# IPU Question Paper 2016

## Duration : 3 : 00 Hrs

| Exam IPU | | Total Questions 150 | | |
|---|---|---|---|---|
| Marks for Correct Answer | Negative Marks | Physics | Chemistry | Biology |
| 4 | 1 | 50 | 50 | 50 |

### Physics

1. Choose the most appropriate option.

A gas undergoes a process in which its pressure p and volume V are related as $Vp^n$ = constant. The bulk modulus of the gas in this pressure is

(a) $p^{1/n}$

(b) $\frac{p}{n}$

(c) $\frac{n}{p}$

(d) $\rho^n$

Correct: b

2. Choose the most appropriate option.

A ball is thrown from the ground to clear a wall 3 m high at a distance of 6 m and falls 18 m away from the wall, the angle of projection of ball is

(a) $\tan^{-1}\left(\frac{3}{2}\right)$

(b) $\tan^{-1}\left(\frac{2}{3}\right)$

(c) $\tan^{-1}\left(\frac{1}{2}\right)$

(d) $\tan^{-1}\left(\frac{3}{4}\right)$

Correct: b

3. Choose the most appropriate option.

A proton and an electron are placed in a uniform electric field. Which of the

following is correct?
(a) The electric forces acting on them will be equal
(b) The magnitude of the forces will be equal
(c) Their accelerations will be equal
(d) The magnitude of their accelerations will be equal

Correct: b

4. A light meter measures the intensity I of the light falling on it. Theory suggests that this varies as the inverse square of the distance d.
Which graph of the results supports this theory?
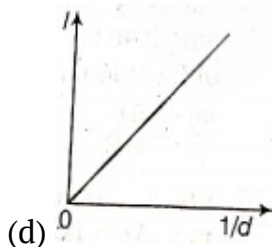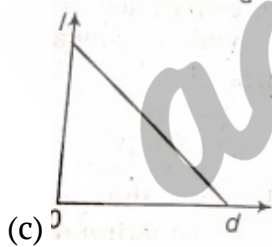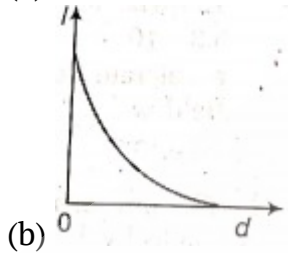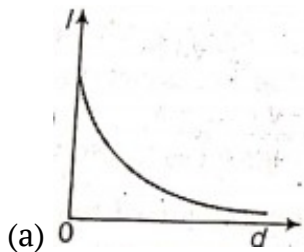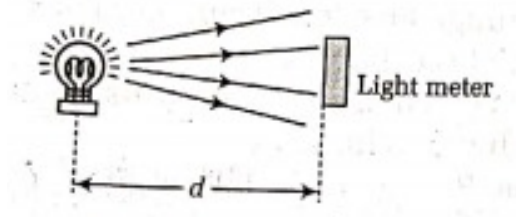


Correct: a

5. Choose the most appropriate option.
A long string with a charge of a per unit length passes through an imaginary cube of edge L.
The maximum possible flux of electric field through the cube will be

(a) $\frac{\lambda L}{\varepsilon_0}$

(b) $\frac{\sqrt{2}\lambda L}{\varepsilon_0}$

(c) $\frac{\sqrt{3}\lambda L}{\varepsilon_0}$

(d) $\frac{\sqrt{5}\lambda L}{\varepsilon_0}$

Correct: c

6. Choose the most appropriate option.
Kepler's third law states that the square of period of revolution (T) of a planet around the sun, is proportional to third power of average distance, r between the sun and the planet i.e. $T^2 = Kr^3$.
Here, K is constant.
If masses of the sun and the planet are M and m respectively, then as per Newton's law of gravitation, force of attraction between them is $F = \frac{GMm}{r^2}$, where G is gravitational constant.
The relation between G and K is described as
(a) $GK = 4\pi^2$
(b) $GMK = 4\pi^2$
(c) K=G
(d) $K = \frac{1}{G}$

Correct: b

7. Choose the most appropriate option.
Two spherical conductors A and B of radii 1mm and 2mm are separated by a distance of 5 cm and are uniformly charged. If the spheres are connected by a conducting wire, then at equilibrium condition, the ratio of the magnitude of the electric fields at the surface of spheres A and B is
(a) 4:1
(b) 1:2
(c) 2:1
(d) 1:4

Correct: c

8. Choose the most appropriate option.
An open organ pipe has a fundamental frequency of 300 Hz. The first overtone of a closed organ pipe has the same frequency as the first overtone of organ pipe. How long is each pipe?
(a) 41.25 cm
(b) 42.3 cm
(c) 49.5 cm
(d) 40.5 cm

Correct: a

9. Choose the most appropriate option.
It takes 16 min to boil some water in an electric kettle. Due to some defect, it becomes necessary to remove 10% turns of heating coil of the kettle. After repairs, how much time will it take to boil the same mass of water?
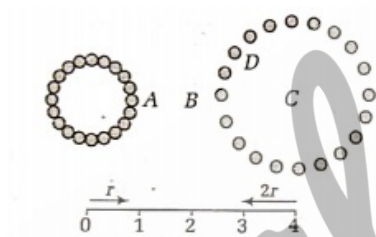(a) 17.7 min
(b) 13.7 min
(c) 20.9 min
(d) 14.4 min

Correct: d

10. Choose the most appropriate option.
The magnetic moment of atomic neon (in units of Bohr's magnetron) is
(a) zero
(b) 1/2
(c) 3/2
(d) 1

Correct: a

11. 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.



If the position of the spheres approximates two uniformly dense rings, which of the following is the concerning a mass placed at position D?
(a) The net gravitational force due to the spheres of the larger ring would be zero
(b) The net gravitational force due to the spheres of the smaller ring would be zero
(c) The net gravitational force due to the spheres of
both rings would be zero
(d) If the smaller ring were removed, the mass would move towards the centre of the larger ring
Correct: a

12. Choose the most appropriate option.
A child swings a ball on a string in a circular motion. The ball moves in a plane vertical to the ground. If the sun is directly overhead how does the shadow move?
(a) In a circle
(b) In an ellipse
(c) In a figure 8 patterns
(d) Back and forth along a straight line

Correct: d

13. Choose the most appropriate option.
In a car race, car A takes a timet less than car B at the finish and passes the finishing point with speed v more than that of the car B. Assuming that both the cars starts from rest and travel with constant accelerations $a_1$, and $a_2$ respectively. So, the value of v will be

(a) $\left( \sqrt{a_1/a_2} \right) t$

(b) $\left( \sqrt{a_2/a_1} \right) t$

(c) $\left( a_1 \sqrt{a^2} \right) t$

(d) $\left( \sqrt{a_1 a_2} \right) t$
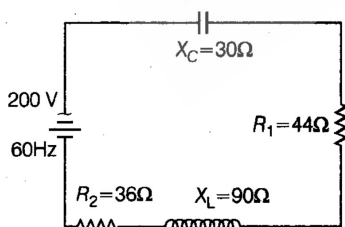
Correct: d

14. Choose the most appropriate option.
The period of oscillation of a simple pendulum of length l suspended from the roof of a vehicle which moves down without friction on an inclined plane of inclination θ, is given by

