COMEDK UGET 2026 May 9 Shift 2

Question Paper

Conducted by Consortium of Medical, Engineering and Dental Colleges of Karnataka

General Instructions

(i) The test is of 3 hours duration.

(ii) This test paper consists of 180 questions. The maximum marks are 180.

(iii) Physics and Chemistry and Mathematics each contain 60 questions.

(iv) Each question carries +1 marks for correct answer and there is no negative marking for wrong answer.

1. The critical angle for a typical glass air interface is $42°$. If a ray of light falls normally on one of the faces of the prism of angle $45°$, the emergent ray will:

(A) Go undeviated

(B) Will undergo refraction with a refracting angle $45°$

(C) Will pass parallel to the second surface

(D) Undergo total internal reflection from the second face

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2. In a uniform electric field 10 N C^{-1}, an electric dipole of length 4 cm is placed with its axis making an angle $60°$ with the electric field. If the dipole experiences a torque of $8\sqrt{3}$ N m, find the potential energy of the dipole.

(A) 8 J

(B) -8 J

(C) -16 J

(D) 16 J

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3. Calculate the vapour pressure that can help the formation of a spherical droplet of water of radius 6.25×10^{-5} m at $22°$C. Given: The surface tension of water at the given temperature is

7.28×10^{-2} **N m**$^{-1}$**.**

(A) 8.81×10^3 Pa

(B) 2.33×10^3 Pa

(C) 6.64×10^4 Pa

(D) 1.01×10^5 Pa

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4. An electric coil is rated 400 **W,** 200 **V. It is cut into two equal parts and connected in parallel to the same source of** 200 **V. Calculate the percentage increase in energy produced per second.**

(A) 100%

(B) 200%

(C) 300%

(D) 400%

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5. A boy, standing at a certain height, kicks a football horizontally with a velocity of 19.6 **m s**$^{-1}$**. What will be the ratio of horizontal and vertical components of velocities after** 2 **s? (Take** $g = 9.8$ **m s**$^{-2}$**)**

(A) 1 : 1

(B) $(\frac{\sqrt{3}}{2}) : 1$

(C) $1 : \sqrt{2}$

(D) 1 : 0.5

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6. When a current of 2.5 **A passes through the primary coil of a transformer of** 200 **number turns, the magnetic flux linked with the secondary coil having** 400 **turns is** 600×10^{-6} **T m**^{2}**. Find the induced emf in the secondary coil, when the current in the primary coil increases at a rate of** 0.2 **A s**$^{-1}$**.**

(A) 0.92×10^{-4} V

(B) 1.92×10^{-4} V

(C) 0.92×10^{-2} V

(D) 1.92×10^{-2} V

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7. A block of a certain material is heated to a temperature of 500°**C and then placed on a large ice block. If** 1.455 **kg of ice melts, find the mass of the block. Specific heat of the material is**

0.39 **J/g°C and heat of fusion of water is** 335 **J/g.**

(A) 1.455 kg

(B) 2.5 kg

(C) 0.67 kg

(D) 2.67 kg

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8. The material selected for making a permanent magnet should have:

(A) Low coercivity, low permeability and low retentivity

(B) High coercivity, low permeability and high retentivity

(C) Low coercivity, low permeability and high retentivity

(D) High coercivity, high permeability and high retentivity

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9. Which of the following statements is/are true?

(A) Three vectors not lying in a plane give zero resultant

(B) Three vectors lying in a plane can give zero resultant

(C) Two vectors of different magnitude can be combined to give a zero resultant

(A) Statements (A) and (C)

(B) Statement (B)

(C) Statement (A)

(D) Statements (B) and (C)

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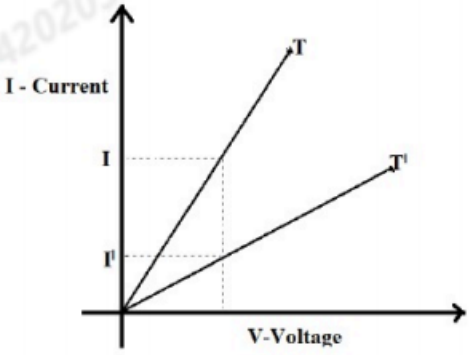
10. The voltage-current graph for a metal wire of uniform area of cross section at two different temperatures T and T' is shown. Then choose the correct statement:



(A) Resistance of the conductor at temperature T is greater than resistance of the conductor at temperature T'

(B) Temperature T is greater than temperature T'

(C) Temperature T' is greater than temperature T

(D) Resistivity is independent of temperature

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11. A metallic circular loop is placed with its plane perpendicular to a uniform magnetic field of 0.3 T. If the radius of the loop decreases at a constant rate of 2 mm s^{-1}, what will be the induced emf in the loop when the radius of the loop becomes 5 cm?

(A) 1.5×10^{-6} V

(B) 1.89×10^{-4} V

(C) 1.84×10^{-6} V

(D) 0.75×10^{-6} V

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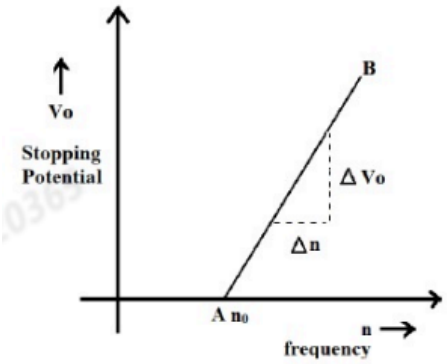
12. The variation of the stopping potential (V_0) with the frequency of incident radiation (ν) is plotted. If ν_0 is the threshold frequency, h is Planck's constant, and e is the electronic charge, then the slope of the graph with the frequency axis is:



(A) $\frac{h\nu_0}{V_0}$

(B) $\frac{V_0}{\nu_0}$

(C) $\frac{\nu_0}{V_0}$

(D) $\frac{h}{e}$

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13. An object is dropped from a certain point A at a height 'h' from the ground. During its journey straight downwards, the object passes points B and C such that the ratio of time taken t_1 to cover AB and t_2 to cover BC is $1 : (\sqrt{2}-1)$. What is the ratio of distances $AB : BC$?

(A) $\sqrt{2}:1$

(B) $(\sqrt{2}-1):1$

(C) $1:1$

(D) $1:\sqrt{2}$

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14. A wire made of a certain material of length l and area of cross section a can withstand a maximum load W without breaking. If another wire of the same material and cross-sectional area is used with double the original length, what will be the maximum load that the wire can withstand without breaking?

(A) Remains the same $= W$

(B) Will be halved to $0.5W$

(C) Would be four times $= 4W$

(D) Will be doubled to $2W$

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15. If μ_0 is the permeability of free space and ε_0 is the permittivity of free space, then the dimension for $(\mu_0\varepsilon_0)$ is:

(A) $[L^{-1}T]$

(B) $[MLT^{-1}]$

(C) $[L^{-2}T^2]$

(D) $[ML^{-1}T]$

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16. An object placed 40 cm in front of a thin convex lens is moved to 60 cm from the lens. If the focal length of the lens is 30 cm, the ratio of magnification of the image at the initial position to the final position is:

(A) $1:3$

(B) $3:1$

(C) $2:3$

(D) $3:2$

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17. A singer, during his performance, stands on the edge of a circular turntable and begins to walk along its edge with a speed of 1.5 m s^{-1} relative to the ground. The turntable is mounted on a frictionless vertical axle. Its radius $R = 3$ m and its moment of inertia about the axle is

150 kg m^2. It is initially at rest. If the mass of the singer is 75 kg, the time taken by the man to complete one full revolution relative to the ground is:

(A) 12.57 s

(B) 20.5 s

(C) 6.28 s

(D) 8.56 s

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18. A particle moves along a parabolic path $y = 9x^2$ in such a way that the x-component of velocity remains constant. If the total acceleration of the particle is $2\hat{j}$ m s^{-2}, find the x-component of velocity.

(A) $\frac{1}{9}$ m s^{-1}

(B) $\frac{1}{3}$ m s^{-1}

(C) $\frac{1}{4}$ m s^{-1}

(D) $\frac{1}{6}$ m s^{-1}

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19. A circular coil of radius $r = 10$ cm having 300 turns carries a current of 2 A. The coil is suspended vertically in a uniform magnetic field of strength 0.7 T. If the plane of the coil makes an angle of 30° with the magnetic field, the torque needed to prevent it from turning is:

(A) 22.84 N m

(B) 1.1 N m

(C) 5.71 N m

(D) 11.42 N m

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20. Two point charges $P = +25\mu$C and $Q = -16\mu$C are placed 5 cm apart. Find the position of the point at which the resultant electric field is zero:

(A) 25 cm from Q and 20 cm from P on the dipole axis

(B) 20 cm from Q and 25 cm from P on the dipole axis

(C) 2.5 cm from Q and 2.5 cm from P on the dipole axis

(D) 1 cm from Q and 4 cm from P on the dipole axis

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21. The ratio of the angle of deviation produced by a thin prism, when it is placed in air to the angle of deviation produced when it is immersed in water of refractive index $\frac{4}{3}$ is: (Take

refractive index of glass $= \frac{3}{2}$)

(A) 1 : 4

(B) 9 : 8

(C) 4 : 1

(D) 8 : 9

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22. A source of alternating emf $e = \varepsilon_0 \sin(\omega t)$ is connected to a pure capacitor. Then the instantaneous current in the circuit is:

(A) $I = I_0 \sin\left(\omega t + \frac{\pi}{2}\right)$

(B) $I = \sqrt{2} I_0 \sin\left(\omega t + \frac{\pi}{2}\right)$

(C) $I = I_0 \sin(\omega t)$

(D) $I = I_0 \sin\left(\omega t - \frac{\pi}{2}\right)$

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23. The distance between the objective and eyepiece of an astronomical telescope in normal adjustment is 27 cm and its magnifying power is 8. What is the focal length of the eyepiece?

