

# IPU Question Paper

Duration : 3:00 Hrs

Exam IPU		Total Questions		
Marks for Correct Answer	Negative Marks	Physics	Chemistry	Biology
4	1	50	50	50

## Physics

1. A candle C sits between two parallel mirrors at a distance  $0.2d$  from mirror. Here  $d$  denotes the distance between the mirrors. Multiple images of the candle appear in both mirrors. How far behind mirror 1 are the nearest three images of the candle in that mirror?

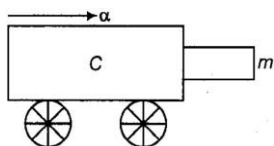
- (a)  $0.2d, 1.8d, 2.2d$
- (b)  $0.2d, 2.2d, 4.2d$
- (c)  $0.2d, 1.8d, 3.8d$
- (d)  $0.2d, 0.8d, 1.4d$

Correct: a

2. Choose the most appropriate option.

A block of mass  $m$  is in contact with the cart C as shown in the figure.

The coefficient of static friction between the block and the cart is  $\mu$ . The acceleration  $a$  of the cart that will prevent the block from falling satisfies.



- (a)  $a > \frac{mg}{\mu}$
- (b)  $a > \frac{g}{2\mu}$
- (c)  $a \geq \frac{g}{\mu}$
- (d)  $a < \frac{g}{\mu}$

Correct: c

3. Choose the most appropriate option.

If the escape speed of a projectile on Earth's surface is  $11.2 \text{ km s}^{-1}$  and a body is projected out with thrice this speed, then determine the speed of the body far away from the Earth.

- (a)  $56.63 \text{ km s}^{-1}$
- (b)  $33 \text{ km s}^{-1}$
- (c)  $39 \text{ km s}^{-1}$
- (d)  $31.7 \text{ km s}^{-1}$

Correct: d

4. Choose the most appropriate option.

Consider the analogy between an oscillating spring-body system and an oscillating L-C-R circuit. Then, the correspondence between the two systems that is NOT correct is

- (a) charge  $q$  corresponds to displacement  $x$  of the body
- (b) inductance  $L$  corresponds to mass  $m$  of the body
- (c) capacitance  $C$  corresponds to spring constant  $k$
- (d) magnetic energy corresponds to kinetic energy of the body

Correct: c

5. Choose the most appropriate option.

A tank is filled with a liquid upto a height  $H$ . A small hole is made at the bottom of this tank. Consider  $t_1$  be the time taken to empty first half of the tank and  $t_2$  be the time taken to empty rest half of the tank. Then, determine the ratio  $\frac{t_1}{t_2}$ .

- (a) 1.33
- (b) 1.5
- (c) 2
- (d) 0.414

Correct: d

6. In a cinema, a picture 2.5 cm wide on the film is projected to an image 3.0 m wide on a screen that is 18 m away. The focal length of the lens is about

- (a) 7.5 cm
- (b) 10 cm
- (c) 12.5 cm
- (d) 15 cm

Correct: d

7. Choose the most appropriate option.

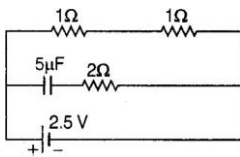
The coefficient of volume expansion of glycerine is  $49 \times 10^{-5} \text{K}^{-1}$ . What is the fractional change in its density for a  $30^\circ\text{C}$  rise in temperature?

- (a)  $1.5 \times 10^{-2}$
- (b)  $2 \times 10^{-4}$
- (c)  $3.5 \times 10^{-3}$
- (d)  $2.5 \times 10^{-2}$

Correct: a

8. Choose the most appropriate option.

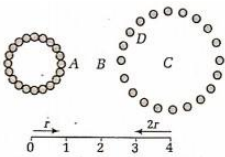
A capacitor of capacitance  $5 \mu\text{F}$  is connected as shown in the figure. The internal resistance of the cell is  $0.5 \Omega$ . The amount of charge on the capacitor plate is



- (a) Zero
- (b)  $5 \mu\text{C}$
- (c)  $10 \mu\text{C}$
- (d)  $25 \mu\text{C}$

Correct: c

9. Use the diagram below to answer the following questions. 40 spheres of equal mass make two rings of 20 spheres each. The ring on the right has a radius twice as large as the ring on the left.



At what position could a mass be placed so that the gravitational force that it would experience would be the same from both rings?

- (a) A
- (b) B
- (c) C
- (d) D

Correct: b

10. Choose the most appropriate option.

If pressure of  $\text{CO}_2$  (real gas) in a container is given by  $P = \frac{RT}{2v-b} - \frac{a}{4b^2}$ , then mass of the gas in the container is

- (a) 11 g
- (b) 22 g
- (c) 33 g
- (d) 44 g

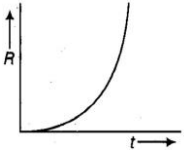
Correct: b

11. Two litres of water kept in a container at  $27^\circ\text{C}$  is heated with a coil of  $1\text{ kW}$ . The lid of the container is open and energy dissipates at the rate of  $160\text{ J/s}$ . If the specific heat of water is  $4.2\text{ kJ/kg}$ , then time taken by coil to raise the temperature of water from  $27^\circ\text{C}$  to  $77^\circ\text{C}$  is
- 840 S
  - 500 S
  - 420 S
  - 372

Correct: b

12. Choose the most appropriate option.

The resistance  $R$  of a conductor varies with temperature  $t$  as shown in figure. If the variation is represented by  $R_t = R_0(1 + \alpha t + \beta t^2)$ .



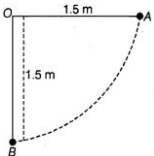
Then,

- $\alpha$  and  $\beta$  both negative
- $\alpha$  is positive and  $\beta$  is negative
- $\alpha$  and  $\beta$  both are positive
- $\alpha$  is negative and  $\beta$  is negative

Correct: c

13. Choose the most appropriate option.

The bob of a pendulum is released from a horizontal position A as shown in the figure. If the length of the pendulum is  $1.5\text{ m}$ , what is the speed with which the bob arrives at the lower most point B, given that it dissipated 5% of its initial energy against air resistance?



- 5 m/s
- 5.5 m/s
- 5.3 m/s
- 4.4 m/s

Correct: c

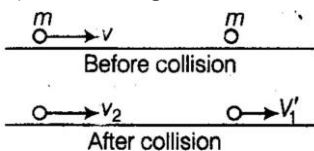
14. A ring of radius  $R$  is first rotated with an angular velocity  $\omega$ , and then carefully placed on a rough horizontal surface. The coefficient of friction between the surface and the ring is  $\mu$ . Time after which its angular speed is reduces to half is

- $\frac{2\omega_0 R}{\mu g}$
- $\frac{\omega_0 R}{2\mu g}$
- $\frac{\omega_0 \mu R}{\omega_0 \mu R}$
- $\frac{\omega_0 g}{2\mu R}$

Correct: b

15. Choose the most appropriate option.

A ball of mass  $m$  moving at a speed  $v$  makes a head on collision with an identical ball at rest. The kinetic energy at the balls after the collision is  $3/4$ th of the original. What is the coefficient of restitution?



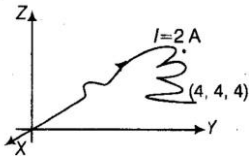
- $1/\sqrt{3}$
- $1/\sqrt{2}$
- $\sqrt{2}$
- $\sqrt{3}$

Correct: b

16. Choose the most appropriate option.

A wire of arbitrary shape carries a current  $I = 2\text{A}$ . Consider the portion of wire between  $(0,0,0)$  and  $(4, 4, 4)$ . A magnetic field given by

$\vec{B} = (1.2 \times 10^{-4}\hat{i} + 2 \times 10^{-4}\hat{j})$  exists in the region. The force acting on the given portion of the wire is



- (a)  $x = 10.25 \sin(\omega t + \phi)$
- (b)  $x = 10.25 \sin(\omega t - \phi)$
- (c)  $x = 11.25 \sin(\omega t + \phi)$
- (d)  $x = 11.25 \sin(\omega t - \phi)$

Correct: b

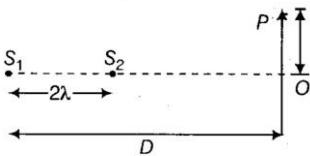
17. The power of the combination of two lenses made by keeping the convex lens of focal length 40 cm in contact with the concave lens of focal length 25 cm, is

- (a) - 1.5D
- (b) - 6.5D
- (c) + 6.5 D
- (d) + 6.67 D

Correct: a

18. Choose the most appropriate option.

Two coherent point sources  $S_1$  and  $S_2$  vibrating in phase emit light of wavelength  $\lambda$ . The separation between them is  $2\lambda$ . The light is collected on a screen placed at a distance  $D \gg \lambda$  from the slit  $S_1$  as shown. The minimum distance, so that intensity at P is equal to intensity at O.