(a) $2\pi \sqrt{\dfrac{l}{g \cos \theta}}$

(b) $2\pi \sqrt{\dfrac{l}{g \sin \theta}}$

(c) $2\pi \sqrt{\dfrac{l}{g \tan \theta}}$

(d) $2\pi \sqrt{\dfrac{l}{g}}$

Correct: a

15. Choose the most appropriate option.
As given in the figure a series circuit connected across a 200 V, 60 Hz line consists of a capacitor of capacitive reactance 30 Ω, a non-inductive resistor 44 Ω, a coil of inductive reactance 9012 and another resistance of resistance 36 Ω. The power dissipated in the circuit is



(a) 320 W
(b) 176 W
(c) 144 W
(d) 0 W

Correct: a

16. Choose the most appropriate option.
Twenty seven identical liquid drops, each charge to a potential of 4V combine to form a big drop. The potential of the big drop is
(a) 4 V
(b) 16 V
(c) 24 V
(d) 36 V

Correct: d

17. A ball rolls up a slope. At the end of three seconds its velocity is 20 cm/s, at the end of eight seconds its velocity is 0. What is the average acceleration from the third to the eighth second?
(a) 2.5 cm/s
(b) 4.0 cm/s
(c) 5.0 cm/s
(d) 6.0.cm/s

Correct: b

18. Choose the most appropriate option.
When you flip a switch to turn on a light, the delay before the light turns on is determined by
(a) the speed of the electric field moving in the wire
(b) the drift speed of the electrons in the wire
(c) the number of electron collisions per second in the wire
(d) None of the above, since the light comes on instantly

Correct: a

19. Choose the most appropriate option.
Two singly ionised isotopes, X and Y of the same element move at same speed perpendicular to a uniform magnetic field. Isotope X follows a path of radius 3.35 cm while isotope Y moves along a path 3.43 cm in radius. What is the ratio of the two isotope masses, $m_Y/m_X$?
(a) 0.977
(b) 0.954
(c) 1.05
(d) 1.02

Correct: d

20. Choose the most appropriate option.
Different objects at different distances are seen by the eye. The parameter that remains constant is
(a) the focal length of the eye lens
(b) the object distance from the eye lens
(c) the radii of curvature of the eye lens

(d) the image distance from the eye lens

Correct: d

21. The density of ice is $9.2 \times 10^2 \mathrm{kg/m^3}$ If a chunk displaces $10^{-2} \mathrm{m^3}$ the buoyant force on the ice is most nearly
(a) 0.1 N
(b) 10 N
(c) 100 N
(d) 1000 N

Correct: c

22. Choose the most appropriate option.
The resistors in the circuits below each represent a light bulb. If all three circuits use the same size battery, which circuit will produce the most light?
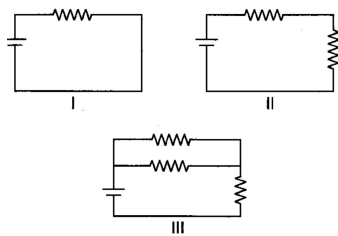


(a) I only
(b) II only
(c) III only
(d) I, II and III will produce the same amount of light

Correct: a

23. Choose the most appropriate option.
If a guitar string is 0.5 m long, what is the wavelength of its third harmonic?
(a) 0.25 m
(b) 0.33 m
(c) 0.5 m
(d) 1 m

Correct: b

24. Choose the most appropriate option.
When a piece of metal is illuminated by a monochromatic light of wavelength λ, then stopping potential is 3Vs When same surface is illuminated by light of wavelength 2λ, then stopping potential becomes Vs. The value of threshold wavelength for photoelectric emission will be
(a) 4 λ
(b) 8 λ
(c) 4λ/3

(d) 6 λ

Correct: a

25. Choose the most appropriate option.
Which of the following gives the percent change to the Young's modulus for a substance, when its cross-sectional area is increased by a factor of 3?
(a) 0%
(b) 33%
(c) 300%
(d) 900%

Correct: a
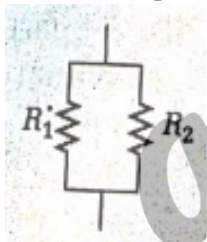
26. Choose the most appropriate option.
An ideal fluid with pressure p flows through a horizontal pipe with radius r. If the radius of the pipe is increased by a factor of 2, which of the following most likely gives the new pressure?
(a) p
(b) 4p
(c) 16p
(d) The new pressure cannot be determined without more information

Correct: d

27. Resistors $R_1$ and $R_2$ are placed in parallel as shown. If they have values of 5 Ω and 10 Ω respectively, their combined equivalent resistance is



(a) 0.032
(b) 0.32
(c) 3.022
(d) 3.312

Correct: d

28. Choose the most appropriate option.
The chemical potential energy in gasoline is converted to kinetic energy in cars. If a car accelerates from zero to 60 km/h, compared to the energy necessary to increase the velocity of the car from zero to 30 km/h, the energy necessary to increase the velocity of the car from 30 to 60 km/h is
(a) half as great

(b) the same

(c) twice as great

(d) three times as great

Correct: d

29. Choose the most appropriate option.

An air bubble starts rising from the bottom of a lake. Its diameter is 3.6 mm at the bottom and 4 mm at the surface. The depth of the lake is 250 cm and the temperature at surface is 40°C. What is the temperature at the bottom of the lake? Given atmospheric pressure = 76 cm of Hg and g = 980cm/s$^2$

(a) 11°C

(b) 12.36°C

(c) 13°C

(d) 10.37°C

Correct: d

30. Choose the most appropriate option.

Average energy in one time period of a simple harmonic oscillator whose amplitude is A, angular velocity $\omega$ and mass $m$, is

(a) $\frac{1}{4}m\omega^2 A^2$

(b) $\frac{1}{2}m\omega^2 A^2$

(c) $m\omega^2 A^2$

(d) $\frac{1}{3}m\omega^2 A^2$

Correct: b

31. Choose the most appropriate option.

A train accelerates from rest at a constant rate $\alpha$ for distance $\backslash X_1$ and time $\backslash t_1$. After that retards to rst at constant rate $\beta$ for distance $X_2$ and time $t_2$. Then, it is found that

(a) $\frac{X_1}{X_2} = \frac{\alpha}{\beta} = \frac{t_1}{t_2}$

(b) $\frac{X_1}{X_2} = \frac{\alpha}{\beta} = \frac{t_2}{t_1}$

(c) $\frac{X_1}{X_2} = \frac{\beta}{\alpha} = \frac{t_1}{t_2}$

(d) $\frac{X_1}{X_2} = \frac{\beta}{\alpha} = \frac{t_2}{t_1}$

Correct: c

32. A pendulum with a period of 2 seconds at sea level has its length doubled. Its new period is now most nearly

(a) 1 s

(b) 2 s

(c) 4 s

(d) 5 s

Correct: b

33. Choose the most appropriate option.
The time-period of a charged particle undergoing a circular motion in a uniform magnetic field in independent of its
(a) speed
(b) charge
(c) mass
(d) magnetic induction

Correct: a

34. Choose the most appropriate option.
A smooth inclined plane of length L having inclination θ with the horizontal inside a lift which is moving down with retardation α. The time taken by a body to slide down the inclined plane, from rest, will be
(a) $\sqrt{\dfrac{2L}{g\sin\theta}}$
(b) $\sqrt{\dfrac{2L}{\alpha\sin\theta}}$
(c) $\sqrt{\dfrac{2L}{(g+\alpha)\sin\theta}}$
(d) $\sqrt{\dfrac{2L}{(g-\alpha)\sin\theta}}$

Correct: c

35. Two charged spheres are separated by 2 mm. Which of the following would yield the greatest attractive force?
(a) + 2q and -2q
(b) + 2q and +2q
(c) - 2q and -2q
(d) - 1 and - 4q