(A) 24 cm

(B) 12 cm

(C) 6 cm

(D) 3 cm

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24. Resonance is produced between a tuning fork and a resonance column tube with its upper end open and lower end closed by a water surface. If the frequency of the tuning fork is 800 Hz, and the first two resonances are observed at lengths 9.75 cm and 31.25 cm, find the length at which the third resonance occurs and the speed of sound.

(A) 43.10 cm and 340 m s^{-1}

(B) 31.25 cm and 330 m s^{-1}

(C) 62.60 cm and 335 m s^{-1}

(D) 52.75 cm and 344 m s^{-1}

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25. If the ratio of the nuclear radii of two atoms is 2 : 3, then the ratio of their mass numbers is:

(A) 4 : 9

(B) 9 : 4

(C) 8 : 27

(D) 27 : 8

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26. A pith ball of mass m grams and charge Q is suspended using a massless silk thread near a large charged conducting metal sheet of area A and surface charge density σ. If the silk thread makes an angle θ with the metal sheet, then $\tan\theta$ is equal to:

(A) $\frac{Q\sigma}{2\varepsilon_0 mg}$

(B) $\frac{Q\sigma}{\varepsilon_0 mg}$

(C) $\frac{Q\sigma}{2A\varepsilon_0 mg}$

(D) $\frac{\varepsilon_0 mg}{Q\sigma}$

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27. The main function of cadmium rods used in a nuclear reactor is to:

(A) Remove the heat produced at the core of the reactor

(B) Slow down the fast-moving secondary neutrons produced during nuclear fission

(C) Capture slow neutrons to control the chain reaction rate

(D) Give energy to the secondary neutrons produced in nuclear fission

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28. A vessel of volume 27×10^4 cc contains a mixture of Hydrogen (molar mass $= 2$ g mol^{-1}) and Oxygen (molar mass $= 32$ g mol^{-1}) gas at standard temperature and pressure (S.T.P.). If the mass of hydrogen is 16 g, find the mass of oxygen gas contained in the vessel.

(A) 64 g

(B) 72 g

(C) 129.7 g

(D) 160 g

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29. A capacitor of capacitance 8μF is fully charged by connecting it to a source of 200 V. It is then disconnected from the supply and connected to an uncharged capacitor of capacitance 4μF. The electrostatic energy lost in this sharing process is:

(A) 5.33×10^{-2} J

(B) 21.34×10^{-2} J

(C) 10.67×10^{-2} J

(D) 3.53×10^{-3} J

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30. An electric field of 1.8×10^4 V m^{-1} and a magnetic field of 6×10^{-3} T are applied simultaneously on an electron beam such that the path of the beam remains undeviated. Then the speed of the electron will be:

(A) 3×10^7 m s^{-1}

(B) 1.5×10^7 m s^{-1}

(C) 3×10^6 m s^{-1}

(D) 1.5×10^6 m s^{-1}

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31. A hydrogen atom absorbs energy and rises to the $n = 3$ state from its ground state $n = 1$. If the potential energy of the atom at its ground state is -27.2 eV, find the wavelength emitted by it when it returns to its ground state: (Take Planck's constant $= 6.6 \times 10^{-34}$ J s, speed of light $= 3 \times 10^8$ m s^{-1})

(A) 4000 °A

(B) 7000 °A

(C) 12000 °A

(D) 1020 °A

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32. A block of mass 1.5 kg moves along the floor of a hall with an initial speed of 5 m s^{-1}. It strikes an uncompressed spring and compresses it till the block becomes motionless. If the force constant of the spring is 10000 N m^{-1} and the spring is compressed by 5 cm, calculate the effective force of kinetic friction.

(A) 125 N

(B) 16.4 N

(C) 0 N

(D) 18.7 N

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33. In a single-slit diffraction experiment, the diffraction pattern is observed on a screen placed at a distance of 2 m from a slit of width 1 mm. If the distance between the first dark fringe on either side of the central bright fringe is 2.2 mm, what is the wavelength of the monochromatic

light used in this experiment?

(A) 5500 °A

(B) 11000 °A

(C) 1100 °A

(D) 3900 °A

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34. A uniform electric field of 5×10^3 N C^{-1} is maintained in the positive Y-direction. Now a point charge of 2×10^{-4} C at rest is released from the origin. The kinetic energy attained by the charge when it is at a distance of 5 m from the origin is:

(A) 25 J

(B) 10 J

(C) 5 J

(D) 50 J

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35. The basic principle behind the working of an electron microscope is:

(A) Using charged mirrors to achieve the desired magnification.

(B) Magnifying power of very thin aperture convex lenses.

(C) Electrostatic field created by a beam of electrons.

(D) Wave nature of electrons.

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36. A galvanometer of resistance 50 Ω has 30 divisions and a current sensitivity of 1 mA/div. What should be the shunt resistance so that it can be converted into an ammeter of range 10 A?

(A) 3.15 Ω

(B) 1.55 Ω

(C) 0.15 Ω

(D) 2.50 Ω

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37. The dimensional formula for specific resistance (resistivity) is:

(A) $[ML^{-3}T^{-2}A^{-2}]$

(B) $[ML^{3}T^{-3}A^{-2}]$

(C) $[ML^3T^{-3}A^2]$

(D) $[ML^3T^3A^2]$

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38. In a given circuit, the instantaneous values of alternating voltage and current are $V = 0.5\sin(80\pi t + \pi)$ volts and $I = 0.5\sin(80\pi t)$ amperes respectively. Find the average power consumed in the circuit.

(A) 0.0625 W

(B) 1.25 W

(C) 0.625 W

(D) −0.125 W

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39. A bullet fired into a door gets embedded exactly at its center, causing the door to rotate about its vertical hinge axis practically without friction with an angular velocity of 0.625 rad s^{-1}. The door is 1.0 m wide and weighs 12 kg. If the mass of the bullet is 10 g, find the speed with which it was fired. (Hint: The moment of inertia of the door about the vertical axis at one end is $I = \frac{ML^2}{3}$)

(A) 645 m s^{-1}

(B) 342 m s^{-1}

(C) 124 m s^{-1}

(D) 500 m s^{-1}

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40. The current through a circular coil is halved and the radius of the coil is doubled. If B_1 and B_2 are respectively the initial and final magnetic field strengths at the center of the coil, then:

(A) $B_2 = \frac{B_1}{2}$

(B) $B_2 = 4B_1$

(C) $B_2 = 2B_1$

(D) $B_2 = \frac{B_1}{4}$

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41. On both sides of a magnetic needle, two short magnets A and B are placed on the same horizontal line which is perpendicular to the magnetic meridian. The south poles of A and B are facing each other, which are 10 cm and 20 cm respectively from the magnetic needle. If the needle remains undeflected, the ratio of the magnetic moment of A to that of B is:

(A) 1 : 8

(B) 2 : 1

(C) 8 : 1

(D) 1 : 2

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42. What is the minimum wavelength of radiation required to detect a p-n junction diode made of a semiconductor having a band gap of 3.3 **eV? (Take Planck's constant** $h = 6.6 \times 10^{-34}$ **J s, speed of light** $c = 3 \times 10^{8}$ **m s**$^{-1}$**)**

(A) 3300 °A

(B) 4800 °A

(C) 3750 °A

(D) 7500 °A

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43. The atomic mass of an element ${}_{10}X^{20}$ **is** 19.98170 **amu. The binding energy per nucleon of that element is: (Given mass of neutron** = 1.00867 **amu, mass of proton** = 1.00783 **amu, and** 1 **amu** = 931 **MeV)**

(A) 8.533 MeV/nucleon

(B) 85.33 MeV/nucleon

(C) 170.66 MeV/nucleon

(D) 17.66 MeV/nucleon

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44. When a metal of work function 1.4 **eV is exposed to radiation, the maximum kinetic energy of the emitted electrons is** 0.4 **eV. The stopping potential required is:**

(A) 1.4 V

(B) 2.8 V

(C) 0.2 V

(D) 0.4 V

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45. Pick out the correct statement from the following:

(A) The maximum energy required to shift an electron from the conduction band to valence band is called the energy band gap

(B) In a semiconductor, no free electrons are found in the conduction band at 0 K

(C) The number density of free electrons in the valence band decides the strength of the electric current

(D) Valence band is always completely filled, while conduction band is always partially filled

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46. The width of the fringes obtained with light of wavelength 6.2×10^{-7} m is 1.82 mm. If the entire apparatus is immersed in a liquid of refractive index 1.3, what will be the width of the resulting fringes?