- (a)  $\sqrt{2}D$
- (b)  $\sqrt{3}D$
- (c)  $\sqrt{8}D$
- (d)  $\sqrt{5}D$

Correct: b

19. Choose the most appropriate option.

What will be the displacement equation of the simple harmonic motion obtained by combining the motions?

$$x_1 = 2 \sin \omega t, x_2 = 4 \sin \left( \omega t + \frac{\pi}{6} \right)$$

$$x_3 = 6 \sin \left( \omega t + \frac{\pi}{3} \right)$$

- (a)  $x = 10.25 \sin(\omega t + \phi)$
- (b)  $x = 10.25 \sin(\omega t - \phi)$
- (c)  $x = 11.25 \sin(\omega t + \phi)$
- (d)  $x = 11.25 \sin(\omega t - \phi)$

Correct: c

20. A man holds a rectangular card in front of and parallel to a plane mirror. In order for him to see the entire image of the card, the least mirror area needed is

- (a) that of the whole mirror, regardless of its size
- (b) that of the pupil of his eye
- (c) one-half that of the card
- (d) one-fourth that of the card

Correct: d

21. Choose the most appropriate option.

A stream of water flowing horizontally with the speed of  $15 \text{ ms}^{-2}$  gushes out of a tube of cross-sectional area  $10^{-2} \text{ m}^2$  and hits a vertical wall nearby. What is the force exerted on the wall by the impact of water? Assuming it does not rebound.

- (a) 2250 N
- (b) 2000 N
- (c) 1500 N
- (d) 1000 N

Correct: a

22. Choose the most appropriate option.

The North pole of the earth's magnetic field is at the geographical South pole. A compass is a small magnet whose North pole end is drawn in the approximate direction of

- (a) the geographical South pole along the lines of the magnetic field
- (b) the geographical North pole along the lines of the magnetic field
- (c) the geographical South pole against the lines of the magnetic field
- (d) the geographical North pole against the lines of the magnetic field

Correct: b

23. Choose the most appropriate option.

A shell of mass 0.020 kg is fired by a gun of mass 100 kg. If the muzzle speed of the shell is  $80 \text{ ms}^{-1}$ . What is the recoil speed of the gun?

- (a)  $1.6 \text{ cms}^{-1}$
- (b)  $0.5 \text{ cms}^{-1}$
- (c)  $2 \text{ cms}^{-1}$
- (d)  $3 \text{ cms}^{-1}$

Correct: a

24. Choose the most appropriate option.

An electron of a stationary hydrogen atom passes from the fifth energy level to the ground level. The velocity that the atom acquired as a result of photon emission will be

- (a)  $\frac{24hR}{25m}$
- (b)  $\frac{25hR}{24m}$
- (c)  $\frac{24m}{25hR}$
- (d)  $\frac{25m}{24hR}$

Correct: a

25. Choose the most appropriate option.

If torques of equal magnitudes are applied to a hollow cylinder and a solid sphere both having the same mass and radius. The cylinder is free to rotate about its standard axis of symmetry and the sphere is free to rotate about an axis passing through its centre. Which of the two will acquire a greater angular speed after a given time?

- (a)  $\omega_1 > \omega_2$
- (b)  $\omega_1 = \omega_2$
- (c)  $\omega_2 > \omega_1$
- (d) None of these

Correct: c

26. Choose the most appropriate option.

Which of the following factors by itself will increase the frequency at which an observer hears a sound emanating from a source?

- (a) A wind blows from the source to the observer
- (b) The source and the observer move away from each other at the same speed
- (c) The source and the observer move in the same direction at the same speed
- (d) The source moves away from the observer more slowly than the observer moves toward the source

Correct: d

27. Choose the most appropriate option.

If two simple pendulums first of bob mass  $M_1$  and length  $l_1$ , second of bob mass  $M_2$  and  $l_2$ . Given  $M_1 = M_2$  and  $l_1 = 2l_2$ . If the vibrational energies of both are same, then which of the following is correct?

- (a) Amplitude of  $B$  is smaller than  $A$
- (b) Amplitude of  $B$  is greater than  $A$
- (c) Amplitude will be same
- (d) None of the above

Correct: a

28. Choose the most appropriate option.

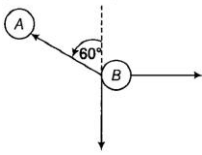
If 10% of a radioactive substance decays in every 5 yr, then the percentage of the substance that will have decayed in 20 yrs, will be

- (a) 40%
- (b) 50%
- (c) 65.6%
- (d) 34.4%

Correct: d

29. Choose the most appropriate option.

Ball A moving at 12 m/s collides elastically with ball B, initially at rest as shown. If both balls have the same mass, then what is the final velocity of ball A?



(Given,  $\sin 60^\circ = 0.87$ ;  $\cos 60^\circ = 0.5$ )

- (a) 3 m/s
- (b) 6 m/s
- (c) 9 m/s
- (d) 12 m/s

Correct: b

30. Choose the most appropriate option.

A stretched string of length 1 m fixed at both ends, when vibrated in one loop has a frequency 200 Hz. It is now plucked at a point situated at 25 cm from one end. The stretched string would vibrate with a frequency of

- (a) 100 Hz
- (b) 200 Hz
- (c) 400 Hz
- (d) 800 Hz

Correct: c

31. Choose the most appropriate option.

a and b are at an angle of  $60^\circ$  with each other. Their resultant makes an angle of  $45^\circ$  with a. If  $b = 2$  units, then a is

- (a)  $\sqrt{3}$
- (b)  $\sqrt{3} + 1$
- (c)  $\sqrt{2}$
- (d)  $\sqrt{3} - 1$

Correct: d

32. Choose the most appropriate option.

A beam of light ( $\lambda = 600$  nm) from a distant source, falls on a single slit 1 mm wide and the resulting diffraction pattern is observed on a screen 2 m away. The distance between the first dark fringes on either side of the central bright fringe is

- (a) 1.2 cm
- (b) 1.2 mm
- (c) 2.4 cm
- (d) 2.4 mm

Correct: d

33. Choose the most appropriate option.

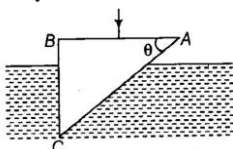
A liquid is poured into a vessel at rest with the hole in a wall closed by a valve. It is filled to height H. The distance of hole from the top surface is h. What is the horizontal acceleration required to move the vessel so that the liquid does not come out when the valve is opened (given,  $l =$  length of the base)?

- (a)  $2gh$
- (b)  $g$
- (c)  $l/gH$
- (d)  $2gh/l$

Correct: d

34. Choose the most appropriate option.

A glass prism ABC (refractive index 1.5), immersed in water (refractive index  $4/3$ ). A ray of light is incidentally normally on face AB. If it is totally reflected at face AC, then



- (a) 40%

- (b) 50%
- (c) 65.6%
- (d) 34.4%

Correct: a

35. Choose the most appropriate option.

Two trains A and B of length 400 m each are moving on two parallel tracks with a uniform speed of  $72 \text{ kmh}^{-1}$  in the same direction, with A head of speed B. The driver of B decides to overtake A and accelerates by  $1 \text{ m/s}^2$ . If after 50s, the guard of B just brushes past the driver of A, what was the original distance between them?