Correct: a

36. Choose the most appropriate option.
When a satellite is on the surface of a planet, it experiences a gravitational force W. What is the gravitational force when the satellite is at height R/50, where R is the radius of the planet?
(a) 1.02 W
(b) 1.00 W
(c) 0.92 W
(d) 0.96 W

Correct: d

37. Choose the most appropriate option.

The Young's modulus of brass and steel are $10 \times 10^{10} \text{Nm}^{-2}$ and $20 \times 10^{10} \text{Nm}^{-2}$, respectively. A brass wire and steel wire of the same length are extended by 1 mm under the same force. If the radii of the brass and steel wires are $R_B$ and $R_S$ respectively, then

(a) $R_S = \frac{R_B}{4}$

(b) $R_S = 4R_B$

(c) $R_s = \sqrt{2}, R_B$

(d) $R_S = \frac{R_B}{\sqrt{2}}$

Correct: d

38. Choose the most appropriate option.

A drop of liquid of density p is floating half-immersed in a liquid of density d. If σ is the surface tension, then the diameter of the drop of the liquid is

(a) $\sqrt{\frac{\sigma}{g(2\rho - d)}}$

(b) $\sqrt{\frac{2\sigma}{g(2\rho - d)}}$

(c) $\sqrt{\frac{8\sigma}{g(2\rho - d)}}$

(d) $\sqrt{\frac{12\sigma}{g(2\rho - d)}}$

Correct: d

39. Choose the most appropriate option.

Two identical wires A and B have the same length L and carry the same current I. Wire A is bent into a circle of radius R and wire B is bent to form a square of side a. If B₁ and B₂ are the values of magnetic induction at the centre of the square respectively, then the ratio is $\frac{B_1}{B_2}$ is

(a) $\left(\frac{\pi^2}{8}\right)$

(b) $\left(\frac{\pi^2}{8\sqrt{2}}\right)$

(c) $\left(\frac{\pi^2}{16}\right)$

(d) $\left(\frac{\pi^2}{16\sqrt{2}}\right)$

Correct: b

40. Choose the most appropriate option.

Consider a rotating spherical planet. The velocity of a point on its equator is v. The effect of rotation of the planet is to make g at the equator 1/2 of g at the pole. What is the escape velocity for a polar particle on the planet expressed as a multiple of v?

(a) 0.5 V

(b) v

(c) $\sqrt{2}v$

(d) 2 v

Correct: d

41. Choose the most appropriate option.

Two conductors have the same resistance at 0° C but the temperature coefficients of resistance are $\alpha_1$ and $\alpha_2$. The respective temperature coefficients of their series and parallel combinations are nearly

(a) $\frac{\alpha_1+\alpha_2}{2}, \alpha_1 + \alpha_2$

(b) $\alpha_1 + \alpha_2, \frac{\alpha_1+\alpha_2}{3}$

(c) $\frac{\alpha_1+\alpha_2}{3}, \alpha_1 + \alpha_2$

(d) $\frac{\alpha_1+\alpha_2}{2}, \frac{\alpha_1+\alpha_2}{2}$

Correct: d

42. Choose the most appropriate option.

A transformer having efficiency of 90% is working on 200 V and 3 kW power supply. If the current in the secondary coil is 6 A the voltage across the secondary coil and the current in the primary coil respectively are

(a) 300 V, 15A

(b) 450 V, 15 A

(c) 450 V, 13.5 A

(d) 600 V, 15 A

Correct: b

43. Choose the most appropriate option.

A ray of unpolarised light is incident on a glass plate at the polarising angle of 57°. Now,

(a) both the reflected and transmitted rays will be completely polarised

(b) the reflected ray will be completely polarised and transmitted ray will be partially polarised

(c) the reflected ray will be partially polarised and transmitted ray will be completely polarised

(d) both the reflected and transmitted rays will be partially polarised

Correct: b

44. The maximum and minimum distances of a comet from the Sun are $8 \times 10^{12}$m and $1.6 \times 10^{12}$m If its velocity when nearest to the Sun is $60 \text{ms}^{-1}$ , what will be its velocity in $ms^{-1}$ ? when it is farthest?

(a) 12

(b) 6

(c) 112

(d) 60

Correct: a

45. Choose the most appropriate option.
The momentum of a photon is p. The frequency associated with it is given by
(a) $\frac{pc}{h}$
(b) $\frac{hc}{p}$
(c) $\frac{h}{pc}$
(d) $\frac{ph}{c}$

Correct: a

46. Each of the above three springs are identical (they have the same equilibrium length and spring constant k). They are fixed together as shown in figure. What is the effective spring constant of the assembly?
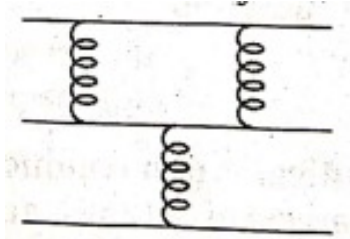


(a) k
(b) $\left(\frac{2}{3}\right)k$
(c) $\left(\frac{1}{2}\right)k$
(d) $\left(\frac{1}{3}\right)k$

Correct: b

47. Choose the most appropriate option.
The wavelength of the de-Broglie wave associated with a thermal neutron of mass m at absolute temperature T is given by (here, K is the Boltzmann constant)
(a) $\frac{h}{\sqrt{mKT}}$
(b) $\frac{h}{\sqrt{2mkT}}$
(c) $\frac{h}{\sqrt{3mkT}}$
(d) $\frac{h}{2\sqrt{mkT}}$

Correct: c

48. What are the units of the constant in the above equation
(a) length / time
(b) length /Time3

(c) length
(d) length/Time2

Correct: d

49. Choose the most appropriate option.
Although waves in the open ocean propagate in all directions, waves washing into any shore usually move nearly perpendicular to the shore. Which of the following best explains the reason for this phenomenon?
(a) The shallow water decreases the speed of the waves causing them to refract
(b) The shallow water increases, the speed of the waves causing them to refract
(c) The shallow water decreases the speed of the waves causing them to diffract
(d) The shallow water increases the speed of the waves causing them to diffract

Correct: c

50. Four forces, 5 N North, 6 N 20° S of E, 9 N 20°N of W and 10 N South, act on an object. The equilibrium force equals
(a) 4.9 N 35° W of S
(b) 4.9 N 35o E of N.
(c) 2.8 NW
(d) 2.8 NSW

Correct: c

# Chemistry

51. Choose the most appropriate option.
Which of the following is true for an acid-base concentration cell such as the one used by the pH meter?
(a) Current always flows towards the more acidic solution
(b) Current always flows towards the more basic solution
(c) Current always flows towards the more neutral solution
(d) Current always flows away from the more neutral solution

Correct: a

52. The shortest bond would be present in which of the following substances?
(a) $I_2$
(b) CO
(c) $CCl_4$
(d) $O_2$

Correct: b

53. Choose the most appropriate option.
A buffer is formed by adding 500 ml of 0.20 M correct to 500 mL of 0.10 M
NaC H202. What would be the maximum amount of HCl that could be added to this solution
without exceeding the capacity of the buffer?
(a) 0.01 mol
(b) 0.05 mol
(c) 0.10 mol
(d) 0.15 mol

Correct: c

54. What is the molality of a 10% (by weight) $C_6H_2O$ molecular weight = 90) solution?
(a) 0.012 m
(b) 0.12 m
(c) 1.2 m
(d) 12 m

Correct: c

55. Choose the most appropriate option.
The product formed by the condensation reaction of alcohols is
(a) alcohol
(b) carboxylic acid
(c) ester
(d) ether