(A) 1.82 mm

(B) 0.71 mm

(C) 2.8 mm

(D) 1.4 mm

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47. A charge of 5μC is placed at the center of a spherical shell S_1 of radius 10 cm. Now this system is enclosed inside another spherical shell S_2 of radius 20 cm. The ratio of the electrical flux through the surface S_2 to S_1 is:

(A) 1 : 1

(B) 4 : 1

(C) 2 : 1

(D) 1 : 2

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48. In the equation $X = G^{1/2}h^{1/2}c^{-5/2}$, where G is the universal gravitational constant, h is Planck's constant, and c is the velocity of light, the dimensions of X match those of:

(A) Momentum

(B) Stress

(C) Upthrust

(D) Length

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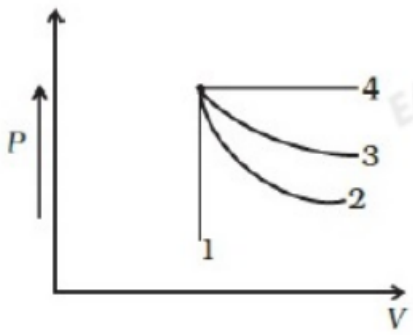
49. The given graph shows four different processes (adiabatic, isothermal, isobaric, and isochoric) for an ideal gas starting from the same initial state. Study the graph carefully and state which statement is correct:



(A) Process 3 is isochoric

(B) Process 2 is isobaric

(C) Process 1 is isochoric

(D) Process 4 is adiabatic

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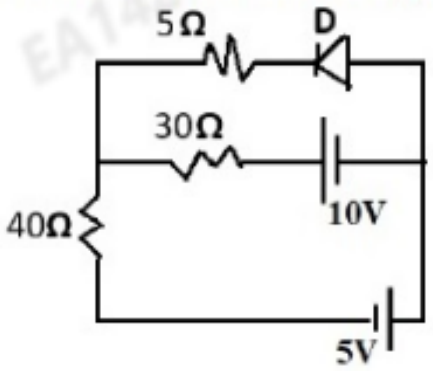
50. Find the current through the 40 Ω resistor in the given circuit containing an ideal diode, three resistors, and two cells.



(A) 0.21 A

(B) 1.2 A

(C) 0.5 A

(D) 2.1 A

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51. A parallel combination of 'n' cells of emf 'E' and internal resistance each, are connected across the external resistance 'R'. If the external resistance 'R' is negligibly small, then the current 'I' through the external resistance is:

(A) $I = \frac{nE}{R}$

(B) $I = \frac{rE}{n}$

(C) $I = \frac{E}{nR}$

(D) $I = \frac{E}{R}$

52. What is the frequency of the electron in the first orbit of hydrogen atom of orbital radius 0.5×10^{-10} m, if its orbital velocity in that orbit is 2.2×10^{6} m s^{-1}?

(A) 3.49×10^{13} Hz

(B) 6.98×10^{15} Hz

(C) 6.98×10^{13} Hz

(D) 3.49×10^{15} Hz

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53. Force constant of interatomic bond, in a certain element, is 1 N m^{-1}. If the atom oscillates in SHM in a certain direction, what is its frequency? Given: Mole weight of the given element is 108 g and Avogadro's number $= 6.023 \times 10^{23}$ g mol^{-1}.

(A) 0.005×10^{12} s^{-1}

(B) 6.667×10^{12} s^{-1}

(C) 1×10^{12} s^{-1}

(D) 3.45×10^{22} s^{-1}

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54. If the intensity of the central maximum in the Young's double slit experiment is I_0, what will be the intensity at the same region when one of the slits is blocked by an opaque object?

(A) I_0

(B) $\frac{I_0}{2}$

(C) $\frac{I_0}{4}$

(D) $\frac{I_0}{8}$

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55. An electronic device operates at 2 MHz. The oscillating circuit has an inductance 20×10^{-5} H. What is the capacitive reactance of the resonant circuit?

(A) $2512\ \Omega$

(B) $1256\ \Omega$

(C) $5024\ \Omega$

(D) $251.2\ \Omega$

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56. A block of metal, of 25 g mass moves down without acceleration when the plane is inclined at an angle of 30°. When the inclination is increased by 30°, find the downward acceleration

of the block.

(A) 1.9 m s^{-2}

(B) 2.6 m s^{-2}

(C) 5.66 m s^{-2}

(D) 3.8 m s^{-2}

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57. Two particles, one heavy and the other light, placed at 50 cm from each other, are under the influence of gravitational force of one another. If mass of the heavier particle is 4 kg and its acceleration under the influence of gravitational force is 5×10^{-10} m s^{-2}, find the mass of the lighter particle.

(A) 7.843 kg

(B) 1.8728 kg

(C) 3.675 kg

(D) 0.364 kg

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58. Bodies P, Q, R, S are labelled as having charges $Q_P = 0.5 \times 10^{-19}$ C, $Q_Q = 0.7 \times 10^{-19}$ C, $Q_R = 2.1 \times 10^{-19}$ C, $Q_S = 4.8 \times 10^{-19}$ C respectively. Select the body having the correct charge. [Given electronic charge $e = 1.6 \times 10^{-19}$ C]

(A) $Q_P = 0.5 \times 10^{-19}$ C

(B) $Q_S = 4.8 \times 10^{-19}$ C

(C) $Q_R = 2.1 \times 10^{-19}$ C

(D) $Q_Q = 0.7 \times 10^{-19}$ C

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59. Two neutral bodies of masses m_1 and m_2 are kept at a distance of r cm from one another in a vacuum medium. A gravitational force F acts between the two bodies. The entire set-up is then transferred, as it is, to a water medium. The force between the bodies is then F_w. The ratio of F to F_w is:

(A) 1 : 3

(B) 1 : 1.33

(C) 1 : 1

(D) 3 : 2

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60. Find the mass of oxygen gas with which 1.882×10^{23} degrees of freedom are associated at N.T.P. Given: Molar mass of diatomic gas, oxygen is 32 g mol^{-1} and oxygen molecule possess three translational and two rotational degrees of freedom.

(A) 16 g

(B) 2 g

(C) 32 g

(D) 5 g

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61. In the synthesis of NH_3 from H_2 and N_2 if 6×10^{-2} mole of hydrogen disappears in 10 minutes, the number of moles of NH_3 formed in 0.3 minutes is:

(A) 1.2×10^{-3} moles

(B) 4.0×10^{-3} moles

(C) 6.0×10^{-3} moles

(D) 1.5×10^{-3} moles

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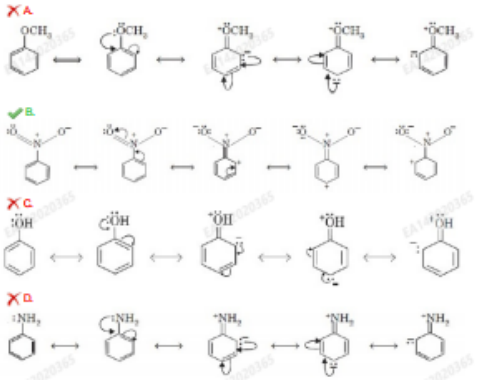
62. Among the given resonating structures of molecules negative mesomeric effect is represented by:



(A) Nitrobenzene orientation ($-NO_2$)

(B) Anisole orientation ($-OCH_3$)

(C) Phenoxide ion orientation ($-O^-$)

(D) Aniline orientation ($-NH_2$)

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63. Choose the incorrect statement.

(A) Relative ease of dehydration of alcohols on heating with a protic acid is Primary > Secondary > Tertiary

(B) Reaction of alcohols with anhydrides is carried out in the presence of small amounts of Conc. H_2SO_4 to remove the water formed

(C) p-Nitrophenol is more acidic than p-Cresol

(D) Cyclic C_4H_7OH exists as four structural isomers

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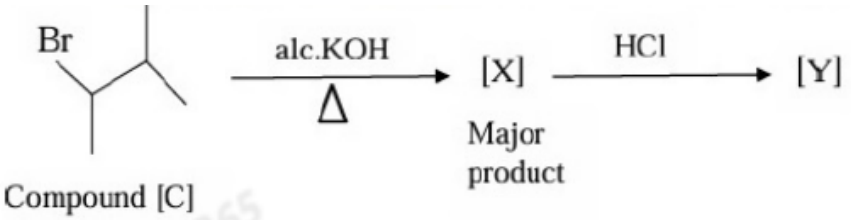
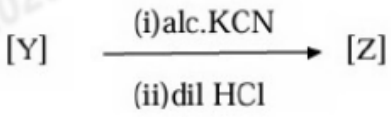
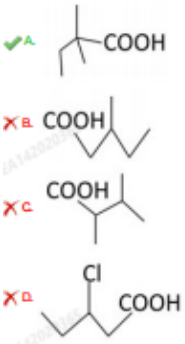
64. What is the major product [Z] formed when compound [C] undergoes the following reactions?







[C] (Cyclohexyl bromide) $\xrightarrow[\Delta]{\text{alc. KOH}}$ **[X]** $\xrightarrow{\text{HCl}}$ **[Y]** $\xrightarrow{\text{(i) alc. KCN, (ii) dil. HCl}}$ **[Z]**

Option A

Option B

Option C

Option D

---

65. The ΔG° for the reaction, $Cd^{2+}(aq)+Zn(s) \rightarrow Zn^{2+}(aq)+Cd(s)$ is: (Given $E^\circ_{Cd^{2+}/Cd} = -0.403$ V, $E^\circ_{Zn^{2+}/Zn} = -0.763$ V)