- (a) 100 m
- (b) 1150 m
- (c) 1300 m
- (d) 1250 m

Correct: d

36. Choose the most appropriate option.

An ideal gas is taken through a cyclic thermodynamical process through four steps. The amounts of heat involved in these steps are  $Q_1 = 5960 \text{ J}$ ,  $Q_2 = -5585 \text{ J}$ ,  $Q_3 = -2980 \text{ J}$  and  $Q_4 = 3645 \text{ J}$ , respectively. The value of  $W_4$  is

- (a) 1315 J
- (b) 275 J
- (c) 765 J
- (d) 675 J

Correct: c

37. Choose the most appropriate option.

A rocket is fired from the Earth towards the Sun. At what distance from the Earth's centre, the gravitational force on the rocket is zero? Mass of the Sun =  $2 \times 10^{30} \text{ kg}$  and mass of the Earth =  $6 \times 10^{24} \text{ kg}$ .

- (a)  $2.6 \times 10^8 \text{ m}$
- (b)  $3.2 \times 10^8 \text{ m}$
- (c)  $3.9 \times 10^9 \text{ m}$
- (d)  $2.3 \times 10^9 \text{ m}$

Correct: a

38. A block of mass  $m$  slides down with uniform speed on an inclined plane having inclination  $\theta$ . If the coefficient of friction between the inclined plane and the block is  $\mu$ , then the contact force between them is

- (a)  $mg \sin \theta$
- (b)  $mg$
- (c)  $\sqrt{(mg \sin \theta)^2 + (\mu mg \cos \theta)^2}$
- (d)  $mg \cos \theta \sqrt{1 + \mu^2}$

Correct: d

39. Choose the most appropriate option.

A solid cylinder of mass 20 kg rotates about its axis with angular speed  $100 \text{ rad s}^{-1}$ . The radius of the cylinder is 0.25 m. What is the kinetic energy associated with the rotation of cylinder? What is the magnitude of angular momentum of cylinder about its axis?

- (a) 62.5 T-s
- (b) 70.4 T-s
- (c) 79.6 T-s
- (d) 60.5 T-s

Correct: a

40. A body of density  $D$ , and mass  $M$  is moving downward in glycerine of density  $D_2$ . What is the viscous force acting on it?

- (a)  $MgD_1$
- (b)  $MgD_2$
- (c)  $Mg \left(1 - \frac{D_2}{D_1}\right)$
- (d)  $Mg \left(1 - \frac{D_1}{D_2}\right)$

Correct: c

41. Choose the most appropriate option.

A stone of mass 0.25 kg tied to the end of a string is whirled round in a circle of radius 1.5 m with speed 40 rev/min in a horizontal plane. What is the tension in the string and what is the maximum speed with which the stone can be whirled around, if the string can withstand a maximum tension of 200 N?

- (a)  $6.6\text{N}, 35\text{ms}^{-1}$
- (b)  $6\text{N}, 37\text{ms}^{-1}$
- (c)  $7.5\text{N}, 46\text{ms}^{-1}$
- (d)  $8\text{N}, 38\text{ms}^{-1}$

Correct: a

42. Choose the most appropriate option.

If  $N_0$  be the number of nuclei present at time  $t = 0$ . Then, the number of undecayed nuclei,  $N$  present after  $n$  mean life

- (a)  $N = \left(\frac{1}{2}\right)^n N_0$
- (b)  $N = \left(\frac{1}{2}\right)^{1/n} N_0$
- (c)  $N = \left(\frac{1}{4}\right)^n N_0$
- (d)  $N = \left(\frac{1}{4}\right)^{1/n} N_0$

Correct: a

43. Choose the most appropriate option.

A U-shaped wire is dipped in a soap solution and removed. The thin soap film formed between the wire and light slider supports a weight of  $1.5 \times 10^2$  N. The length of the slider is 30 cm. What is the surface tension of the film?

- (a)  $3 \times 10^{-3}\text{Nm}^{-1}$
- (b)  $2 \times 10^{-5}\text{Nm}^{-1}$
- (c)  $4 \times 10^{-4}\text{Nm}^{-1}$
- (d)  $2.5 \times 10^{-2}\text{Nm}^{-1}$

Correct: d

44. Choose the most appropriate option.

An object stands 4 cm in front of a converging lens. If the lens has a focal distance of 1 cm, where is the image formed?

- (a) 0.75 cm in front of the lens
- (b) 0.75 cm behind the lens
- (c) 1 cm behind the lens
- (d) 1.33 cm behind the lens

Correct: d

45. Choose the most appropriate option.

The length of a magnet is large compared to its width and breadth. The time period of its oscillation in vibration magnetometer is 2 s. The magnet is cut along its length into three equal parts and three parts are then placed on each other with their like poles together. The time period of this combination will be

- (a)  $\frac{2}{3}\text{s}$
- (b)  $\sqrt{\frac{2}{3}}\text{s}$
- (c)  $\frac{3}{2}\text{s}$
- (d)  $\sqrt{\frac{3}{2}}\text{s}$

Correct: a

46. Choose the most appropriate option.

The image seen in a flat bathroom mirror is a

- (a) real image that appears behind the mirror
- (b) real image that appears in front of the mirror
- (c) virtual image that appears behind the mirror
- (d) virtual image that appears in front of the mirror

Correct: c

47. Choose the most appropriate option.

If electrical force between two charges is 200 N and we increase 10% charge on one of the charges and decrease 10% charge on the other, then electrical force between them for the same distance becomes

- (a) 200 N
- (b) 202 N
- (c) 198 N
- (d) 19 N



Correct: c

48. Choose the most appropriate option.

Electrons are accelerated through a potential difference  $V_0$  and protons are accelerated through a potential difference of 4 V. The de-Broglie wavelengths are  $\lambda_e$  and  $\lambda_p$  for electrons and protons, respectively. The ratio of  $\frac{\lambda_e}{\lambda_p}$  is given by (given,  $m_e$  is mass of electrons and  $m_p$  is mass

- of proton)
- (a)  $\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_p}{m_e}}$
- (b)  $\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_e}{m}}$
- (c)  $\frac{\lambda_e}{\lambda_p} = \frac{1}{2} \sqrt{\frac{m_e}{m_p}}$
- (d)  $\frac{\lambda_e}{\lambda_p} = 2 \sqrt{\frac{m_p}{m_e}}$

Correct: d

49. Choose the most appropriate option.

In hydrogen atom spectrum, frequency of  $2.7 \times 10^{15}$  Hz of EM wave is emitted when transition takes place from 2 to 1. If it moves from 3 to 1, the frequency emitted will be

- (a)  $3.2 \times 10^{15}$  Hz
- (b)  $32 \times 10^{15}$  Hz
- (c)  $1.6 \times 10^{15}$  Hz
- (d)  $16 \times 10^{15}$  Hz

Correct: a

50. Given

- I. Plane mirrors  
II. Concave mirrors  
III. Convex mirrors

Given the preceding choices, virtual images can be formed by

- (a) I, II and III
- (b) I and II
- (c) I and III
- (d) II only

Correct: c

## Chemistry

51. Choose the most appropriate option.

Consider the following reaction sequence of alkene.



- (a)  $\text{CH}_3\text{CH}_2\text{COCH}_3$
- (b)  $\text{CH}_3\text{COCH}_2$
- (c)  $\text{CH}_3\text{CHO}$
- (d)  $\text{CH}_3\text{CH}_2\text{CHO}$

Correct: c

52. Choose the most appropriate option.

Which of the following transition of an electron in H-atom will emit maximum energy?