Correct: d

56. Choose the most appropriate option.
Gas A decomposed according to the following reaction
$A(g) \rightleftharpoons B(g) + C(g)$
A student conducted an experiment and determined that the equilibrium pressure of gas A
was 0.20 P, where P was the total pressure of the system. What is the equilibrium constant $K_P$
for this reaction?
(a) 0.10 P
(b) 0.20 P
(c) 0.40 P
(d) 0.80 P

Correct: d

57. Choose the most appropriate option.
Which of the following does not show hydrogen bonding?
(a) Ammonia, $NH_3$

(b) Hydrazine, $N_2H_4$
(c) Hydrogen peroxide, $H_2O_2$
(d) Dimethyl ether, $CH_3OCH_3$

Correct: d

58. Which molecular formula is also an empirical formula?
(a) $PCl_3$
(b) $C_6H_4$
(c) $H_2O_2$
(d) $C_6H_{12}O_6$

Correct: a

59. Choose the most appropriate option.
Which of the following would be the most soluble in water?
(a) Carbon tetrachloride
(b) Methane
(c) Octane
(d) Ethyl alcohol

Correct: b

60. Choose the most appropriate option.
An imaginary metal crystallises in a cubic lattice. The unit cell edge length is 100 pm, (1 pm = $10^{-12}$m). The density of this metal is 200 g/cm$^3$. The atomic mass of the metal is 60.2 g/mol. How many of these metal atoms are there within a unit cell?
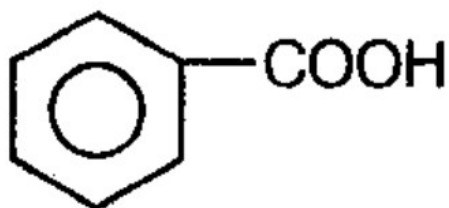(a) 1
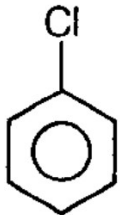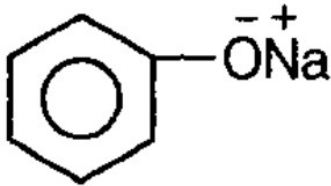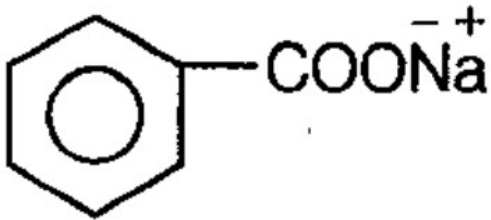(b) 2
(c) 4
(d) 6

Correct: b

61. Choose the most appropriate options.
Toluene reacts with excess of Cl, in the presence of sunlight to give a product which on hydrolysis followed by reaction with NaOH gives



(a)

(b)



(c)



(d)

Correct: b

62. Choose the most appropriate option.
A man straightens up his room. His action does not violate the second law of thermodynamics because
(a) the entropy of his roam increaæd
(b) energy of the universe was conserved
(c) tle entropy increases by the breakdown of nutrients in his body is greater than the entropy decreases by the straightening of his room
(d) his action violates the second law of

Correct: c

63. What is the oxidation state of sulfur in $HSO_4^-$?
(a) +2
(b) +3
(c) +6
(d) +7

Correct: c

64. Choose the most appropriate option.
A 25 mL sample of hard water is titrated with a 0.001 M solution of EDTA, and the end point of the titration is reached at 50 mL of EDTA added. What is the concentration of $Ca^{2+}$ and $Mg^{2+}$ ions in solution?
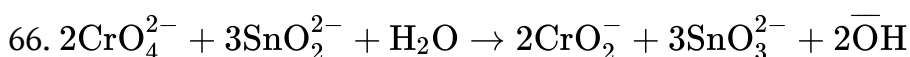(a) 0.0005 M
(b) 0.001 M
(c) 0.002 M

(d) 0.006 M

Correct: a

65. Choose the most appropriate option.
Describe the phase change for $H_2O$ as pressure is raised at 100°C.
(a) Sublimation
(b) Vaporisation
(c) Condensation
(d) Melting

Correct: c

66. $2CrO_4^{2-} + 3SnO_2^{2-} + H_2O \rightarrow 2CrO_2^- + 3SnO_3^{2-} + 2\overline{OH}$
How many moles of OH form when 50.0 ml. of 0.100M $CrO_4^{2-}$ is added to a flask containing 50.0 mL of 0.100 M $SnO_2^{2-}$?
(a) 0.100mol
(b) $6.66 \times 10^{-3}$mol
(c) $3.33 \times 10^{-3}$mol
(d) $5.00 \times 10^{-3}$mol

Correct: c

67. Choose the most appropriate option.
Why can the relative strength of HCl and $HClO_4$ be determined in acetic acid but not in water?
(a) Because acetic acid is a weaker acid than $H_3O^+$
(b) Because acetic acid is a stronger acid than $H_3O^+$
(c) Because acetic acid is a weaker Bronsted-Lowry base than $H_2O$
(d) Because acetic acid is a stronger Bronsted-Lowry base than $H_2O$

Correct: a

68. Choose the most appropriate option.
Which of the following compounds will give racemic mixture on nucleophilic substitution by $OH^-$ ions?

(i) $CH_3 — \underset{\underset{C_2H_5}{|}}{C}H — Br$

(ii) $CH_3 — \underset{\underset{C_2H_5}{|}}{\overset{\overset{CH_2Br}{|}}{C}} — CH_3$

(iii) $CH_3 — \underset{\underset{C_2H_5}{|}}{C}H — CH_2 — Br$
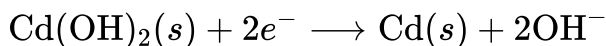
(a) Only (i)
(b) (i), (i) and (ii)
(c) (ii) and (iii)
(d) (i) and (iii)

Correct: a

69. Choose the most appropriate option.
Rechargeable batteries have become an essential part of our environmentally conscientious society. The nickel-cadmium cell battery is a rechargeable battery used in small electronic devices. The half reactions that take place in the nickel-cadmium battery during discharge are
Half reaction 1
$$\text{Cd(OH)}_2(s) + 2e^- \longrightarrow \text{Cd}(s) + 2\text{OH}^-$$
$$E^\circ = -0.4\text{V}$$
Half reaction 2
$$2\text{NiO}_2(s) + \text{H}_2\text{O} + 2e^- \longrightarrow 2\text{Ni(OH)}_2(s) + 2\text{OH}^-$$
$$E^\circ = -0.5\text{V}$$
What is the oxidising agent in the nickel cadmium battery during discharge?
(a) Cd
(b) $\text{CdOH}_2$
(c) $\text{NiO}_2$
(d) $\text{Ni(OH)}_2$

Correct: b

70. Aldehydes are readily oxidised to yield carboxylic acids but ketones are inert to oxidation. Which is the most likely explanation regarding this difference in reactivity?
(a) Aldehydes have a proton attached to the carbonyl that is abstracted during oxidation Ketones lack this proton and so cannot oxidised
(b) Reducing agents like $\text{HNO}_3$ are sterically hindered by ketone's carbonyl carbon
(c) Aldehydes and ketones are hybridisation of similar hybridisation
(d) The rate of the forward oxidation reaction is equal to the rate of the reverse reduction reaction in ketones

Correct: a

71. Choose the most appropriate option.
Which of the following solutions is the most concentrated? (assume 1 L of water has a mass of 1 kg)
(a) 1 M NaCl
(b) 1 m Nacl
(c) An aqueous solution with Nacl mole fraction of 0.01
(d) 55 g of NaCl mixed with one litre of water

