \int_0^x (3\sin x + 4\cos x) dx$ on the interval $\left[\frac{5\pi}{4}, \frac{4\pi}{3}\right]$ is
- a. $\frac{3}{2} - \frac{\sqrt{3}}{2}$ b. $\frac{5 - 4\sqrt{3}}{2}$
 c. $\frac{7 - 4\sqrt{3}}{2}$ d. $\frac{9 - 4\sqrt{3}}{2}$
- 133.** If z_1 and \bar{z}_1 represents adjacent vertices of a regular polygon of n sides and if $\frac{I_m(z_1)}{R_e(z_1)} = \sqrt{2} - 1$, then n is equal to
- a. 8 b. 16 c. 18 d. 24
- 134.** In the expansion of $(1 + x + x^3 + x^4)^{10}$, the coefficient of x^4 is
- a. 235 b. 310 c. 285 d. 325
- 135.** A person writes letter to six friends and addresses the corresponding envelopes. Let x be the numbers of ways so that at least two of the letters are in wrong envelopes and y be the numbers of ways so that all the letters are in wrong envelopes. Then $x - y$ is equal to
- a. 719 b. 265
 c. 454 d. 720
- 136.** If $x = \log_5 3 + \log_7 5 + \log_9 7$, then
- a. $x > \frac{3}{2}$ b. $x > \frac{1}{\sqrt[3]{2}}$ c. $x > \frac{3}{\sqrt[3]{2}}$ d. $x > \sqrt[3]{2}$

- 137.** Let p and q be roots of the equation $x^2 - 2x + A = 0$ and let r and s be the roots of the equation $x^2 - 18x + B = 0$. If $p < q < r < s$ are in AP, then A and B are
 a. $-3, -77$ b. $3, -77$
 c. $-3, 77$ d. $3, 77$
- 138.** Let a, b and $c \in R^+$ and the system of equations $(1-a)x + y + z = 0$, $x + (1-b)y + z = 0$ and $x + y + (1-c)z = 0$ has infinitely many solutions, the minimum value of ' abc ' is
 a. $3\sqrt{3}$ b. 9
 c. 27 d. 3
- 139.** If A is an 3×3 non-singular matrix, such that $AA' = A'A$ and $B = A^{-1}A'$, then BB' equals to
 a. $(B^{-1})'$ b. $I + B$
 c. I d. B^{-1}
- 140.** If $\sin^{-1} x + \tan^{-1} x = \pi/2$, then $2x^2 + 1 =$
 a. $\sqrt{5}$ b. $\frac{\sqrt{5}-1}{2}$
 c. 2 d. $\frac{\sqrt{5}+1}{2}$
- 141.** Number of solution of the equation $|\cos x| = 2[x]$ are (where $|x|$, $[x]$ are modulus and greatest integer function respectively).
 a. 0 b. 2
 c. 1 d. infinitely many
- 142.** Let $\cos(\alpha + \beta) = \frac{4}{5}$ and let $\sin(\alpha - \beta) = \frac{5}{13}$, where $0 \leq \alpha, \beta \leq \frac{\pi}{4}$, then $\tan 2\alpha =$
 a. $\frac{20}{7}$ b. $\frac{25}{16}$
 c. $\frac{56}{33}$ d. $\frac{19}{2}$
- 143.** Cards are drawn one by one at random from a well shuffled pack of 52 cards until 2 aces are obtained for the first time. The probability that 18 draws are required for this is
 a. $3/34$ b. $17/455$
 c. $\frac{561}{15925}$ d. None of these
- 144.** If $\mathbf{a} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\mathbf{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\mathbf{c} = 3\hat{i} + \hat{j}$ and $\mathbf{a} + p\mathbf{b}$ is normal to \mathbf{c} , then p is equal to
 a. 0 b. 1
 c. 5 d. 3
- 145.** Let $f(x) = x[x]$, $x \in Z$, ($[]$ denotes greatest integer function), then $f'(x)$ is equal to
 a. $2x$ b. $[x]$
 c. $2[x]$ d. 1
- 146.** The difference of maximum and minimum values of $f(x) = x^2 e^{-x}$ is
 a. e b. $1/e$
 c. $1 - \frac{1}{e}$ d. $1 + \frac{1}{e}$
- 147.** If $f'(x) = f(x) + \int_0^1 f(x) dx$, $f(0) = 1$, then $f(x) =$
 a. $\frac{2e^x}{3-e} + \frac{1-e}{3-e}$ b. $\frac{e^x}{3-e} + \frac{1+e}{1-e}$
 c. $\frac{3e^x}{2-e} + \frac{1+e}{1-e}$ d. $\frac{3e^x}{2-e} + \frac{1-e}{3+e}$
- 148.** The distance between the origin and the normal to curve $y = e^{2x} + x^2$ at $x = 0$ is
 a. $\frac{2}{\sqrt{3}}$ b. $\frac{2}{\sqrt{5}}$
 c. $\frac{1}{\sqrt{3}}$ d. $\frac{1}{\sqrt{5}}$
- 149.** Reflection of the line $\frac{x-1}{-1} = \frac{y-2}{3} = \frac{z-4}{1}$ in the plane $x + y + z = 7$ is
 a. $\frac{x-1}{3} = \frac{y-2}{1} = \frac{z-4}{1}$
 b. $\frac{x-1}{-3} = \frac{y-2}{-1} = \frac{z-4}{1}$
 c. $\frac{x-1}{-3} = \frac{y-2}{1} = \frac{z-4}{-1}$
 d. $\frac{x-1}{3} = \frac{y-2}{1} = \frac{z-4}{1}$
- 150.** If $x, y, z \in R$, $x + y + z = 5$ and $x^2 + y^2 + z^2 = 9$, then length of interval in which x lies is
 a. $8/3$ b. $4/3$
 c. $2/3$ d. $1/3$