- (a)  $n_6 \rightarrow n_5$
- (b)  $n_1 \rightarrow n_2$
- (c)  $n_3 \rightarrow n_2$
- (d)  $n_4 \rightarrow n_3$

Correct: c

53. Which of the following compounds produces the most heat per mole of compound when reacted with oxygen?

- (a)  $\text{CH}_4$
- (b)  $\text{C}_2\text{H}_6$
- (c) Cyclohexane
- (d) Cycloheptane

Correct: d

54. Choose the most appropriate option.

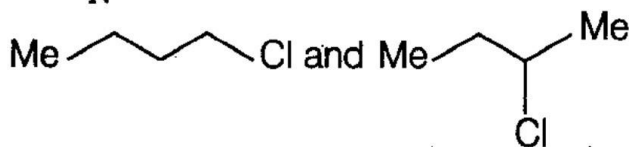
The correct set of quantum numbers for an element ( $Z=17$ ) for the unpaired electron will be

- (a) 3, 1, 1, 1/2
- (b) 2, 0, 0, 1/2
- (c) 3, 0, 0, 1/2
- (d) 2, 1, 1, 0

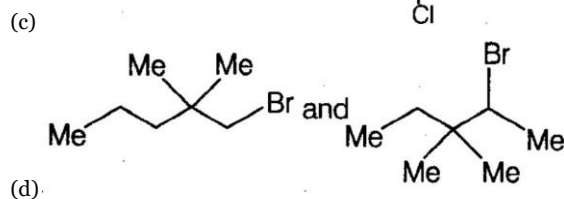
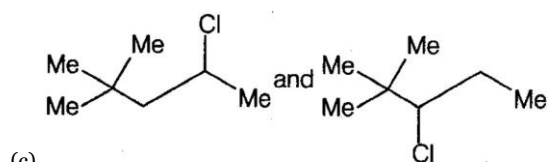
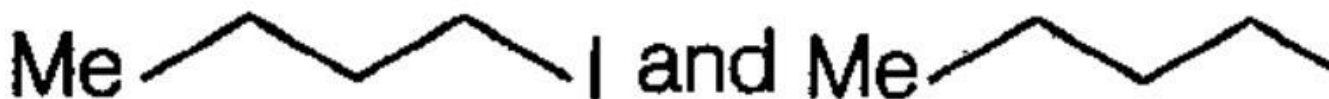
Correct: a

55. Choose the most appropriate option.

From the following which pairs give the faster  $S_N2$  reaction?



- (a)
- (b)



Correct: a

56. The combustion of carbon monoxide yields carbon dioxide. The volume of oxygen gas needed to produce 22 g of carbon dioxide at STP is

- (a) 4.0L
- (b) 5.6 L
- (c) 11 L
- (d) 22 L

Correct: b

57. Choose the most appropriate options.

What is the bond angle between Cl-O-Cl in  $Cl_2O_7$ ?

- (a) 109.
- (b) 119°
- (c) 108°25
- (d) 120°

Correct: b

58. Choose the most appropriate option.

A metal rod is in thermal contact with the two heat reservoirs both at constant temperature one at 100K and the other at 200K . The rod conducts 1000 J of heat from the warmer to the colder reservoir .If no energy is exchanged with the surrounding what is the total change of entropy?

- (a)  $-5J/K$
- (b)  $0J/K$
- (c)  $5J/K$
- (d)  $10J/K$

Correct: d

59. Choose the most appropriate options.

Which of the following relation is correct for gaseous and reversible reactions?

- (a)  $\frac{K_c}{K_p} = (RT)^{\Delta n_g}$   
 (b)  $\frac{K_p}{K_c} = (p)^{\Delta n_g}$   
 (c)  $\frac{K_c}{K_x} = (p)^{-\Delta n_g}$   
 (d)  $\frac{K_c}{K} = \left(\frac{p}{RT}\right)^{\Delta n_g}$

Correct: b

60. Choose the most appropriate option.  
 What is the conjugate base of  $\text{H}_2\text{SO}_4$ ?

- (a)  $\text{H}_2\text{O}$   
 (b)  $\text{OH}^-$   
 (c)  $\text{HSO}_4^-$   
 (d)  $\text{SO}_4^{2-}$

Correct: c

61. Choose the most appropriate options.

If the dipole moment of HBr is  $2.60 \times 10^{-30} \text{Cm}$  and the interatomic spacing is  $1.41 \text{ \AA}$ , then the percent ionic character of HBr is

- (a) 16.23%  
 (b) 13.21%  
 (c) 11.50%  
 (d) 15.81%

Correct: c

62. Choose the most appropriate options.

In the redox reaction  
 $\text{MnO}_4^- + \text{C}_2\text{O}_4^{2-} + \text{H}^+ \rightarrow \text{Mn}^{2+} + \text{CO}_2 + \text{H}_2\text{O}$

The correct coefficients of  $\text{C}_2\text{O}_4^{2-}$  and  $\text{H}^+$

Correct: b

63. Choose the most appropriate option.

In a sodium-sulphur battery, what is the half reaction for sodium in the spontaneous direction?

- (a)  $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$   
 (b)  $\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$   
 (c)  $\text{Na} \rightarrow \text{Na}^{2+} + 2\text{e}^-$   
 (d)  $\text{Na}^+ + \text{OH}^- \rightarrow \text{NaOH}$

Correct: b

64. Choose the most appropriate options.

Which of the following is not a true statements about ozone?

- (a) Both the O---O bonds in  $\text{O}_3$  are of equal length.  
 (b) Bond order lie in between 1 and 2.  
 (c) o----o----o bond angle in  $\text{O}_3$  is approximately  
 (d) Ozone react with acidified  $\text{KCr}_2\text{O}_7$  and oxidise it.

Correct: d

65. Benzene and toluene combine to form an ideal solution. At  $80^\circ\text{C}$ , vapour pressure of pure benzene is 800 mmHg and the vapour pressure of pure toluene is 300 mmHg. If the vapour pressure of the solution is 400 mmHg, what are the mole fractions of benzene and toluene?

- (a) 60% benzene and 40% toluene  
 (b) 50% benzene and 50% toluene  
 (c) 40% benzene and 60% toluene  
 (d) 20% benzene and 80% toluene

Correct: d

66. Choose the most appropriate options.

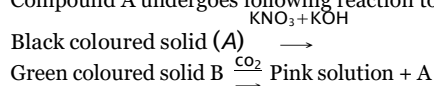
Which of the following statement about halogens are correct?

- (a) HF is the strongest hydrohallic acid  
 (b)  $\text{F}_2$  is the strongest reducing agent among all type of halogen.  
 (c) The order of -ve electron gain enthalpy for halogens is  $\text{F} > \text{Cl} > \text{Br} > \text{I}$   
 (d)  $\text{F}_2$  has lower bond dissociation energy than  $\text{Cl}_2$

Correct: d

67. Choose the most appropriate options.

Compound A undergoes following reaction to form B and C



(C) decolorised by  $\text{Fe}^{+}$

Identify A,B and C respectively

- (a)  $\text{MnO}_2$ ,  $\text{KMnO}_4$  and  $\text{K}_2\text{MnO}_4$
- (b)  $\text{MnO}_2$ ,  $\text{K}_2\text{MnO}_4$  and  $\text{KMnO}_4$
- (c)  $\text{KMnO}_4$ ,  $\text{MnO}_2$  and  $\text{K}_2\text{MnO}_4$
- (d)  $\text{KMnO}_4$ ,  $\text{K}_2\text{MnO}_4$  and  $\text{MnO}_2$

Correct: b

68. Choose the most appropriate options.

Terylene is a condensation polymer of ethylene glycol and

- (a) benzoic acid
- (b) phthalic acid
- (c) salicylic acid
- (d) terephthalic acid

Correct: d

69. Choose the most appropriate option.

When a sample of aluminium of unknown mass was subjected to 1.8 kJ of heat, the temperature of the aluminium sample increased from  $26^\circ\text{C}$  to  $31^\circ\text{C}$ . What was the mass of the sample?

(specific heat of Al =  $0.90\text{J/g}^\circ\text{C}$ ).