Correct: a

72. Choose the most appropriate option.
NaCl dissolves spontaneously in water.
Based upon the following reaction,
$$\text{NaCl}(s) \longrightarrow \text{Na}^+(g) + \text{Cl}^-(g)$$

$\Delta H = 786$ the heat of hydration for NaCl must be

(a) negative with a magnitude less than 786
(b) negative with a magnitude greater than 786
(c) positive with a magnitude greater than 786
(d) nothing can be determined about the heat of hydration without more information

Correct: b

73. What is the IUPAC name for the following cycloalkane?
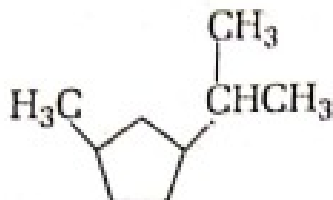


(a) Methyl-propylcyclopentane
(b) 1-methyl-3-isopropylcyclopentane
(c) Methyl-propylcycloalkane
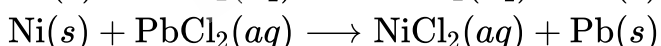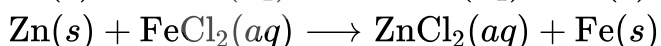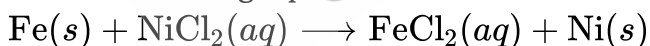(d) 1-isopropyl-3-methylcyclopentane

Correct: d

74. Choose the most appropriate option.
20 g of NaCl is poured into a coffee cup calorimeter containing 250 mL of water. If the temperature inside the calorimeter drops 1°C by the time, the NaCl is totally dissolved, what is the heat of solution for NaCl and water? (specific heat of water is 4.18 J/g °C.)
(a) -3 kJ/mol
(b) − 1 kJ/mol
(c) 1 kJ/mol
(d) 3 kJ/mol

Correct: d

75. The following equations indicate reactions that occur spontaneously.
$\mathrm{Fe}(s) + \mathrm{NiCl}_2(aq) \longrightarrow \mathrm{FeCl}_2(aq) + \mathrm{Ni}(s)$
$\mathrm{Zn}(s) + \mathrm{FeCl}_2(aq) \longrightarrow \mathrm{ZnCl}_2(aq) + \mathrm{Fe}(s)$
$\mathrm{Ni}(s) + \mathrm{PbCl}_2(aq) \longrightarrow \mathrm{NiCl}_2(aq) + \mathrm{Pb}(s)$
Which is the increasing order of the reactivity of the metals?
(a) Fe < Ni < Zn < Pb
(b) Pb < Ni < Fe < Zn
(c) NiZn < Pb < Fe
(d) Zn < Fe < Ni < Pb

Correct: b

76. Choose the most appropriate option.

What is the total heat needed to change 1g of water from -10°C to 110°C at 1 atm?
($\Delta H_{\text{fusion}} = 80\text{cal/g}, \Delta H_{\text{vaporisation}} = 540\text{cal/g}$ specific heat of ice and steam are 0.5 cal/g °C)
(a) -730 cal
(b) -630 cal
(c) 630 cal
(d) 730 cal

Correct: d

77. Choose the most appropriate option.
Calcium chloride is sometimes sprinkled on winter sidewalks to melt snow and ice. If 333g of calcium chloride is dissolved completely in 1.00 kg of water, what will be the freezing point of the solution? (the molal freezing point depression constant for water is 1.86°C kg/mol)
(a) -5.58°C
(b) -9.30°C
(c) -11.7°C
(d) -16.7°C

Correct: a

78. Which of the following groups contains only atoms that are paramagnetic in their ground state?
(a) Be, O and N .
(b) Mg, He and Rb
(c) K, C and Fe
(d) Br, Sb and Kr

Correct: c

79. Choose the most appropriate option.
Which of the following is the $K_b$ for the conjugate base of carbonic acid?
(a) $\dfrac{[\text{H}_2\text{CO}_3]}{[\text{H}^+][\text{HCO}_3^-]}$
(b) $\dfrac{[\text{OH}^-][\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3]}$
(c) $\dfrac{[\text{H}^+][\text{H}_2\text{CO}_3]}{[\text{HCO}_3^-]}$
(d) $\dfrac{[\text{OH}^-][\text{H}_2\text{CO}_3]}{[\text{HCO}_3^-]}$

Correct: d

80. Choose the most appropriate option.
The acid dissociation constant for $\text{HC}_6\text{H}_7\text{O}_6$ is $8.0 \times 10^{-5}$. If a solution contains equal concentrations of $\text{HC}_6\text{H}_7\text{O}_6$ and $\text{C}_6\text{H}_7\text{O}_6^-$ what will be the ph of the solution ?
(a) 3.0

(b) 4.1
(c) 5.3
(d) 9.0

Correct: b

81. The molar masses of C,HA, CH OH and CHF are very similar. How do their boiling points compare?
(a) $C_2H_6 < CH_3OH < CH_3F$
(b) $CH_3F < CH_3OH < C_2H_6$
(c) $CH_3OH < CH_3F < C_2H_6$
(d) $C_2H_6 < CH_3F < CH_3OH$

Correct: d

82. Choose the most appropriate option.
The values of all of the following are reversed when a reaction is reversed except
(a) enthalpy
(b) Gibbs energy
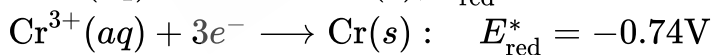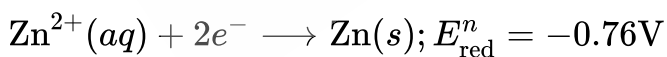(c) rate constant
(d) reaction potential. .

Correct: d

83. Choose the most appropriate option.
Which of the following is true for an electrolytic cell?
(a) Reduction takes place at the anode
(b) The reaction is spontaneous
(c) Electrons start to flow from the cathode
(d) An electrolytic cell requires a salt bridge

Correct: c

84. Given that
$$Zn^{2+}(aq) + 2e^- \longrightarrow Zn(s); E^n_{red} = -0.76V$$
$$Cr^{3+}(aq) + 3e^- \longrightarrow Cr(s): \quad E^*_{red} = -0.74V$$
Calculate the equilibrium constant K at 25°C for the following balanced reaction,
$$3Zn(s) + 2Cr^{3+}(aq) \longrightarrow 3Zn^{2+}(aq) + 2Cr(s)$$
(a) $K = e^{-0.02}$
(b) $K = e^{0.02}$
(c) $K = e^{4.7}$
(d) $K = e^{2.0}$
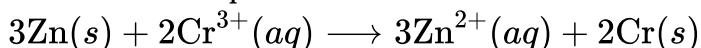
Correct: c

85. Choose the most appropriate option.

What type of intermolecular bonding occurs in gaseous $CH_4$?
(a) Covalent
(b) Ionic
(c) Hydrogen
(d) Van der Waals'

Correct: d

86. Using the above information, determine the standard reduction potential for the following reaction,
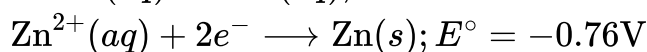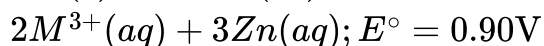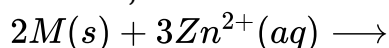$2M(s) + 3Zn^{2+}(aq) \longrightarrow$
$2M^{3+}(aq) + 3Zn(aq); E° = 0.90V$
$Zn^{2+}(aq) + 2e^- \longrightarrow Zn(s); E° = -0.76V$
(a) 0.90 V
(b) +1.66V
(c) -0.62 V
(d) -1.66 V

Correct: d

87. Choose the most appropriate option.
If a mole of $C_3H_8$ is reacted with 2.5 moles of $O_2$ how many moles of $H_2O$ will be produced ?
(a) 1 mole of $H_2O$
(b) 2 moles of $H_2O$
(c) 3 moles of $H_2O$
(d) 4 moles of $H_2O$

Correct: b

88. Choose the most appropriate option.
Which of the following demonstrates non-ideal behaviour of a gas?
(a) Some of the molecules move more rapidly than others
(b) Condensation occurs at low temperatures
(c) The gas exerts a force on the walls of its container
(d) The average speed of the molecules in the gas is directly proportional to the square root of the absolute temperature.