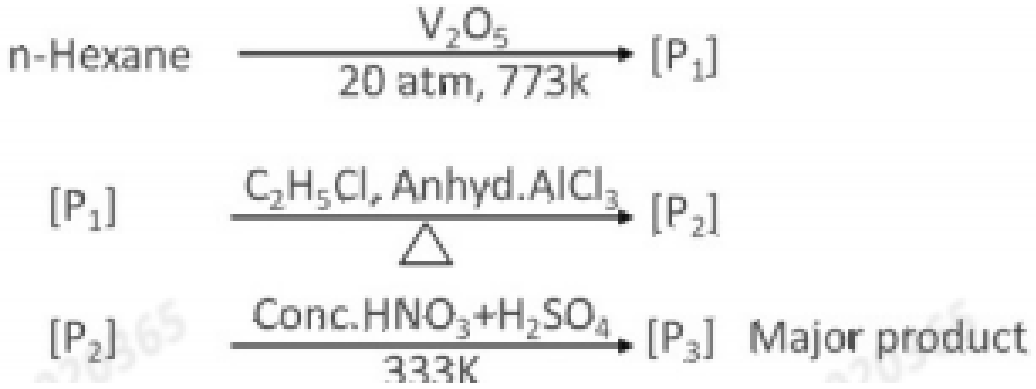
(A) −44.5 kJ

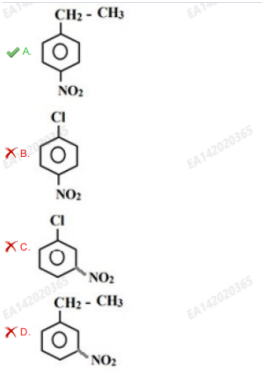
(B) −50 kJ

(C) −72.2 kJ

(D) −69.5 kJ

66. What is the major product [P3] formed when n-Hexane undergoes the given series of reactions?





$$\text{n-Hexane} \xrightarrow[\text{20 atm, 773 K}]{V_2O_5} [P] \xrightarrow[\Delta]{C_2H_5Cl,\ \text{Anhyd. } AlCl_3} [P2] \xrightarrow[\text{333 K}]{\text{Conc. } HNO_3+H_2SO_4} [P3]$$

Option (A)

Option (B)

Option (C)

Option (D)

---

67. A small segment of a polypeptide gave on complete hydrolysis 3 molecules of alanine, 2 molecules of glycine, and 3 molecules of cysteine. What is the number of peptide linkages in the segment of the polypeptide?

(A) 7

(B) 8

(C) 5

(D) 6

---

68. x moles of $K_2Cr_2O_7$ oxidises 1 mole of ferrous oxalate, in acidic medium. Hence 'x' is:

(A) 1.0

(B) 0.5

(C) 1.5

(D) 2

---

69. Identify the INCORRECT statement.

(A) At 273 K, for the transition Ice(s) $\rightarrow$ Water(l), $\Delta G = 0$

(B) Entropy is an extensive property and state function

(C) For spontaneous process $(\Delta H_{\text{system}} - T\Delta S_{\text{system}}) < 0$

(D) A process will always be spontaneous at all temperatures, if $T\Delta S$ is positive

---

70. The quantity of Ca that can be produced from molten $CaCl_2$, with the same quantity of electricity (in coulombs) required to produce 4.8 g of Mg from molten $MgCl_2$ is: [Atomic mass of Mg = 24 u; Atomic mass of Ca = 40 u]

(A) 5.2 g

(B) 4.8 g

(C) 6.0 g

(D) 8.0 g

---

71. A first order reaction is 50% complete in 30 minutes at 300 K and in 10 minutes at 320 K. The activation energy of the reaction (E_a) is: [R = 8.314 J K^{-1} mol^{-1}, log 2 = 0.3010; log 3 = 0.4771]

(A) 75.2 kJ mol^{-1}

(B) 43.8 kJ mol^{-1}

(C) 23.7 kJ mol^{-1}

(D) 52.5 kJ mol^{-1}

---

72. An unsaturated organic compound (C_3H_6), undergoes the following series of reactions:

$$C_3H_6 \xrightarrow{\text{dil. } H_2SO_4} [B] \xrightarrow{+HCl/ZnCl_2} [C] \xrightarrow{\text{Na / dry ether}} [D] \text{ (Major Product)}$$

Identify compound [D].

(A) Cyclohexane

(B) Hexane

(C) 2,3-dimethylbutane

(D) 2-methyl pentane

---

73. Which of the following is an INCORRECT match?

(A) Metallic character: $Al > Mg > B > K$

(B) First Ionization Enthalpies: $Na < Mg > Al < Si$

(C) Electron Gain enthalpy: $F < Cl > Br > I$

(D) Ionic size: $Na^{+} > Mg^{+2} > Al^{+3} > Si^{+4}$

---

74. Which one of the following complex-isomerism pair matches correctly?

(A) $[PtCl_2(NH_3)_2]$ - Exhibits both cis-trans and optical isomerism

(B) $[CrCl_2(ox)_2]^{3-}$ - Exhibits cis-trans isomerism and cis isomer is optically active

(C) $[Cr(C_2O_4)_3]^{3-}$ - Exhibits cis-trans isomerism and both exhibit optical isomerism

(D) $[Fe(CN)_4(NH_3)_2]^{-}$ - Exhibits cis-trans isomerism but is optically inactive

---

75. Choose the incorrect statement.

(A) Propan-2-amine can be obtained by reacting acetoxime with Na/C_2H_5OH

(B) Fluorobenzene cannot be prepared from Benzenediazonium chloride by Sandmeyer's reaction because Fluorination of the Diazonium salt is highly endothermic in nature

(C) The decreasing order of basic strength of amines in aqueous solution is Ethanamine > N,N-Dimethylaniline > Benzenamine

(D) Aniline cannot be prepared by Phthalimide reaction

---

76. Identify the complex which exhibits all 3 characteristics: paramagnetic; high spin configuration; octahedral geometry.

(A) $[Ni(H_2O)_2(C_2O_4)_2]^{2-}$

(B) $[Co(NH_3)(Cl)(en)_2]^{2+}$

(C) $[Co(NH_3)_5Cl]Cl_2$

(D) $[Ni(CO)_4]$

---

77. Resistance of 0.2 M solution of an electrolyte is $50\ \Omega$. The conductivity of the solution is 1.3 S m^{-1}. If the resistance of 0.4 M solution of the same electrolyte is $260\ \Omega$, its molar conductivity is:

(A) 6.25×10^{-3} S m^2 mol^{-1}

(B) 6.25×10^{-4} S m^2 mol^{-1}

(C) 625×10^{-4} S m^2 mol^{-1}

(D) 62.5×10^{-4} S m^2 mol^{-1}

---

78. Consider the series of reactions given and identify the final product [Z].

$$\textbf{Cyclohexanol} \xrightarrow{20\%\ H_3PO_4,\Delta} [W] \xrightarrow{(i)\ (BH_3)_2\ \text{in THF, (ii)}\ H_2O_2/NaOH} [X] \xrightarrow{CrO_3} [Y] \xrightarrow{(i)\ C_6H_5MgBr,\ (ii)\ H_2O} [Z]$$

(A) 1-Phenylcyclohexanol

(B) Benzylcyclohexane

(C) Cyclohexyl phenyl ketone

(D) 2-Phenylcyclohexanol

---

79. For an ideal gas undergoing an isothermal change, there is:

(A) a decrease in Internal energy of the system and heat released by the system is equal to the work done by the system

(B) an increase in Internal energy of the system and heat absorbed by the system is greater than the work done on the system

(C) no change in Internal energy of the system and heat released by the system is equal to the work done by the system

(D) no change in Internal energy of the system and heat absorbed by the system is equal to the work done by the system

---

80. According to Molecular orbital theory, which of the following is correct with respect to bond order?

(A) Bond order of N_2^+ and O_2^+ is less than O_2

(B) Bond order of N_2^+ and O_2^+ is more than N_2

(C) Bond order of N_2^+ is less than N_2 while that of O_2^+ is more than O_2

(D) Bond order of N_2^+ is less than O_2 while that of O_2^+ is more than O_2

---

81. The element with the highest third ionisation enthalpy is:

(A) Vanadium ($Z = 23$)

(B) Iron ($Z = 26$)

(C) Manganese ($Z = 25$)

(D) Chromium ($Z = 24$)

---

82. The frequency of photon which is emitted during a transition of electron of He^+ ion from fifth energy level to third energy level will be:

(A) $9.39 \times 10^{14}\ s^{-1}$

(B) $1.34 \times 10^{-14}\ s^{-1}$

(C) $2.34 \times 10^{14}\ s^{-1}$

(D) $8.29 \times 10^{-14}\ s^{-1}$

---

83. Which of the following is an INCORRECT statement?

(A) In sodium nitroprusside test for Sulphur, the violet colour is due to formation of complex $Na_4[Fe(CN)_5NOS]$

(B) CH_3OH and CH_3COCH_3 are separated by fractional distillation

(C) CH_3COO^-, CN^-, CH_3OH, CH_3-O-CH_3, $(CH_3)_3N$ are nucleophiles

(D) $AlCl_3$, NH_3, SO_3, NO_2^+, H_2O are electrophiles

---

84. Which of the following statement is correct?

(A) Photon has momentum as well as wavelength, but electrons do not have momentum and wavelength

(B) In photoelectric effect if frequency $\nu > \nu_0$, then photoelectrons are ejected with certain kinetic energy

(C) Azimuthal Quantum number explains about spatial orientation of orbital

(D) Heisenberg uncertainty principle can be applied to all the objects and for macroscopic objects the uncertainty is extremely large

---

85. In the redox reaction, taking place in acidic medium:

$$\mathbf{X}\ \mathbf{MnO_4^-}(aq) + \mathbf{Y}\ \mathbf{SO_2}(g) \rightarrow \mathbf{Mn^{+2}}(aq) + \mathbf{HSO_4^-}(aq),$$

the ratio of X:Y in a stoichiometrically balanced equation will be:

(A) 5 : 2

(B) 1 : 2

(C) 2 : 3

(D) 2 : 5

---

86. 500 **mL of an aqueous solution of glucose** $C_6H_{12}O_6$ **(Molar mass** 180 **g mol**$^{-1}$**) contains** 6.02×10^{22} **molecules. The concentration of the solution will be:**