- (a) 200 g
- (b) 400 g
- (c) 600 g
- (d) 800 g

Correct: b

70. Choose the most appropriate options.

When 'Z' grams of calcium carbonate completely burnt in air gives 28g of a solid compound. The mass of calcium carbonate halogens is correct?

used will be

- (a) 200g
- (b) 100g
- (c) 56 g
- (d) 50 g

Correct: d

71. Choose the most appropriate options.

The correct increasing order of solubility of sulphates in water

- (a)  $\text{BeSO}_4 > \text{MgSO}_4 > \text{CaSO}_4 > \text{SrSO}_4 > \text{BaSO}_4$
- (b)  $\text{BaSO}_4 > \text{SrSO}_4 > \text{CaSO}_4 > \text{MgSO}_4 > \text{BeSO}_4$
- (c)  $\text{H}_2\text{SO}_3$ ,  $\text{NO}_2$  and  $\text{SO}_2$
- (d)  $\text{SO}_2$ ,  $\text{NO}_2$  and  $\text{H}_2\text{O}$

Correct: a

72. Choose the most appropriate options.

Sulphur(s) when react with  $\text{HNO}_3$  ( conc )Green mainly gives

- (a)  $\text{H}_2\text{SO}_4$ ,  $\text{NO}_2$  and  $\text{H}_2\text{O}$
- (b)  $\text{H}_2\text{S}$ ,  $\text{N}_2\text{O}_5$  and  $\text{SO}_2$
- (c)  $\text{H}_2\text{SO}_3$ ,  $\text{NO}_2$  and  $\text{SO}_2$
- (d)  $\text{SO}_2$ ,  $\text{NO}_2$  and  $\text{H}_2\text{O}$

Correct: a

73. 100 g of  $\text{O}_2$ gand 100 g of He(g) are in separate containers of equal volume. Both gases are at  $100^\circ\text{C}$ . Which one of the following statements is true?

- (a) Both gases would have the same pressure
- (b) The average kinetic energy of the  $\text{O}_2$  molecules is greater than that of the He molecules
- (c) There are equal numbers of He molecules and  $\text{O}_2$  molecules

(d) The pressure of the He (g) would be greater than that of the O<sub>2</sub>(g)

Correct: d

74. Choose the most appropriate options.

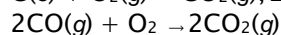
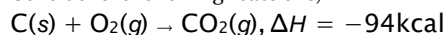
NH<sub>3</sub> molecule attract H<sup>+</sup> ion towards itself to form ammonium ion (NH<sub>4</sub><sup>+</sup>) through

- (a) electrovalent bond
- (b) metallic bond
- (c) co-ordinate bond
- (d) hydrogen bonding.

Correct: c

75. Choose the most appropriate options.

Consider the following reactions,



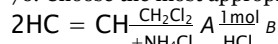
$$\Delta H = -135.2\text{kcal}$$

Then, the heat of formation of CO (g) is ∴ CI

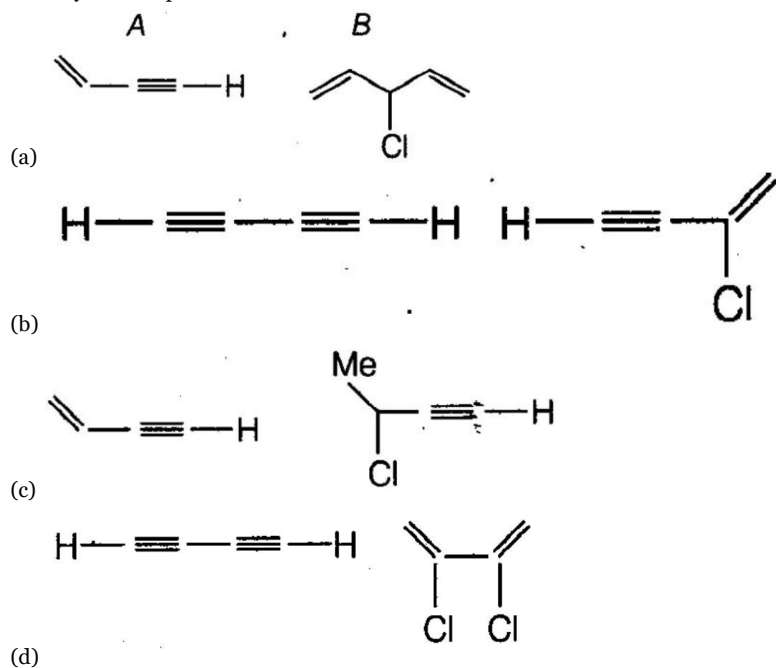
- (a) 26.4kcal
- (b) -26.4kcal
- (c) 41.2kcal
- (d) -41.2kcal

Correct: b

76. Choose the most appropriate options.



Identify the compounds A and B



Correct: a

77. Choose the most appropriate options.

Which one of the following is the correct statement?

- (a) B<sub>3</sub>N<sub>3</sub>H<sub>6</sub> is known as inorganic benzene
- (b) Chlorides of both beryllium and aluminium have bridged chloride structure in gas phase
- (c) Boric acid is a protonic acid
- (d) Beryllium exhibits coordination number of six

Correct: a

78. Choose the most appropriate options.

A work is done on the system such that one mole of an ideal gas at 400K is compressed isothermally and reversibly to 1/10th of its original volume. The amount of (use R=2 in cal) work done will be

- (a) 2.303 k-cal
- (b) 0.184 k-cal

- (c) 1.84 k-cal  
(d) 4.60 k-cal

Correct: c

79. Choose the most appropriate option.

The atomic radius of Ne is

- (a) greater than Ar  
(b) less than Ar  
(c) same as Ar  
(d) cannot be determined

Correct: a

80. Choose the most appropriate options.

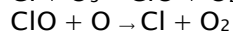
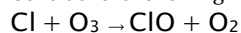
The process involves smelting is

- (a)  $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O} \xrightarrow{\Delta} \text{Al}_2\text{O}_3 + 2\text{H}_2\text{O}$   
(b)  $2\text{PbS} + 3\text{O}_2 \xrightarrow{\Delta} 2\text{PbO} + \text{SO}_2$   
(c)  $2\text{ZnO} + \text{O}_3 \xrightarrow{\Delta} 2\text{ZnO} + \text{CO}_2$   
(d)  $\text{Fe}_2\text{O}_3 + 3\text{C} \xrightarrow{\Delta} 2\text{Fe} + 3\text{CO}$

Correct: d

81. Choose the most appropriate option.

Consider the following mechanism,



In this mechanism, what is the catalyst ?

- (a) Cl  
(b) O<sub>3</sub>  
(c) ClO  
(d) O<sub>2</sub>

Correct: a

82. Choose the most appropriate options.

Which of the following is used as a food preservative?

- (a) Sodium benzoate  
(b) Potassium chloride  
(c) Sodium bicarbonate  
(d) b and c both

Correct: a

83. Choose the most appropriate option.

Silica is a network solid of silicon and oxygen atoms. The empirical formula for silica is SiO<sub>2</sub>. In silica, to how many oxygen atoms is each silicon bonded ?

- (a) 1  
(b) 2  
(c) 3  
(d) 4

Correct: d

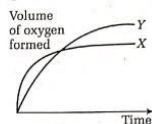
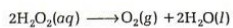
84. Choose the most appropriate options.

Bakelite is obtained by reaction of phenol with

- (a) acetaldehyde  
(b) acetal  
(c) formaldehyde  
(d) chlorobenzene

Correct: c

85. Curve X on the graph below shows the volume of oxygen formed during the catalytic decomposition of a 1.0 mol dm<sup>-3</sup> solution of hydrogen peroxide.



Which change would produce the curve Y?

- (a) Adding water
- (b) Adding some  $0.1 \text{ mol dm}^{-3}$  hydrogen peroxide solution
- (c) Using a different catalyst
- (d) Lowering the temperature

Correct: b

86. Choose the most appropriate options.  
Rate of dehydration of alcohols follows the order

- (a)  $2^\circ > 1^\circ < \text{CH}_3\text{OH} > 3^\circ$
- (b)  $3^\circ > 2^\circ > 1^\circ > \text{CH}_3\text{OH}$
- (c)  $2^\circ > 3^\circ > 1^\circ > \text{CH}_3\text{OH}$
- (d)  $\text{CH}_3\text{OH} > 1^\circ > 2^\circ > 3^\circ$

Correct: b

87. Choose the most appropriate option.  
As temperature is increased, the equilibrium of a gaseous reaction will always

- (a) shift to the right
- (b) shift to the left
- (c) remains constant
- (d) the answer cannot be determined from the given information

Correct: d

88. Choose the most appropriate options.  
The ozone layer forms naturally by

- (a) the interaction of CFC with oxygen.
- (b) the interaction of UV radiations with oxygen.
- (c) the interaction of IR radiations with oxygen
- (d) the interaction of water vapour and oxygen.