Correct: b

89. Given the following notation for an electrochemical cell,
$Pt(s) |H_2(g)| H^+(aq) \| Ag^+(aq)|Ag(s)$
Which of the following represents the overall balanced (net) cell reaction?
(a) $H_2(g) + Ag^+(aq) \longrightarrow 2H^+(aq) + Ag(s)$
(b) $H_2(g) + Ag(s) \longrightarrow H^+(aq) + Ag^+(aq)$
(c) $Ag(s) + H^+(aq) \longrightarrow Ag^+(aq) + H_2(g)$
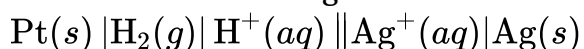
(d) None of the above

Correct: d

90. Choose the most appropriate option.
$H_2$ can be added to ethylene in the presence of a heterogeneous catalyst such as solid What might account for the initial
attraction between the hydrogen molecules and the solid platinum?
(a) Hydrogen bonding
(b) Metallic bonding
(c) Van der Waals' attractions
(d) The plasma continuum effect

Correct: d

91. Choose the most appropriate option.
Which of the following periodic properties increases with increasing atomic number within a family in the periodic table ?
(a) Electronegativity
(b) Electron affinity
(c) Atomic radius
(d) Ionisation energy

Correct: c

92. Equal molar quantities of oxygen and hydrogen gas were placed in container A under high pressure. A small portion of the mixture was allowed to effuse for a very short time into the vacuum in container B. Which of the following is true concerning partial pressures of the gases at the end of the experiment?
(a) The partial pressure of hydrogen in container A is approximately four times as great as the partial pressure of oxygen in container A
(b) The partial pressure of oxygen in container A is approximately four times as great as the partial pressure of hydrogen in container A
(c) The partial pressure of hydrogen in container B is approximately four times as great as the partial pressure of oxygen in container B
(d) The partial pressure of oxygen in container B is approximately four times as great as the partial pressure of hydrogen in container B

Correct: b

93. Choose the most appropriate option.
Name the given compound : $Cu(ClO_4)_2$
(a) Copper (I) chlorate
(b) Copper (II) perchlorite
(c) Copper (III) chlorate
(d) Copper (II) perchlorate

Correct: d

94. Choose the most appropriate options.
Which of the following compound in its anionic form is aromatic.



(a)



(b)
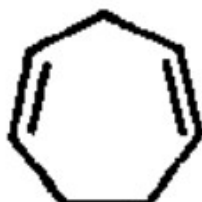


(c)



(d)

Correct: a

95. Choose the most appropriate option.
A 13 g gaseous sample of an unknown hydrocarbon occupies a volume of 11.2 L at STP. What is the hydrocarbon?
(a) CH
(b) $C_2H_4$
(c) $C_2H_2$
(d) $C_3H_3$

Correct: c

96. Choose the most appropriate option.
Which of the following changes to a reaction will always increase the rate constant for that reaction?
(a) Decreasing the temperature
(b) Increasing the temperature

(c) Increasing the concentration of the reactants

(d) Increasing the concentration of the catalyst

Correct: b

97. Which statement about the bonding between carbon atoms is correct? (a) In Ceo fullerene each carbon atom is covalently bonded to three other carbon atoms

(b) In Ceo fullerene each carbon atom is covalently bonded to four other carbon atoms

(c) In graphite each carbon atom is covalently bonded to four other carbon atoms

(d) In graphite each carbon atom forms a double covalent bond with three other carbon atoms

Correct: a

98. Choose the most appropriate option.

Immediately, upon bringing a hot piece of metal into a room, the heat is felt from 5 m away. The type of heat transfer is probably

(a) convection

(b) transduction

(c) radiation

(d) conduction

Correct: a

99. Choose the most appropriate options.

In aqueous solution Cu(+1) salts are unstable because

(a) Cu(+1) has $3d^{10}$ configuration.

(b) They disproportionate easily to Cu and $Cu^{2+}$

states.

(c) They disproportionate easily to $Cu^{2+}$ and $Cu^{3+}$ states.

(d) Its change in free energy is zero

Correct: b

100. Choose the most appropriate option.

Which of the following statements is most likely true concerning the given reaction?

$2A(g) + B(g) \rightarrow 2C(g) + D(s)$
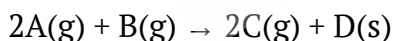
(a) Entropy of system is decreasing

(b) Entropy of system is increasing

(c) The reaction is spontaneous

(d) The reaction is non-spontaneous

Correct: a

# Mathematics

101. Choose the most appropriate options.

$\int \frac{x^2-2}{x^3\sqrt{x^2-1}}dx$ equal to

(a) $\frac{x^2}{\sqrt{x^2-1}}+C$

(b) $-\frac{x^2}{\sqrt{x^2-1}}+C$

(c) $\frac{\sqrt{x^2-1}}{x^2}+C$

(d) $-\frac{\sqrt{x^2-1}}{x^2}+C$

Correct: d

102. Choose the most appropriate option.

$\lim_{x\to 0}\frac{\sqrt{1+x}-\sqrt{1-x}}{x}$ is equal to

(a) 0

(b) 1

(c) -1

(d) $\infty$

Correct: b

103. In how many ways can the four walls of a room be painted with three colours such that no two adjacent walls have the same colour?

(a) 2

(b) 9

(c) 18

(d) 24

Correct: d

104. Choose the most appropriate option.

A die is thrown twice and the sum of the numbers appearing is 6. Then, the conditional probability that the number 4 has appeared at least once is

(a) $\frac{1}{5}$

(b) $\frac{4}{5}$

(c) $\frac{2}{5}$

(d) $\frac{2}{36}$

Correct: c

105. Choose the most appropriate option.

There are 3 true coins and 1 false coin with 'head' on both sides. A coin is chosen at random and tossed 4 times. If 'head' occurs all the 4 times, then the probability that the false coin has

been chosen and used is

(a) $\frac{15}{19}$

(b) $\frac{14}{19}$

(c) $\frac{13}{19}$

(d) $\frac{16}{19}$

Correct: d

106. Choose the most appropriate options.

The value of $^{40}C_0 +^{40}C_1 +^{40}C_2 + \cdots +^{40}C_{20}$ is

(a) $2^{40} + \frac{40!}{(20!)^2}$

(b) $2^{39} - \frac{1}{2} \times \frac{40!}{(20!)^2}$

(c) $2^{39} +^{40}C_{20}$

(d) none of these

Correct: d

107. Choose the most appropriate option.

If $x = e^{y+e^{y+}-x}, x > 0$ then $\frac{dy}{dx}$ is

(a) $\frac{1}{x}$

(b) $\frac{x}{1+x}$

(c) $\frac{1-x}{x}$

(d) $\frac{1+x}{x}$

Correct: c

108. Choose the most appropriate options.

The period of the function

$f(x) = |\sin x| - |\cos x|$ is

(a) $\pi/2$

(b) $\pi$

(c) $2\pi$

(d) $\frac{3\pi}{2}$

Correct: b

109. Choose the most appropriate option.

$\int_{-\pi/2}^{\pi/2} |\sin x| dx$ equals to

(a) 0

(b) 1

(c) -1

(d) 2

Correct: d

110. Choose the most appropriate options.
If P(x) is a polynomial such that $P(x^2 + 1) = \{P(x)\}^2 + 1$ then $P'(0)$ is equal to
(a) 1
(b) 0
(c) -1
(d) None of these