(A) 2.0 M

(B) 1.0 M

(C) 0.2 M

(D) 0.1 M

---

87. The product and its colour when MnO_2 **is fused with KOH in presence of** O_2**:**

(A) Mn_2O_3, Brown

(B) $KMnO_4$, Purple

(C) K_2MnO_4, Dark green

(D) MnO_2, Black

---

88. Using the data given below, the strongest reducing agent is:

$$E^\circ_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33 \text{ V}, E^\circ_{Cl_2/Cl^-} = 1.36 \text{ V}, E^\circ_{MnO_4^-/Mn^{2+}} = 1.51 \text{ V}, E^\circ_{Cr^{3+}/Cr} = -0.74 \text{ V}$$

(A) Cr

(B) Mn^{2+}

(C) Cl^-

(D) Cr^{3+}

---

89. At 30°C **the solubility of** PbI_2 **salt in** 0.2 **M KI solution will be X, if the solubility product of** PbI_2 **at** 30°C **is** 2.4×10^{-9}**. Identify the value of X.**

(A) 3.0×10^{-8} M

(B) 2.4×10^{-8} M

(C) 4.8×10^{-7} M

(D) 6.0×10^{-7} M

---

90. With reference to the two statements Assertion and Reason, choose the correct option.

Assertion: The order of reactivity towards S_N1 reaction is: $C_6H_5CH_2Br > (CH_3)_2CH\text{-}Br > CH_3 - CH_2Br$

Reason: Among the given 3 compounds, the Benzyl carbocation formed is the most stable while Isopropyl carbocation is the least stable one

(A) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion

(C) Reason is correct but Assertion is wrong

(D) Assertion is correct but Reason is wrong

---

91. Match the reactions in List I with the final products formed as given in List II.

List I		List II	
W	$C_6H_5CH_3 \xrightarrow[\text{(ii) } H_3O^+ + \text{heat}]{\text{(i) } CrO_3 + (CH_3CO)_2O}$	P	R_2CO
X	$RCOOC_2H_5 \xrightarrow[\text{(ii) } H_2O]{\text{(i) DIBAL-H}}$	Q	$C_6H_5COCH_3$
Y	$RCN \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) R-MgX/dry ether}}$	R	C_6H_5CHO
Z	$C_6H_5COCl + (CH_3)_2Cd \rightarrow$	S	RCHO

(A) W - R, X - S, Y - P, Z - Q

(B) W - R, X - P, Y - Q, Z - S

(C) W - S, X - R, Y - Q, Z - P

(D) W - Q, X - P, Y - S, Z - R

---

92. Identify the final product formed when benzenamine reacts with the given reagents in the sequential order as: (i) $(CH_3CO)_2O$**/Pyridine, (ii) Conc.** $HNO_3 + H_2SO_4$ **followed by** H_3O^+**, (iii)** $NaNO_2/HCl$ **(273 K) followed by** $H_3PO_2(aq)$**.**

(A) 2-Chloro-4-Nitrophenol

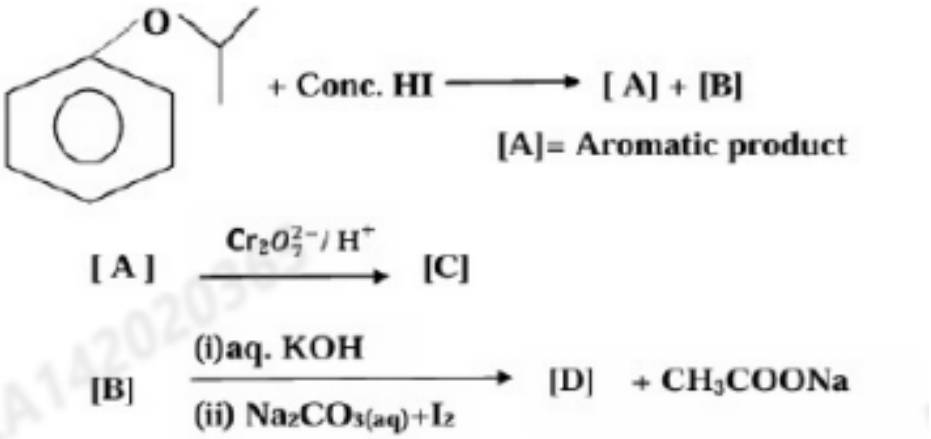
(B) Nitrobenzene

(C) 4-Nitrophenol

(D) 4-Chloro-2-Nitroaniline

93.

A compound [X] (Isopropyl phenyl ether) undergoes reactions as given below. Identify compounds [C] and [D] formed in these reactions.



(A) [C]: Benzoquinone [D]: Iodoform

(B) [C]: Benzene [D]: 2-Iodopropane

(C) [C]: Benzoic acid [D]: Iodoform

(D) [C]: 4-Iodophenol [D]: 1-Iodopropane

---

94. An equilibrium mixture taken in 2 litre vessel of the reaction:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

has 4 moles of SO_2, 3 moles of O_2 and 6 moles of SO_3 then the value of equilibrium constant (K_c) will be:

(A) 0.75 L mol^{-1}

(B) 0.15 mol L^{-1}

(C) 1.5 L mol^{-1}

(D) 15 mol L^{-1}

---

95. The standard enthalpies of formation of $CH_4(g)$, $CO_2(g)$ and $H_2O(l)$ are -74.8, -393.5 and -285.8 kJ mol^{-1} respectively. Calculate ΔH for:

$$2CH_4(g) + 4O_2(g) \rightarrow 2CO_2(g) + 4H_2O(l)$$

(A) +890.3

(B) −890.3

(C) -1780.6

(D) $+1780.6$

---

96. Which of the following does not correctly represent the order of the property indicated against it?

(A) $Ti^{3+} < V^{3+} < Cr^{3+} < Mn^{3+}$ [Increasing order of magnetic moment]

(B) Ti < V < Cr < Mn [Increasing order of melting point]

(C) Ti < V < Cr < Mn [Increasing order of highest oxidation state]

(D) Ti < V < Mn < Cr [Increasing order of second ionisation enthalpy]

---

97. A 5% solution of cane sugar (342 g/mol) in water has a freezing point of 271 K. Find the freezing point of a 5% glucose (180 g/mol) solution. [Water $T_f = 273.15$ K]

(A) 271 K

(B) 269 K

(C) 259 K

(D) 273 K

---

98. Assertion(A): Propene reacts with HBr in presence of organic peroxide gives 1-bromopropane. Reason(R): The reaction occurs through carbocation intermediate.

(A) Both A and R are true but R is not the correct explanation.

(B) A is false but R is true.

(C) A is true but R is false.

(D) Both A and R are true and R is the correct explanation.

---

99. Arrange in increasing order of boiling points: (A) 2,2-dimethylpropane, (B) 2-methylbutane, (C) n-pentane, (D) n-butane.

(A) A < B < C < D

(B) C < A < B < D

(C) D < A < B < C

(D) D < C < B < A

---

100. Which one of the following is the correct statement?

(1) Acetone undergoes reaction in presence of $Ba(OH)_2$ on heating to form 4-Methylpent-3-en-2-one.

(2) Acetone reacts with NH_2NH_2/KOH to form Butane.

(3) Acetophenone cannot be prepared from Benzoyl chloride and Dimethyl cadmium.

(4) Acetophenone does not undergo iodoform test.

---

101. The initial pressure of the system for the reaction

$$A(g) \rightarrow B(g) + C(g)$$

was P_i. Total pressure at time t is P_t. The rate constant k is:

(1) $k = \frac{2.303}{t} \log \frac{P_i}{2P_i - P_t}$

(2) $k = \frac{2.303}{t} \log \frac{P_i}{P_i - P_t}$

(3) $k = \frac{2.303}{t} \log \frac{P_t}{P_i}$

(4) $k = \frac{2.303}{t} \log \frac{2P_t}{P_i}$

---

102. Which factor is altered by a catalyst?

(1) Internal energy

(2) Activation energy

(3) Entropy

(4) Enthalpy

---

103. Bond pairs and lone pairs in IF_5 are respectively:

(1) 4,2

(2) 5,1

(3) 6,0

(4) 4,1

---

104. *o*-hydroxybenzaldehyde is a liquid while the *p*-isomer is a solid because:

(1) *o*-isomer shows intramolecular hydrogen bonding while *p*-isomer shows intermolecular hydrogen bonding.

(2) *o*-isomer shows intermolecular hydrogen bonding while *p*-isomer shows intramolecular hydrogen

bonding.

(3) Both show intermolecular hydrogen bonding.

(4) Both show intramolecular hydrogen bonding.