Correct: b

89. Choose the most appropriate options.  
Which of the following statement is applicable for tyndall effect ?

- (a) The diameter of the dispersed particle is much smaller than the wavelength of the light used
- (b) The diameter of the dispersed phase is much smaller than the wavelength of the light used
- (c) The refractive indices of the dispersed phase is much smaller than the wavelength of the light used
- (d) The refractive indices of the dispersed phase and the dispersion medium must differ greatly in

Correct: d

90. Choose the most appropriate option.  
A catalyst will change all of the following

- (a) enthalpy
- (b) activation energy
- (c) rate of the forward reaction
- (d) rate of the reverse reaction

Correct: a

91. Choose the most appropriate options.  
On reduction of glycolic acid with HI, the product formed is

- (a) acetic acid
- (b) iodo-acetic acid
- (c) formic acid
- (d) None of these

Correct: a

92. Choose the most appropriate options.  
The metallic sodium dissolved in liquid ammonia to form a deep blue colour solution. The deep blue colour is due to the fo

- (a) solvated electrons,  $e^-(NH_3)_x$
- (b) solvated atomic sodium  $Na(NH_3)_4$
- (c)  $(Na^+ + Na)$
- (d)  $(NaNH_2 + H_2)$

Correct: a

93. Which of the following statements is not correct?

- (a) At constant volume, the pressure of a certain amount of gas increases with increasing temperature
- (b) At constant temperature, the pressure of a certain amount of gas increases with increasing volume
- (c) At constant pressure, the volume of a certain amount of gas increases with increasing volume
- (d) In dealing with gas laws, the most convenient scale of temperature to use is the kelvin temperature scale

Correct: b

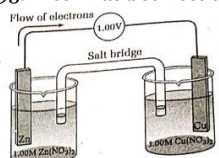
94. Choose the most appropriate options.

Which of the following flux is used to remove acidic impurities in metallurgical process?

- (a) Silica
- (b) Limestone
- (c) Sodium Chloride
- (d) HCl

Correct: b

95. A cell has been set up as shown in the following diagram and  $E^\circ$  has been measured as 1.00V at 25°C. Calculate  $\Delta G^\circ$  for the reaction.



- (a) -386 kJ
- (b) -193 kJ
- (c) 1.00 kJ
- (d) 193 kJ

Correct: b

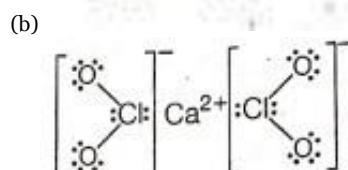
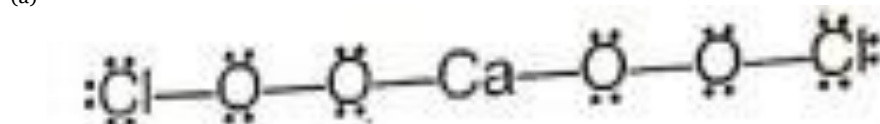
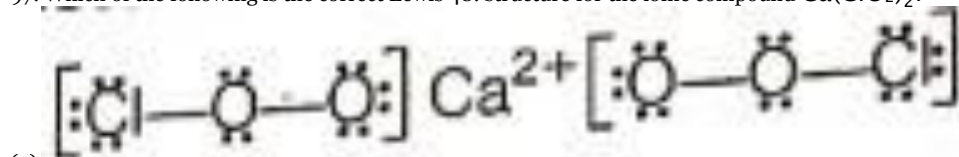
96. Choose the most appropriate options.

Select the incorrect statement

- (a) Physical adsorption is reversible, while chemical is irreversible.
- (b) High pressure favours physical adsorption while magnitude low pressure favours chemical adsorption.
- (c) Physical adsorption is not specific, while chemical adsorption is highly specific.
- (d) High activation energy is required in chemical Adsorption.

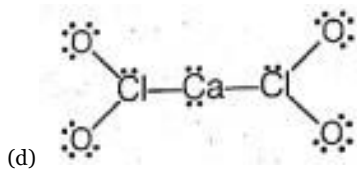
Correct: b

97. Which of the following is the correct Lewis structure for the ionic compound  $Ca(ClO_2)_2$ ?



(c)





Correct: c

98. Choose the most appropriate options.  
For the reactions  $C + O_2 \rightarrow CO_2; \Delta H = -393KJ$   
 $2Zn + O_2 \rightarrow 2ZnO, \Delta H = -412KJ$

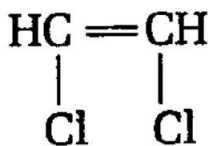
the correct statement is

- (a) carbon can oxidise Zinc
- (b) oxidation of carbon does not takes place
- (c) zinc oxidation is not possible
- (d) Zinc can oxidise carbon

Correct: a

99. Choose the most appropriate options.  
The decreasing order of reactivity towards electrophilic addition of the following is

- I.  $CH = CH$
- II.  $CH_2 = CH_2$
- III.  $H_2C = CH - Cl$



- IV.
- (a)  $I > II > III > IV$
- (b)  $II > I > III > IV$
- (c)  $IV > III > I > II$
- (d)  $IV > III > II > I$

Correct: b

100. Choose the most appropriate options.  
An aqueous solution of 2% (wt/wt) non volatile solute exerts a pressure of 1.004 bar at the boiling point of solvent. What is the remove acidic impurities in metallurgical molecular mass of the solute?

- (a) 0.3655
- (b) 36.55
- (c) 41.34
- (d) 40.16

Correct: c

## Mathematics

101. Consider line segments of lengths 1, 2, 3, ...,10, what is the number of triangles that can be formed from them?

- (a) 20
- (b) 30
- (c) 40
- (d) 50

Correct: d

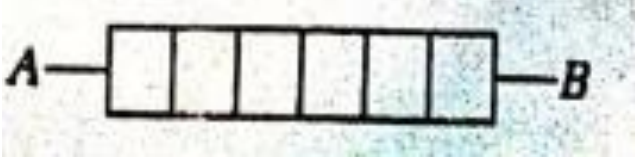
102. Choose the most appropriate options.

The value of  $\lim_{x \rightarrow 0} \frac{\int_0^x \sec^2 t dt}{x \sin x}$  is

- (a) 0
- (b) 3
- (c) 2
- (d) 1

Correct: d

103. How many paths are there from the point A to the point B in figure below, if no point in a path is to be traversed more than once



- (a)  $2^3$
- (b)  $2^6$
- (c)  ${}^{12}C_2$
- (d) 7

Correct: d

104. Choose the most appropriate options.

The number of real roots of  $(6 - x)^4 + (8 - x)^4 = 16$

- (a) 0
- (b) 2
- (c) 4
- (d) 6

Correct: d

105. 
$$\begin{vmatrix} a^2 & b^2 & c^2 \\ (a+1)^2 & (b+1)^2 & (c+1)^2 \\ (a-1)^2 & (b-1)^2 & (c-1)^2 \end{vmatrix}$$
 is equal to

- (a)  $-4(a-b)(b-c)(c-a)$
- (b)  $4(a-b)(b-c)(c-a)$
- (c)  $2(a-b)(b-c)(c-a)$
- (d) 0

Correct: a

106. Choose the most appropriate options.

The function  $f:[0,3] \rightarrow [1,29]$  defined by

$$f(x) = 2x^3 - 15x^2 + 36x + 1$$

- (a) one-one and onto
- (b) onto but not one one
- (c) one-one but not onto
- (d) neither one-one nor onto

Correct: b

107. Choose the most appropriate options.

For all  $n \in N$ ,  $7^{2^n} - 48n - 1$  is divisible by

- (a) 25
- (b) 26
- (c) 1234
- (d) 2304

Correct: d

108. 
$$\sum_{k=0}^5 ({}^5C_k)^2$$
 is equal to

- (a)  ${}^{25}C_5$
- (b)  ${}^{15}C_5$
- (c)  ${}^{10}C_5$
- (d) 1

Correct: c

109. Choose the most appropriate options.

If 
$$f(x) = \frac{1 - \sin x}{(\pi - 2x)^2} \cdot \frac{\log \sin x}{\log(1 + \pi^2 - 4\pi x + x^2)}$$
 
$$k, x = \frac{\pi}{2}$$

$x \neq \frac{\pi}{2}$

is continuous at  $x = \frac{\pi}{2}$  then k is equal to

- (a)  $-\frac{1}{16}$
- (b)  $-\frac{1}{32}$
- (c)  $-\frac{1}{64}$
- (d)  $-\frac{1}{28}$