Correct: a

111. Choose the most appropriate option.
If $y^{\frac{1}{m}} + x^{\frac{1}{m}} = 2x$ then
(a) $(x^2 + 1)\frac{d^2y}{dx^2} + x\frac{dy}{dx} - m^2y = 0$
(b) $(x^2 - 1)\frac{d^2y}{dx^2} + x\frac{dy}{dx} + m^2y = 0$
(c) $(x^2 - 1)\frac{d^2y}{dx^2} + x\frac{dy}{dx} - m^2y = 0$
(d) $(x^2 + 1)\frac{d^2y}{dx^2} - x\frac{dy}{dx} + m^2y = 0$

Correct: c

112. Choose the most appropriate option.
Tangents are drawn from the origin to the curve y=sin x then ,the point of contact lie on the curve is
(a) $y^2 = \frac{x^2}{1-x^2}$
(b) $y^2 = \frac{x^2}{1+y}$
(c) $x^2 = \frac{y^2}{1+y^2}$
(d) $y^2 = \frac{x^2}{1+x^2}$

Correct: d

113. What is the value of $\tan\left(\frac{\pi}{12}\right)$?
(a) $1 - \sqrt{3}$
(b) $\sqrt{3} - 1$
(c) $2 - \sqrt{3}$
(d) $\sqrt{3} - 2$

Correct: c

114. Choose the most appropriate option.
$\int \frac{x^2}{(x\sin x + \cos x)^2}dx$ is equal to

(a) $\frac{x\sin x - \cos x}{x\sin x + \cos x} + C$

(b) $\frac{\cos x - x\sin x}{x\sin x + \cos x} + C$

(c) $\frac{x\cos x - \sin x}{x\sin x + \cos x} + C$

(d) $\frac{\sin x - x\cos x}{x\sin x + \cos x} + C$

Correct: d

115. Choose the most appropriate option.

$\int_0^1 xe^{2x}dx$ is equal to

(a) $e^2 - 1$

(b) $\frac{1}{4}\left(e^2 - 1\right)$

(c) $2e^2 + 1$

(d) $\frac{1}{4}\left(e^2 + 1\right)$

Correct: d

116. A real solution of the equation $\cosh x - 5\sinh x - 5 = 0$ is

(a) - In 2

(b) In 2

(c) - In 5

(d) None of these

Correct: a

117. Choose the most appropriate option.

$\int_{-1}^1 \frac{x\sin^{-1}x}{\sqrt{1-x^2}}dx$ is equal to

(a) 1

(b) 0

(c) 4

(d) 2

Correct: d

118. On the ellipse $9x^2 + 25y^2 = 225$, find the point, the distance from which to the focus $F_2$ is four times the distance to the focus $F_1$

(a) $\left(\frac{-15}{4}, \frac{\sqrt{63}}{4}\right)$

(b) $\left(\frac{15}{4}, \frac{-\sqrt{63}}{4}\right)$

(c) $\left(\frac{-1}{15}, \frac{-\sqrt{63}}{4}\right)$ and $\left(\frac{-1}{15}, \frac{\sqrt{63}}{4}\right)$

(d) $\left(\frac{1}{15}, \frac{-\sqrt{63}}{4}\right)$ and $\left(\frac{1}{15}, \frac{\sqrt{63}}{4}\right)$

Correct: b

119. Choose the most appropriate option.

If the expansion of $\left( x^2 + \frac{2}{x} \right)^n$ for positive integer n has a term independent of x, then n is

(a) 23

(b) 18

(c) 16

(d) 13

Correct: b

120. Find the points of intersection of the given surface $\frac{x^2}{81} + \frac{y^2}{36} + \frac{z^2}{9} = 1$ and the straight line $\frac{x-3}{3} = \frac{y-4}{-6} = \frac{z+2}{4}$

(a) $(3, 4, -1)$

(b) $(6, -2, 2)$

(c) $(3, 4, -2)$ and $(6, -2, 2)$

(d) $(-3, 4, -2)$ and $(6, -2, 2)$

Correct: c

121. Choose the most appropriate option.

Let $a = \cos\theta_1 + i\sin\theta_1$ $b = \cos\theta_2 + i\sin\theta_2$
$c = \cos\theta_3 + i\sin\theta_3$ and $a + b + c = 0$ then
$\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$

(a) 1

(b) $-1$

(c) $\sqrt{2}$

(d) 0

Correct: d

122. Choose the most appropriate option.

For any two vectors u and v , if $|\mathbf{u} + \mathbf{v}| = |\mathbf{u} - \mathbf{v}|$ then the angle between them is equal to

(a) $\frac{\pi}{4}$

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

(c) $\frac{\pi}{2}$

(d) $\pi$

Correct: c

123. Find the derivative of $y = ^{n+m}\sqrt{(1-x)^m(1+x)^n}$ at x=0, where n, m>0.

(a) 0

(b) 1

(c) $\frac{n-m}{n+m}$

(d) $\frac{m}{n^{n+m}} + m^{\frac{n}{m+n}}$

Correct: c

124. Choose the most appropriate option.
Angles A, B and C of a $\triangle ABC$ are in AP and $b : c = \sqrt{3} : \sqrt{2}$, then the $\angle A$ is given by
(a) 45°
(b) 60°
(c) 75°
(d) 90°

Correct: c

125. Choose the most appropriate option.
The straight line $\mathbf{r} = (\mathbf{i} - \mathbf{j} + \mathbf{k}) + \lambda(2\mathbf{i} + \mathbf{j} - \mathbf{k})$ and the plane $\mathbf{r} \cdot (2\mathbf{i} + \mathbf{j} - \mathbf{k}) = 4$ are
(a) perpendicular to each other
(b) parallel
(c) inclined at an angle 60°
(d) inclined at an angle 45°

Correct: a

126. At what point of the curve $y^2 = 2x^3$ is the tangent line perpendicular to the straight line
4x - 3y +2=0?
(a) $\left( \frac{1}{8}, \frac{-1}{16} \right)$
(b) $\left( \frac{1}{4}, \frac{-1}{8} \right)$
(c) $\left( \frac{-1}{16}, \frac{1}{8} \right)$
(d) None of these

Correct: a

127. Choose the most appropriate option.
Find the real solution of the system of equations
$x^4 + y^4 - x^2 y^2 = 13$
And $x^2 - y^2 + 2xy = 1$
Satisfying the condition $xy \geq 0$
(a) $(x = 1, y = -2); (x = -1, y = 2)$
(b) $(x = 2, y = 1); (x = -2, y = -1)$
(c) $(x = 1, y = 2); (x = -1, y = -2)$
(d) $(x = 1, y = -2); (x = -1, y = -2)$

Correct: c

(b) $4 + \pi$

(c) $2 + \pi$

(d) $\pi - 4$

Correct: a

129. Choose the most appropriate option.

For x > 1, how many roots/solutions of the following equation exist.

$$\log_{2x}\left(\frac{2}{x}\right) \log_2^2 x + \log_2^4 x = 1$$

(a) None

(b) One

(c) Two

(d) Infinitely many

Correct: b

130. Choose the most appropriate option.

Solve for $x(x > 0)$

$$\log_{3x}\left(\frac{3}{x}\right) + \log_3^2 x = 1$$

(a) $x = 1$ and there are infinitely more solutions .