---

105. Which of the following is true for a spontaneous galvanic cell?

(1) $E^{\circ}_{cell} < 0,\ \Delta G^{\circ} > 0,\ Q_c > K_c$

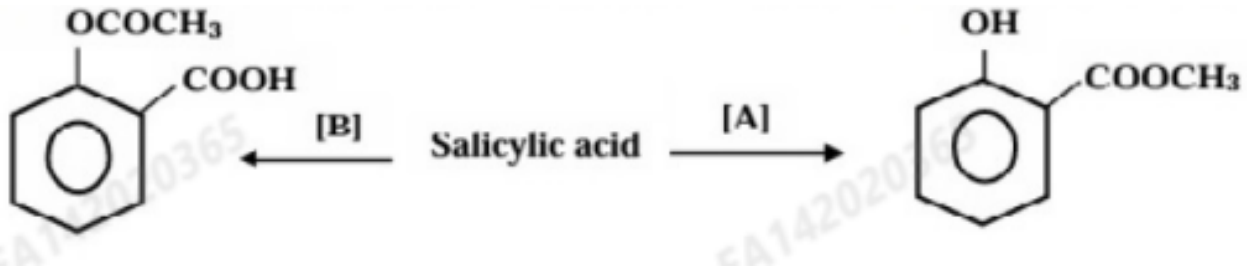
(2) $E^{\circ}_{cell} = 0,\ \Delta G^{\circ} = 0,\ Q_c = K_c$

(3) $E^{\circ}_{cell} < 0,\ \Delta G^{\circ} < 0,\ Q_c < K_c$

(4) $E^{\circ}_{cell} > 0,\ \Delta G^{\circ} < 0,\ Q_c < K_c$

---

106. Identify reagents [A] and [B] in the following reactions of Salicylic acid.



(1) [A]: C_2H_5OH/H^+, [B]: CH_3COCl

(2) [A]: CH_3OH/H^+, [B]: $(CH_3CO)_2O/H^+$

(3) [A]: NaOH, [B]: HCl

(4) [A]: Zn/Hg, [B]: $KMnO_4$

---

107. Assertion (A): Mercury is not a transition element.

Reason (R): Mercury is a liquid metal.

(1) Both A and R are true and R is the correct explanation.

(2) Both A and R are true but R is not the correct explanation.

(3) A is true but R is false.

(4) A is false but R is true.

---

108. One mole of benzene is mixed with one mole of toluene. The vapours above the solution contain:

(1) Equal percentages of benzene and toluene

(2) Higher percentage of benzene

(3) Higher percentage of toluene

(4) Only benzene vapours

---

109. Which of the following statements is correct?

(1) Glucose is a ketose sugar.

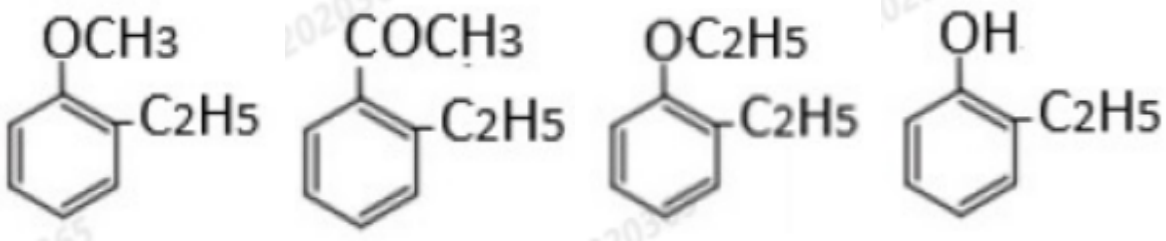
(2) Glucose does not reduce Tollens' reagent.

(3) Glucose is oxidized to gluconic acid by $Br_2(aq)$.

(4) Glucose gives negative Fehling test.

---

110. Identify *o*-ethyl anisole.



(A) FigA

(B) FigB

(C) FigC

(D) FigD

111.

A compound C_3H_5N undergoes reduction to form a primary amine. The amine gives compounds [B] and [C] in the following reactions. Identify [B] and [C].

(1) [B]: alcohol, [C]: nitrile

(2) [B]: ketone, [C]: amide

(3) [B]: amide, [C]: isocyanide

(4) [B]: aldehyde, [C]: nitro compound

---

112. The system that forms maximum boiling azeotrope is: (A) Benzene-toluene

(B) Acetone-chloroform

(C) Carbon-di-sulphide-acetone

(D) Ethyl alcohol-water

---

113. When the concentration of the reactant in a given reaction is halved and if the rate of reaction is halved, the order of the reaction is: (A) 3

(B) 0

(C) 2

(D) 1

---

114. Match the characteristic from Col. I with the Vitamins given in Col. II.

	Characteristics (Col. I)		**Vitamins (Col. II)**
A	Water soluble that is not excreted easily	W	B_2
B	Prevents Cheilosis	X	B_6
C	Fat soluble	Y	B_{12}
D	Prevents seizures and convulsions	Z	E

(A) A-X, B-Y, C-Z, D-W

(B) A-Y, B-W, C-Z, D-X

(C) A-X, B-Z, C-W, D-Y

(D) A-Z, B-Y, C-X, D-W

---

115. Two statements [A] and [B] are given below. Choose the correct option.

A) Protonated $R-CH_2-OH$ can serve as electrophiles while neutral $R-OH$ acts as a nucleophile.

B) The bond between $O-H$ cleaves when $R-CH_2-OH$ acts as electrophiles and the bond between $C-O$ cleaves when they act as nucleophiles.

(A) Both the statements [A] and [B] are correct

(B) Statement [B] is correct but [A] is wrong

(C) Statement [A] is correct but [B] is wrong

(D) Both the statements [A] and [B] are wrong

---

116. How many molecules of $CO_2(g)$ are obtained on reaction of 24 grams of methane with 4 moles of oxygen? (A) 6.022×10^{23}

(B) 3.011×10^{23}

(C) 12.044×10^{23}

(D) 9.033×10^{23}

---

117. Identify the law which is stated as "For any solutions, the partial vapour pressure of each volatile component in the solution is directly proportional to its mole fraction". (A) Dalton's law

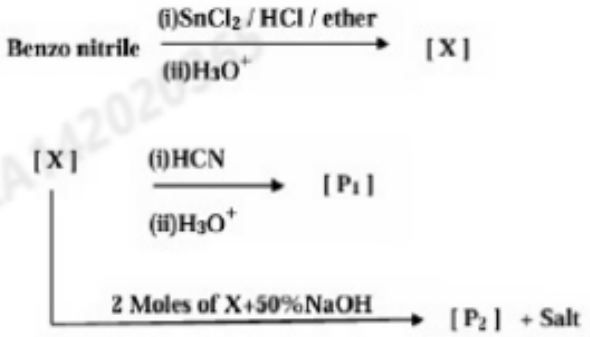
(B) Henry's law

(C) Gay-Lussac's law

(D) Raoult's law

---

118. Identify products P_1 and P_2 formed when Benzonitrile undergoes the following reactions:



(I) Benzonitrile $\xrightarrow[(ii)\ H_3O^+]{(i)\ SnCl_2/HCl/ether} [X]$

(II) $[X] \xrightarrow[(ii)\ H_3O^+]{(i)\ HCN} [P_1]$

(III) 2 moles of $X + 50\% NaOH \rightarrow [P_2]$+ Salt

(A) P_1 Benzoyl chloride and P_2 Acetophenone

(B) P_1 Acetophenone and P_2 Benzoic acid

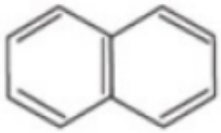
(C) P_1 Phenol and P_2 Sodium benzoate

(D) α-Hydroxy phenylacetic acid and P_2 Benzyl alcohol

---

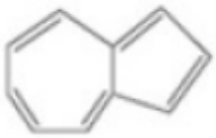
119. Identify the aromatic compounds among the given set based on Huckel's rule:

(I)



(II)

(III)



(IV)

(A) I, III, IV

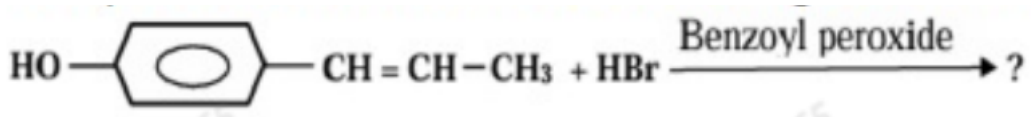
(B) I, II, IV

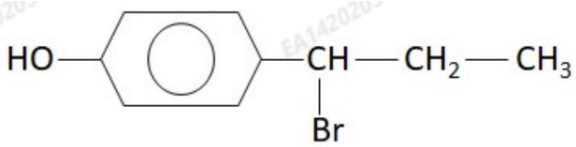
(C) I, II, III

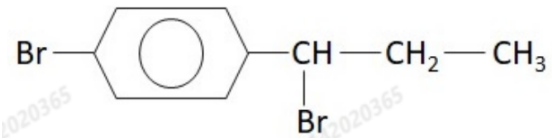
(D) II, III, IV

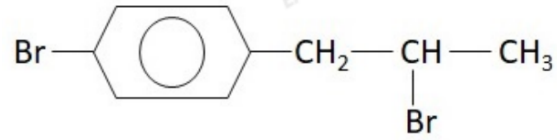
---

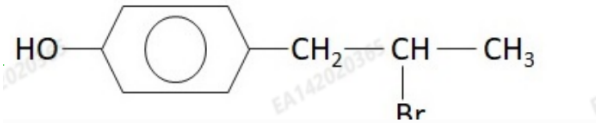
120. The product formed in the following reaction is:











(A) FigA

(B) FigB

(C) FigC

(D) FigD

---

121. The function

$$f(x) = e^{ax} + e^{-ax}, \quad x \in R$$

and $a < 0$, is strictly decreasing for all values of x, where:

(A) $x < 0$

(B) $x > 0$

(C) $x < 1$

(D) $x > 1$

---

122. The domain of the function

$$f(x) = \sin^{-1}(\sqrt{x-1})$$

is:

(A) $(-\infty, 1] \cup [2, \infty)$

(B) $[0, 1]$

(C) $[-1, 1]$

(D) $[1, 2]$

123. If the matrix

$$M = \begin{bmatrix} x+5 & a & -4 \\ -2 & 0 & b \\ c & 6 & y+1 \end{bmatrix}$$

is a skew-symmetric matrix, then the value of

$$ab + c^2 - xy$$

is:

(A) -1

(B) -33

(C) -9

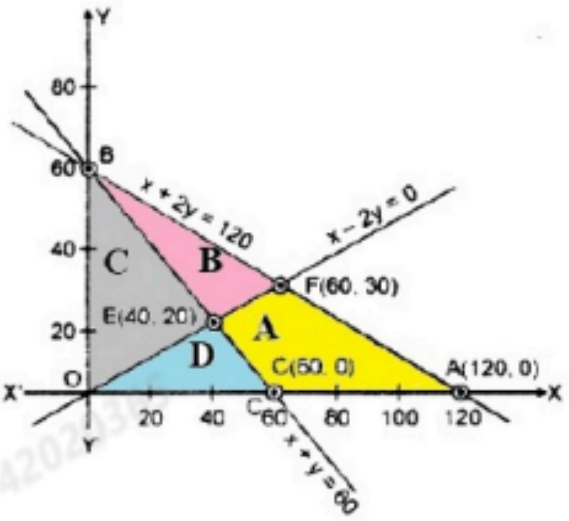
(D) 0

---

124. If the determinant of the matrix

$$\begin{vmatrix} 1 & 2 \\ 3 & x \end{vmatrix}$$

is equal to -2, then the value of x is:



(A) 2

(B) 4

(C) 6

(D) 8

---

125. If

$$\lim_{x\to 0}\left(\frac{p\sin 2x+1-\cos 2x}{x+\tan x}\right)=1,$$

then the value of p is:

(A) $\frac{1}{2}$
(B) -1
(C) 2
(D) 1

---

126. A coffee roaster has 12 rare coffee beans with intensity scores ranked from 1 (mildest) to 12 (strongest). You choose 7 beans at random and line them up from mildest to strongest: $C_1 < C_2 < C_3 < C_4 < C_5 < C_6 < C_7$. What is the probability that the third bean C_3 has an intensity score of exactly 4?

(1) $\frac{5}{18}$
(2) $\frac{35}{132}$
(3) $\frac{21}{44}$
(4) $\frac{1}{4}$

---

127. If the two ends of the major axis of an ellipse are $(5,0)$ and $(-5,0)$ and one focus lies on the line $3x-5y-9=0$, then its equation is:

(1) $\frac{x^2}{25}+\frac{y^2}{16}=1$
(2) $\frac{x^2}{16}+\frac{y^2}{25}=1$
(3) $\frac{x^2}{25}+\frac{y^2}{34}=1$
(4) $\frac{x^2}{25}+\frac{y^2}{9}=1$

---

128. If $f(x)=x^3-3x^2+1$, then the interval in which the function is decreasing is:

(1) $(-\infty, 0)$

(2) $(0, 2)$

(3) $(2, \infty)$

(4) $(-\infty, \infty)$

129.

$$\int (\sin^6 x + \cos^6 x + 3\sin^2 x \cos^2 x)\, dx =$$

(1) $-\frac{3}{2}\cos 2x + C$

(2) $x + C$

(3) $\frac{3}{2}\sin 2x + C$

(4) $\frac{2}{3}x + C$

---

130. Let the population of a species of birds surviving at a time t be governed by the differential equation

$$\frac{dp}{dt} - p = -100$$

If $p(0) = 50$, then $p(-\ln 2)$ is equal to:

(1) 90

(2) 40

(3) 75

(4) 100

---

131. A company is migrating its database, and two software engineers, Ishaan and Kavya, take turns running a data-sync script that has a constant success rate of $\frac{3}{8}$ per attempt. If Ishaan initiates the first attempt and they persist until the migration is successful, what is the probability that Kavya is the one who initiates the successful sync?

(1) $\frac{8}{13}$

(2) $\frac{3}{11}$

(3) $\frac{8}{11}$

(4) $\frac{5}{13}$

---

132. If the vectors $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{b} = \hat{i} - 2\hat{j} + 4\hat{k}$, then $\vec{a} \cdot \vec{b}$ is:

(1) -8

(2) -4

(3) 6

(4) 10

---

133. If the mean and variance of the numbers $2, 4, 6, 8, 10$ are μ and σ^2 respectively, then the value of $\mu + \sigma^2$ is:

(A) 12

(B) 14

(C) 16

(D) 18

---

134. If the equation of the tangent to the parabola $y^2 = 4ax$ at the point $(at^2, 2at)$ is perpendicular to the line $x + y = 1$, then the value of t is:

(A) 1

(B) -1

(C) ± 1

(D) 0

---

135. An open hemispherical storage tank has radius 13 m. Oil flows into the tank such that the depth h of oil in the tank changes at the rate of 3 m/hr. When $h = 1$ m, the rate of change of the area of the top surface of the oil is:

(A) 24π m^2/hr

(B) 72π m^2/hr

(C) 26π m^2/hr

(D) 75π m^2/hr

---

136. If $\log y = \log(\sin x) - x^2$, then

$$\frac{d^2y}{dx^2} + 4x\frac{dy}{dx} + 4x^2y =$$

(A) $-2y$

(B) $3y$

(C) 0

(D) $-3y$

---

137. The degree of the differential equation

$$\sqrt{1+\left(\frac{dy}{dx}\right)^{1/3}} = \frac{d^2y}{dx^2}$$

is:

(A) 6

(B) 3

(C) 1

(D) 2

---

138. If $y = e^{mx}\sin(nx)$, then the value of

$$\frac{d^2y}{dx^2} - 2m\frac{dy}{dx} + (m^2+n^2)y$$

is:

(A) 0

(B) y

(C) $2y$

(D) $-y$

---

139. If the tangent at any point (x, y) of a curve intercepts equal lengths on the coordinate axes, then the differential equation of the curve is:

(A) $\frac{dy}{dx} = \frac{y}{x}$

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

(C) $\frac{dy}{dx} = x + y$

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

---

140. The order and degree of the differential equation

$$\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^2 + y = 0$$

are respectively:

(A) $2, 3$

(B) $3, 2$

(C) $2, 2$

(D) $3, 3$

---

141. If $\frac{dy}{dx} = y \tan x$, then the solution of the differential equation is:

(A) $y = C \sin x$

(B) $y = C \cos x$

(C) $y = C \sec x$

(D) $y = C \tan x$

---

142. Let $A = [a_{ij}]$ be a square matrix of order 3×3, where

$$a_{ij} = \begin{cases} i - 2j, & i = j \\ 0, & i > j \\ 1, & i < j \end{cases}$$

Then the value of $|A^T|$ is:

(A) 1

(B) -6

(C) -11

(D) -5

---

143. If

$$\begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^2 & b^2 & c^2 \end{vmatrix} = 0$$

then:

(A) $a = b = c$

(B) At least two of a, b, c are equal

(C) $a + b + c = 0$

(D) $abc = 0$

---

144. If the system of equations

$$x + y + z = 6$$

$$x + 2y + 3z = 14$$

$$2x + y + z = 7$$

has solution (x, y, z)**, then the value of** $x + y + z$ **is:**

(A) 5

(B) 6

(C) 7

(D) 8

---

145. If A **is a skew-symmetric matrix of order** 3**, then** $|A|$ **is:**

(A) 1

(B) 0

(C) -1

(D) Depends on matrix

---

146. If the matrix

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

then the value of $|A|$ is:

(A) -2

(B) 2

(C) 10

(D) -10

---

147. If

$$A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

then A is:

(A) Singular matrix

(B) Identity matrix

(C) Null matrix

(D) Skew-symmetric matrix

---

148. If the inverse of a matrix exists, then the matrix is called:

(A) Singular

(B) Non-singular

(C) Symmetric

(D) Skew-symmetric

149.

$$\int \frac{dx}{x\sqrt{x^2+4}} =$$

(A)

$$\frac{1}{2}\log\left|\frac{\sqrt{x^2+4}+2}{\sqrt{x^2+4}-2}\right| + C$$

(B)

$$\frac{1}{4}\log\left|\frac{\sqrt{x^2+4}-2}{\sqrt{x^2+4}+2}\right| + C$$

(C)

$$\frac{1}{2}\log\left|\frac{\sqrt{x^2+4}-2}{\sqrt{x^2+4}+2}\right|+C$$

(D)

$$\frac{1}{4}\log\left|\frac{\sqrt{x^2+4}+2}{\sqrt{x^2+4}-2}\right|+C$$

---

150. The foci of a hyperbola are the same as those of the ellipse

$$9x^2+16y^2=144$$

If the length of the transverse axis of the hyperbola is $2\cos\alpha$, then its equation is:

(A)

$$\frac{x^2}{\cos^2\alpha}-\frac{y^2}{7-\cos^2\alpha}=1$$

(B)

$$\frac{x^2}{\cos^2\alpha}-\frac{y^2}{7+\cos^2\alpha}=1$$

(C)

$$\frac{x^2}{7-\cos^2\alpha}-\frac{y^2}{\cos^2\alpha}=1$$

(D)

$$\frac{x^2}{\cos^2\alpha}-\frac{y^2}{5-\cos^2\alpha}=1$$

---

151. Let A and B be two subsets of $\{1,2,3,\ldots,44,45\}$ such that

$$A=\{x : x \text{ is divisible by 3 and 4}\}$$

$$B=\{x : x \text{ is a perfect square number}\}$$

Then $n(B-A)$ equals

(A) 5

(B) 2

(C) 9

(D) 1

---

152. Let A be a square matrix of order 3×3. If $|A| = -4$, then the value of

$$\left|\frac{A^{-1}}{-2}\right|$$

is:

(A) -1

(B) 2

(C) $\frac{1}{32}$

(D) $-\frac{1}{16}$

---

153. Cards are numbered from 12 to 51. Two cards are drawn one after the other without replacement. Find the probability that one card is a multiple of 6 and the other card is a multiple of 8.