Correct: c

110. The length of the axes of the conic

$$9x^2 + 4y^2 - 6x + 4y + 1 = 0$$

- (a)  $\frac{1}{2}, 9$
- (b)  $3, \frac{2}{5}$
- (c)  $1, \frac{2}{3}$
- (d)  $3, 2$

Correct: d

111. Choose the most appropriate options.

A differentiable function  $f(x)$  has a relative minimum at  $x=0$ , then the function  $y = f(x) + ax + b$  has a relative minimum at  $x=0$  for

- (a) all a and All b
- (b) all b, if  $a=0$
- (c) all  $b > 0$
- (d) all  $a > 0$

Correct: b

112. The maximum number of points into which 4 circles and 4 straight lines intersect, is

- (a) 26
- (b) 50
- (c) 56
- (d) 72

Correct: b

113. Choose the most appropriate options.

The solution of the differential equation  $(x^2 - yx^2) \frac{dy}{dx} + y^2 + xy^2 = 0$

is

- (a)  $\log\left(\frac{x}{y}\right) = \frac{1}{x} + \frac{1}{y} + C$
- (b)  $\log\left(\frac{y}{x}\right) = \frac{1}{x} + \frac{1}{y} + C$
- (c)  $\log(xy) = \frac{1}{x} + \frac{1}{y} + C$
- (d)  $\log(xy) + \frac{1}{x} + \frac{1}{y} = C$

Correct: a

114. Given that  $\alpha_1, \alpha_2, \alpha_3$  are the roots of  $3x^3 - x^2 - 10x + 8 = 0$  then the value of  $\alpha_1^2 + \alpha_2^2 + \alpha_3^2$

- (a) 9/61
- (b) 61/9
- (c) 16/9
- (d) 9/16

Correct: b

115. Choose the most appropriate options.

The area bounded by the curves  $y = \cos x$  and  $y = \sin x$  between the ordinates  $x=0$  and  $x = \frac{3\pi}{2}$  is

- (a)  $4\sqrt{2} - 1$
- (b)  $4\sqrt{2} + 1$
- (c)  $4\sqrt{2} - 2$
- (d)  $4\sqrt{2} + 2$

Correct: c

116. Choose the most appropriate option.

$\int_0^{\frac{\pi}{2}} \frac{\sqrt{\cos x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx$  is equal to

- (a) 1
- (b)  $\frac{\pi}{2}$
- (c)  $\frac{\pi}{4}$

(d)  $\frac{\pi}{3}$

Correct: c

117. Choose the most appropriate options.

The value of the integral  $\int_0^{0.9} [x - 2[x]] dx$  where  $[.]$  denotes the greatest integer function,

- (a) 0.9
- (b) 0
- (c) 1.8
- (d) -0.9

Correct: b

118. Choose the most appropriate option.

The value of  $\int_0^{\frac{\pi}{2}} \sin^7 \theta \cos^4 \theta d\theta$  is

- (a)  $\frac{16}{1155}$
- (b)  $\frac{16}{385}$
- (c)  $\frac{16\pi}{385}$
- (d)  $\frac{8\pi}{1155}$

Correct: a

119. Choose the most appropriate options.

The number of solutions of the equation  $3 \sin^2 x - 7 \sin x + 2 = 0$  in the interval  $[0, 5\pi]$  is

- (a) 0
- (b) 5
- (c) 6
- (d) 10

Correct: c

120. Choose the most appropriate option.

The inverse of matrix  $\begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix}$  is

- (a)  $\begin{bmatrix} 4 & 1 & -1 \\ 3 & -1 & 3 \\ 4 & -3 & -3 \end{bmatrix}$
- (b)  $\begin{bmatrix} 4 & -3 & 4 \\ 3 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$
- (c)  $\begin{bmatrix} 3 & -4 & 4 \\ 4 & 1 & -3 \\ 0 & 1 & 1 \end{bmatrix}$
- (d)  $\begin{bmatrix} -4 & 3 & 4 \\ 3 & -3 & 4 \end{bmatrix}$

Correct: b

121. Choose the most appropriate options.

If  $\mathbf{a} = \hat{i} + \hat{j}$ ,  $\mathbf{b} = 2\hat{j} - \hat{k}$  and  $\mathbf{r} \times \mathbf{a} = \mathbf{b} \times \mathbf{a}$ ,  $\mathbf{r} \times \mathbf{b} = \mathbf{a} \times \mathbf{b}$  then a unit vector in the direction of  $\mathbf{r}$  is

- (a)  $\frac{1}{\sqrt{11}} (\hat{i} + 3\hat{j} - \hat{k})$
- (b)  $\frac{1}{\sqrt{11}} (\hat{i} - 3\hat{j} + \hat{k})$
- (c)  $\frac{1}{\sqrt{3}} (\hat{i} + \hat{j} + \hat{k})$
- (d) None of these

Correct: a

122. Choose the most appropriate option.

The solution of the differential equation  $\frac{d^2y}{dx^2} + 3y = -2x$  is

- (a)  $c_1 \cos \sqrt{3}x + c_2 \sin \sqrt{3}x - \frac{2}{3}x$
- (b)  $c_1 \cos \sqrt{3}x + c_2 \sin \sqrt{3}x - \frac{4}{3}$

(c)  $c_1 \cos \sqrt{3}x + c_2 \sin \sqrt{3}x - 2x^2 + \frac{4}{9}$   
 (d)  $c_1 \cos \sqrt{3}x + c_2 \sin \sqrt{3}x - \frac{2}{3}x^2 + \frac{4}{9}$

Correct: a

123. Choose the most appropriate options.

From the bottom of a pole of height  $h$ , the angle of elevation of the top of a tower is  $\alpha$ . The pole subtends an angle  $\beta$  at the top of tower. The height of the tower is

- (a)  $\frac{h \sin \alpha \sin(\alpha - \beta)}{\sin \beta}$   
 (b)  $\frac{h \sin \alpha \cos(\alpha + \beta)}{\cos \beta}$   
 (c)  $\frac{h \sin \alpha \cos(\alpha - \beta)}{\sin \beta}$   
 (d)  $\frac{h \sin \alpha \sin(\alpha + \beta)}{\cos \beta}$

Correct: c

124. Choose the most appropriate option.

If the numbers  $a_1, a_2, \dots, a_n$  are different from zero and form an arithmetic progression, then  $\frac{1}{a_1 a_2} + \frac{1}{a_2 a_3} + \frac{1}{a_3 a_4} + \dots + \frac{1}{a_{n-1} a_n}$  is equal to

- (a)  $\frac{1}{a_1 a_n}$   
 (b)  $\frac{n}{a_1 a_n}$   
 (c)  $\frac{n+1}{a_1 a_n}$   
 (d)  $\frac{n-1}{a_1 a_n}$

Correct: d

125. Choose the most appropriate options.

The equation of a straight line passing through the point of intersection of  $x - y + 1 = 0$  and  $3x + y - 5 = 0$  and perpendicular to one of them, is

- (a)  $x + y + 3 = 0$   
 (b)  $x - y - 3 = 0$   
 (c)  $x - 3y - 5 = 0$   
 (d)  $x - 3y + 5 = 0$

Correct: d

126. Choose the most appropriate options.

The number of integral values of  $\lambda$  for which the equation

$$x^2 + y^2 - 2\lambda x + 2\lambda y + 14 = 0$$

represent a circle whose radius cannot exceed 6 is

- (a) 10  
 (b) 11  
 (c) 12  
 (d) 9

Correct: b

127. Choose the most appropriate option.

Let  $x_1$  and  $x_2$  be the roots of the equation  $ax^2 + bx + c = 0$  ( $ac \neq 0$ )