(b) $x_1 = 1, x_2 = \frac{1}{3}$ only two solutions

(c) $x_1 = 1, x_2 = 3$ only two solutions

(d) $x_1 = 1, x_2 = 3, x_3 = \frac{1}{3}$ only three solutions

Correct: c

131. $\int_0^1 x^5 \sqrt{1 - x^3} dx$ is equal to

(a) $1/15$

(b) $2/45$

(c) $2/15$

(d) $4/45$

Correct: d

132. Choose the most appropriate option.

$\frac{1}{2\sin 10^\circ} - 2\sin 70^\circ$ is equal to

(a) $0$

(b) $\frac{1}{2}$

(c) $\frac{1}{\sqrt{2}}$

(d) $1$

Correct: d

133. Choose the most appropriate option.
$(1 + 2i)^6$ is equal to
(a) None of these
(b) $-177 + 44j$
(c) $177 + 44j$
(d) $177 - 44i$

Correct: a

134. What is the number of ordered pairs of real numbers (a,b) such that
$(a + bi)^{2002} = a - bi$?
(a) 1001
(b) 1002
(c) 2004
(d) 2002

Correct: c

135. Choose the most appropriate option.
Which of the following complex numbers is conjugate to its square?
(a) $1 - i\sqrt{3}$
(b) $-1 - i\sqrt{3}$
(c) $\frac{1}{2} - \frac{i\sqrt{3}}{2}$
(d) $-\frac{1}{2} + \frac{i\sqrt{3}}{2}$

Correct: d

136. Choose the most appropriate option.
Given $\varepsilon_k = \cos\left(\frac{2\pi k}{n}\right) + i\sin\left(\frac{2\pi k}{n}\right)$ find the $\prod_{k=0}^{n-1}\left(\varepsilon_k^2 - 2\varepsilon_k \cos\theta + 1\right)$
(a) $2(1 - \cos n\theta)$
(b) $2(1 + \cos n\theta)$
(c) $(1 - \cos n\theta)^2$
(d) $1 + \cos^2 n\theta$

Correct: a

137. $\lim_{x \to \pi/4} \frac{(1 - \cos x)^2}{\tan^2 x - \sin^2 x}$ is equal to
(a) $0$
(b) $(\sqrt{2} - 1)^2$
(c) $1$
(d) $\infty$

Correct: b

138. Choose the most appropriate option.
$\lim_{n\to\infty} \left[ \frac{1}{5} - \frac{1}{25} + \ldots + (-1)^{n-1} \frac{1}{5^n} \right]$
(a) $\frac{1}{2}$
(b) $\frac{1}{4}$
(c) $\frac{1}{6}$
(d) $\frac{1}{8}$

Correct: b

139. Choose the most appropriate option.
$\lim_{x\to 0} \frac{a^x - 1}{x}$ is equal to
(a) a
(b) $\log a$:
(c) 0
(d) $\infty$

Correct: b

140. $\lim_{x\to 0} \frac{\tan^{-1}\left(\frac{x}{\sqrt{1-x^2}}\right)}{\ln(1-x)}$ is equal to
(a) 0
(b) 1
(c) $-1$
(d) $\infty$

Correct: c

141. Choose the most appropriate option.
Find the angles formed by the unit vectors $e_1$, and $e_2$, if it is known that the vectors
$\mathbf{a} = \mathbf{e}_1 + 2\mathbf{e}_2$ and $\mathbf{b} = 5\mathbf{e}_1 - 4\mathbf{e}_2$ are mutually perpendicular.
(a) $\frac{\pi}{4}$
(b) $\frac{\pi}{3}$
(c) $\frac{\pi}{2}$
(d) $\pi$

Correct: b

142. Choose the most appropriate option.
Find the component of the vector a (-1,2,0) perpendicular to the plane of the vectors
$\mathbf{e}_1[1, 0, 1]$ and $\mathbf{e}_2(1, 1, 1)$.

(a) $\left(-\frac{1}{2} \cdot \frac{1}{2}, 0\right)$

(b) $\left(0, -\frac{1}{2}, \frac{1}{2}\right)$

(c) $\left(-\frac{1}{2}, 0, \frac{1}{2}\right)$

(d) $\left(\frac{1}{2}, 0, \frac{-1}{2}\right)$

Correct: c

143. If $\vec{I} = \sqrt{-1}$ then $\lim_{n \to \infty} \frac{(n+2i)(3+7in)}{(2-i)(6n^2+1)}$ is equal to

(a) $-7/5$

(b) $\frac{14}{5} - \frac{7}{5}i$

(c) $\frac{7}{5} - \frac{14}{5}i$

(d) $\frac{-7}{30} + \frac{7}{15}i$

Correct: d

144. Choose the most appropriate option.
What is the shape of the figure given by the following equations?
i. $16x^2 - 9y^2 - 64x - 54y - 161 = 0$
Ii. $9x^2 - 16y^2 + 90x + 32y - 367 = 0$
iii. $16x^2 - 9y^2 - 64x - 18y + 199 = 0$

(a) Line
(b) Ellipse
(c) Hyperbola
(d) Parabola

Correct: a

145. Choose the most appropriate option.
What is the equation of the curve in which point M performs its motion, if the sum of the distances from this point to the points A(-1, -1) and B (1, 1) remains constant is equal to $2\sqrt{3}$?

(a) $2x^2 - 2xy + 2y^2 - 3 = 0$
(b) $2x^2 + 2xy - 2y^2 - 3 = 0$
(c) $2x^2 - 2xy - 2y^2 + 3 = 0$
(d) $2x^2 + 2xy + 2y^2 + 3 = 0$

Correct: a

146. Find the component of the vector a (-1,2,0) perpendicular to the plane of the vectors $e_1(1, 0, 1)$ and $\mathbf{e}_2(1, 1, 1)$

(a) $(1/2, 0, 1/2)$

(b) $(-1/2, 0, 1/2)$

(c) $(1/2, 0, -1/2)$

(d) $(-1/2, 0, -1/2)$

Correct: b

147. Choose the most appropriate option.

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

(a) 1

(b) 2

(c) 3

(d) 4

Correct: a

148. Choose the most appropriate options.

If y = sec(tan$^{-1}$x), then y at x =1 is equal to term is the sum of two preceding terms. Then, the common ratio of the G.P. is

(a) $\dfrac{1}{\sqrt{2}}$

(b) $\dfrac{1}{2}$

(c) 1

(d) $\sqrt{2}$

Correct: a

149. Choose the most appropriate option.

$\lim_{x \to \infty} \dfrac{\ln x}{x^m}$ is equal to point

(a) 0

(b) 1

(c) $-\dfrac{1}{2}$

(d) $\infty$

Correct: a

150. Choose the most appropriate options.

Every term of G.P. is positive and also every term is the sum of two preceding terms. Then, the common ratio of the G.P. is

(a) $\dfrac{1 - \sqrt{5}}{2}$

(b) $\dfrac{\sqrt{5} + 1}{2}$

(c) $\dfrac{\sqrt{5} - 1}{2}$

(d) 1

Correct: b