(A) $\frac{4}{65}$

(B) $\frac{7}{156}$

(C) $\frac{3}{52}$

(D) $\frac{8}{195}$

---

154. A student needs to buy notebooks (n) for a semester. Double the number of notebooks plus 5 must strictly exceed 15, but the number of notebooks plus 10 must be no more than 22. What is the range of notebooks they can buy?

(A) $\{5, 6, 7, 8, 9, 10, 11, 12\}$

(B) $\{6, 7, 8, 9, 10, 11\}$

(C) $\{6, 7, 8, 9, 10, 11, 12\}$

(D) $\{5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15\}$

---

155. Every term of a geometric progression is positive, and every term is the sum of the two preceding terms. Then the common ratio of the geometric progression is:

(A) 1

(B) $\frac{\sqrt{5}-1}{2}$

(C) $\frac{1-\sqrt{5}}{2}$

(D) $\frac{1+\sqrt{5}}{2}$

---

156. Let point Q be the image of point $P(2,-1)$ in the line

$$3x+5=4y.$$

Find the area of the circle that has the segment PQ as the diameter.

(A) 9π

(B) 1.96π

(C) 36π

(D) 3π

---

157. The absolute maximum and minimum values of the function

$$f(x)=\sin x+\sqrt{3}\cos x, \quad x\in[0,\pi]$$

are:

(A) Minimum value $=\frac{1}{\sqrt{3}}$, maximum value $=2$

(B) Minimum value $=-\sqrt{3}$, maximum value $=2$

(C) Minimum value $=\sqrt{3}$, maximum value $=2$

(D) Minimum value $=-\frac{1}{\sqrt{3}}$, maximum value $=2$

---

158. The function

$$x+y=\tan^{-1}y$$

is the solution of which of the following differential equations?

(A) $y^2y'+y^2+1=0$

(B) $y^2y'' - 2y' = 0$

(C) $y^2y' - y^2 + 1 = 0$

(D) $y^2 - 2y' + 1 = 0$

---

159. The expression

$$\frac{\tan\left(x - \frac{\pi}{2}\right)\cos\left(\frac{3\pi}{2} + x\right) - \sin^2\left(\frac{7\pi}{2} - x\right)}{\cos\left(x - \frac{\pi}{2}\right)\tan\left(\frac{3\pi}{2} + x\right)}$$

simplifies to:

(A) $\cos^2 x - \sin^2 x$

(B) $\sin^2 x$

(C) $1 + \cos^2 x$

(D) $-(1 + \cos^2 x)$

---

160. Evaluate the integral

$$\int_0^{\frac{\pi}{2}} \frac{3\sin x + 4\cos x}{\sin x + \cos x}\, dx$$

(A) $\frac{7\pi}{4}$

(B) 7π

(C) $\frac{7\pi}{2}$

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

---

161. Let the line l_1 be a line passing through the point $(0, -6)$ and making an angle of $150°$ with the positive x-axis. The equation of a line l_2 parallel to l_1 and crossing the y-axis at a distance 2 units below the origin is:

(A) $x + \sqrt{3}y + 2\sqrt{3} = 0$

(B) $x - \sqrt{3}y - 2\sqrt{3} = 0$

(C) $\sqrt{3}x + y + 6 = 0$

(D) $x - \sqrt{3}y + 6\sqrt{3} = 0$

---

162. If

$$(\vec{a} + \vec{b}) \perp \vec{b} \quad \text{and} \quad (\vec{a} + 2\vec{b}) \perp \vec{a},$$

then

(A) $|\vec{a}| = 2|\vec{b}|$

(B) $|\vec{a}| = \sqrt{2}|\vec{b}|$

(C) $2|\vec{a}| = |\vec{b}|$

(D) $|\vec{a}| = |\vec{b}|$

---

163. The conjugate of the multiplicative inverse of the complex number

$$z = \frac{1+7i}{3+i}$$

is:

(A) $1+2i$

(B) $\frac{1}{5}+\frac{2}{5}i$

(C) $\frac{2}{5}+\frac{1}{5}i$

(D) $\frac{1}{5}-\frac{2}{5}i$

---

164. A line L passes through the point of intersection of the lines $3x+y-10=0$ and $x-y-2=0$. If the perpendicular distance of the line L from the point $(5,1)$ is exactly $\frac{2}{\sqrt{5}}$ units, which of the following represents the equation of line L?

(A) $2x-y-5=0$

(B) $x+2y-5=0$

(C) $2x+y-7=0$

(D) $x-2y+1=0$

---

165. If

$$y = \tan^{-1}\left(\frac{\sqrt{1+x^3}+\sqrt{1-x^3}}{\sqrt{1+x^3}-\sqrt{1-x^3}}\right)$$

then $\frac{dy}{dx}$ is equal to:

(A) $-\frac{3x^2}{2\sqrt{1-x^6}}$

(B) $\frac{6x^2}{\sqrt{1-x^6}}$

(C) $-\dfrac{6x^2}{\sqrt{1-x^6}}$

(D) $\dfrac{3x^2}{\sqrt{1-x^6}}$

---

166. The second derivative of $\sin 3x \cos 5x$ is:

(A) $2\sin 2x - 16\sin 8x$

(B) $2\sin 2x + 16\sin 8x$

(C) $2\sin 2x - 32\sin 8x$

(D) $2\sin 2x + 32\sin 8x$

---

167. The variance of a set of 20 observations is 16. If 7 is added to each observation, and then 5 is subtracted from each resulting observation, what will be the new standard deviation?

(A) 4 (B) 18 (C) 9 (D) 2

---

168. The area enclosed by the curve $y = -x^2$ and the line $x + y + 2 = 0$ is:

(A) 4 sq units

(B) 4.5 sq units

(C) 5.5 sq units

(D) 3.5 sq units

---

169. The function $f(x) = |x| + |x - 1|$ is:

(A) Differentiable at $x = 0$ but not at $x = 1$

(B) Neither differentiable at $x = 0$ nor at $x = 1$

(C) Differentiable at $x = 1$ but not at $x = 0$

(D) Differentiable at $x = 0$ and $x = 1$

---

170. Evaluate:

$$\lim_{x \to \frac{\pi}{2}} \left(\frac{1 - \sin x}{\cos x} \right)$$

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

(B) -1

(C) 0

(D) 1

---

171. Let $f : \mathbb{R} \to \mathbb{R}$ be defined by

$$f(x) = x^3 - 3x + 1$$

Then the function f is:

(A) One-one and onto

(B) One-one but not onto

(C) Onto but not one-one

(D) Neither one-one nor onto

---

172. If the arithmetic mean between two positive numbers is 10 and the geometric mean is 8, then the numbers are:

(A) $6, 14$

(B) $8, 12$

(C) $4, 16$

(D) $2, 18$

---

173. A bag contains 5 red balls and 3 blue balls. Two balls are drawn at random without replacement. What is the probability that both balls are red?

(A) $\frac{5}{28}$

(B) $\frac{10}{28}$

(C) $\frac{15}{56}$

(D) $\frac{5}{14}$

---

174. The polynomial

$$p(x) = x^4 - 5x^2 + 4$$

has:

(A) Four distinct real roots

(B) Two distinct real roots

(C) No real roots

(D) One repeated real root

---

175. If

$$\vec{a} = 2\hat{i} - \hat{j} + 3\hat{k}$$

and

$$\vec{b} = \hat{i} + 4\hat{j} - 2\hat{k},$$

then $\vec{a} \cdot \vec{b}$ is equal to:

(A) 8

(B) -8

(C) 4

(D) -4

---

176. If

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}, \qquad B = \begin{bmatrix} 2 & 0 \\ 1 & 5 \end{bmatrix}$$

then AB is equal to:

(A)

$$\begin{bmatrix} 4 & 10 \\ 10 & 20 \end{bmatrix}$$

(B)

$$\begin{bmatrix} 4 & 10 \\ 10 & 15 \end{bmatrix}$$

(C)

$$\begin{bmatrix} 4 & 10 \\ 10 & 20 \end{bmatrix}$$

(D)

$$\begin{bmatrix} 4 & 10 \\ 10 & 15 \end{bmatrix}$$

---

177. Find the area bounded by the curve $y = |2 - x|$, the x-axis, and the lines $x = 0$ and $x = 5$.

(A) 12.5 sq units

(B) 4.5 sq units

(C) 6.5 sq units

(D) 8.5 sq units

---

178. If the projection of

$$\vec{a} = 5\hat{i} + \hat{j} + \lambda\hat{k}$$

on

$$\vec{b} = 2\hat{i} + 6\hat{j} + 3\hat{k}$$

is 4 **units, then** $\lambda =$

(A) 6

(B) 4

(C) 5

(D) 3

---

179. Evaluate:

$$\int \tan^{-1}\left(\sqrt{\frac{1-\sin x}{1+\sin x}}\right) dx$$

(A) $\frac{\pi x}{2} - \frac{x^2}{4} + C$

(B) $\frac{\pi x}{4} - \frac{x^2}{2} + C$

(C) $\frac{\pi x}{4} - \frac{x}{4} + C$

(D) $\frac{\pi x}{4} - \frac{x^2}{4} + C$

---

180. A coach needs to select a 4-player starting lineup from a pool of 10 players consisting of:

- 5 guards
- 3 forwards
- 2 centres

Find the number of different selections if the lineup must include:

- At least 1 guard
- At most 1 forward
- Exactly 1 centre

(A) 70

(B) 60

(C) 80

(D) 20