Find the value of  $\frac{1}{x_1^2} + \frac{1}{x_2^2}$

- (a)  $\frac{\sqrt{b^2 - 2ac}}{c}$   
 (b)  $\frac{c}{\sqrt{b^2 - 2ac}}$   
 (c)  $\frac{b^2 - 2ac}{c^2}$   
 (d)  $\frac{c}{b^2 - 2ac}$

Correct: c

128. Choose the most appropriate options.

A line makes the same angle  $\theta$  with each of the X and Z-axis. If the angle  $\beta$  which it makes with Y-axis is such that

$\sin^2 \beta = 3 \sin^2 \theta$ , then  $\cos^2 \theta$  equals

- (a)  $2/5$   
 (b)  $1/5$   
 (c)  $3/5$   
 (d)  $2/3$

Correct: c

129. Choose the most appropriate options.

The mid-point of the chord  $2x + y - 4 = 0$  of the parabola  $y^2 = 4x$  is

- (a)  $(5/2, -1)$
- (b)  $(-1, 5/2)$
- (c)  $(3/2, -1)$
- (d) None of these

Correct: a

130. Choose the most appropriate options.

Gas is being pumped into a spherical balloon. Then, the rate at which the radius increases when it reaches the value 15ft, is

- (a)  $\frac{1}{30\pi}$  ft/min
- (b)  $\frac{1}{15\pi}$  ft/min
- (c)  $\frac{1}{20}$  ft/min
- (d)  $\frac{1}{25}$  ft/min

Correct: a

131. Choose the most appropriate option.

If  $n$  is an integer, compute the value of the fraction  $\frac{(1+i)^n}{(1-i)^{n-2}}$

- (a)  $2i$
- (b)  $(2i)^n$
- (c)  $2i^{n-1}$
- (d)  $2i^{n-2}$

Correct: a

132. Choose the most appropriate options.

If the tangent at  $(1,1)$  on  $y^2 = x(2-x)^2$  meets the curve again at  $P$ , then  $P$  is

- (a)  $(4,4)$
- (b)  $(-1,2)$
- (c)  $(9/4, 3/8)$
- (d) None of these

Correct: c

133. Choose the most appropriate options.

If  $|a| < 1$  and  $|b| < 1$  then the sum of the series  $a(a+b) + a^2(a^2+b^2) + a^3(a^3+b^3) + \dots$  is

- (a)  $\frac{a}{1-a} + \frac{ab}{1-ab}$
- (b)  $\frac{a^2}{1-a^2} + \frac{ab}{1-ab}$
- (c)  $\frac{b}{1-b} + \frac{a}{1-a}$
- (d)  $\frac{b^2}{1-b^2} + \frac{ab}{1-ab}$

Correct: b

134. Three points are chosen randomly and independently on a circle. What is the probability that all three pairwise distances between the points are less than the radius of the circle?

- (a)  $1/36$
- (b)  $1/24$
- (c)  $1/18$
- (d)  $1/12$

Correct: d

135. Choose the most appropriate options.

If  $A$  is a square matrix such that  $A^2 = A$  and  $B = I - A$  then  $AB + BA + I - (I - A)^2$  is equal

- (a)  $A$
- (b)  $2A$
- (c)  $-A$
- (d)  $I - A$

Correct: a

136. Choose the most appropriate option.

Calculate  $\begin{vmatrix} x & y & x+y \\ y & x+y & x \\ x+y & x & y \end{vmatrix}$

- (a)  $x^3 + y^3$
- (b)  $x^3 + y^3 + 3x^2y + 3xy^2 + 1$
- (c)  $-2(x^3 + y^3)$
- (d)  $2(x^3 + y^3)$

Correct: c

137. Choose the most appropriate options.

Let  $f(x) = (x^3 + 2)^{30}$ . If  $f^{(n)}(x)$  is a polynomial of degree 20 where  $f^{(n)}(x)$  denotes the  $n + h$  order derivative of  $f(x)$  with respect to  $x$  then the value of  $n$  is

- (a) 60
- (b) 40
- (c) 70
- (d) 50

Correct: c

138. Choose the most appropriate options.

The set of values of  $x$  satisfying the system of in equations  $5x+2 < 3x+8$  and  $\frac{x+2}{x-1} < 4$  is

- (a)  $(-\infty, 1)$
- (b)  $(2, 3)$
- (c)  $(-\infty, 3)$
- (d)  $(-\infty, 1) \cup (2, 3)$

Correct: d

139. Choose the most appropriate option.

$\lim_{x \rightarrow a} \frac{\log_a x - 1}{x - a}$  is equal to

- (a)  $\frac{1}{a}$
- (b)  $a$
- (c)  $\log_a e$
- (d)  $\frac{1}{a} \log_a e$

Correct: d

140. Choose the most appropriate options.

If  $|z^2 - 1| = |z^2| + 1$ , then  $z$  lies on a

- (a) circle
- (b) parabola
- (c) ellipse
- (d) None of these

Correct: d

141. Choose the most appropriate options.

If  $f(x) = [x \sin \pi x]$ , then which of the following is incorrect?

- (a)  $f(x)$  is continuous at  $x = 0$
- (b)  $f(x)$  is continuous in  $(-1, 0)$
- (c)  $f(x)$  is differentiable at  $x = 1$
- (d)  $f(x)$  is differentiable in  $(-1, 1)$

Correct: c

142. Choose the most appropriate option.

Find the distance from the point A  $(2, 3, -1)$  to the given straight line.

$$x = 3t + 5$$

$$y = 2t$$

$$z = -2t - 25$$

- (a) 15
- (b) 17
- (c) 19
- (d) 21

Correct: d

143. Choose the most appropriate options.

The degree of the differential equation

$$x = 1 + \frac{dy}{dx} + \frac{1}{2!} \left(\frac{dy}{dx}\right)^2 + \frac{1}{3!} \left(\frac{dy}{dx}\right)^3 + \dots$$

- (a) 3
- (b) 1
- (c) not defined
- (d) None of these

Correct: b

144. Choose the most appropriate option.

On the sphere  $(x - 1)^2 + (y + 2)^2 + (z - 3)^2 = 25$  find the point  $M_0$  to the plane  $3x - 4z + 19$

- (a) (7, -2, -2)
- (b) (2, -2, 7)
- (c) (-2, -2, 7)
- (d) (-2, 7, -2)

Correct: c

145. Choose the most appropriate options.

$\lim_{x \rightarrow 0} \frac{1 - \cos 2x}{x \tan 4x}$  is equal to

- (a) 4
- (b) 3
- (c) 2
- (d)  $\frac{1}{2}$

Correct: c

146. Choose the most appropriate options.

If A(2,3) and B(-2, 1) are two vertices of a triangle and third vertex moves on the line  $2x + 3y = 9$ , then the locus of the centroid of the new set of observations will be the triangle is

- (a)  $2x + 3y = 1$
- (b)  $2x + y = 3$
- (c)  $2x - 3y = 1$
- (d)  $x - y = 1$

Correct: a

147. Choose the most appropriate option.

$\lim_{x \rightarrow 0} \frac{1 - \cos 2x}{\sin 2x}$  is equal to

- (a) 0
- (b) 1
- (c)  $\frac{1}{2}$
- (d)  $\infty$

Correct: a

148. Choose the most appropriate options.

Let  $f(x) = ax^3 + 5x^2 - bx + 1$ . If  $f(x)$  when divided by  $2x + 1$  leaves 5 as remainder, and  $f(x)$  is divisible by  $3x - 1$ , then

- (a)  $a = 26, b = 10$
- (b)  $a = 24, b = 12$
- (c)  $a = 26, b = 12$
- (d) None of these.

Correct: c

149. Choose the most appropriate options.

If the SD of a set of observations is 8 and each observation is divided by -2, then the SD of new set of observation will be

- (a) -4
- (b) -8
- (c) 8
- (d) 4

Correct: d



150. Choose the most appropriate option.

$\lim_{x \rightarrow 1} \sin(x - 1) \tan \frac{\pi x}{x}$  is equal to

- (a) 0
- (b)  $-\frac{1}{\pi}$
- (c)  $-\frac{2}{\pi}$
- (d)  $-\frac{3}{\pi}$

Correct: a