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| Paper: | B.E_B.Tech |
| Set Name: | SET 30 |
| Exam Date: | 30 July 2022 |
| Exam Shift: | 2 |
| Langauge: | English |

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| Topic: | Physics-Section A |
| Item No: | 1 |
| Question ID: | **15477154561** |
| Question Type: | MCQ |
| Question: | If current (I) , kinetic energy (K) and charge (Q) are taken as the fundamental quantities, The dimensional representation of power will be : |
| A: | $[K^{-1} Q I^{-1}]$ |
| B: | $[K I Q^{-1}]$ |
| C: | $[K Q I^{-1}]$ |
| D: | $[K^{-1} Q^{-1} I]$ |

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| Topic: | Physics-Section A |
| Item No: | 2 |
| Question ID: | **15477154562** |
| Question Type: | MCQ |
| Question: | Two trucks A and B are approaching each other on a straight path with the velocities of 16 m/s and 20 m/s respectively. When they are 200 m apart their drivers see each other and applies the breaks simultaneously. If the truck A decelerates with 2 $m/s^2$ and truck B decelerates with 4 $m/s^2$ , what is the distance between them when they finally stop? |
| A: | 14 m |
| B: | 114 m |
| C: | 86 m |
| D: | 64 m |

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| Topic: | Physics-Section A |
| Item No: | 3 |
| Question ID: | **15477154563** |
| Question Type: | MCQ |
| Question: | A bullet of mass 10 gram is fired with velocity of 100 m/s from the gun of mass 1 kg . Recoil speed of the gun is : |
| A: | $1\ m/s$ |

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| B: | $10\ {}^{m}/_{s}$ |
| C: | $0.5\ {}^{m}/_{s}$ |
| D: | $0.1\ {}^{m}/_{s}$ |

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| Topic: | Physics-Section A |
| Item No: | 4 |
| Question ID: | **15477154564** |
| Question Type: | MCQ |
| Question: | A mass of 0.5 kg is attached to one end of a massless spring whose natural length is 1 m and spring constant is 800 N/m The other end of the spring is fixed while the mass moves in a circular path in a horizontal plane with an angular speed of 20 rad/s. The extension in the length of the spring will be : |
| A: | $\frac{1}{10}$ m |
| B: | $\frac{1}{4}$ m |
| C: | $\frac{1}{3}$ m |
| D: | $\frac{1}{5}$ m |

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| Topic: | Physics-Section A |
| Item No: | 5 |
| Question ID: | **15477154565** |
| Question Type: | MCQ |
| Question: | The time period of X planet of our solar system is 8 years. The distance of earth from the sun is $1.5 \times 10^{11}$ m. The distance of the X planet from the sun will be : |
| A: | $3\sqrt{2} \times 10^{11}$ m |
| B: | $3 \times 10^{11}$ m |
| C: | $6 \times 10^{11}$ m |
| D: | $12 \times 10^{11}$ m |

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| Topic: | Physics-Section A |
| Item No: | 6 |
| Question ID: | **15477154566** |
| Question Type: | MCQ |

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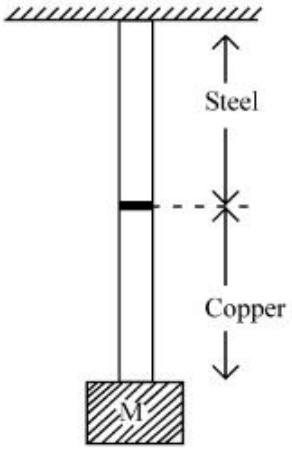
| Question: | A block of mass M is attached to a wire. The upper part of wire is made of steel and lower part of wire of copper ( as shown in figure ) . Both parts have the same area of cross section . Neglecting the mass of wires, the ratio of longitudinal strain developed in steel and copper wires is :<br>( Given, Young's modulus of steel = $2 \times 10^{11}$ N/m$^2$ and<br>Young's modulus of copper = $1.5 \times 10^{11}$ N/m$^2$ )<br>  <br> |
| A: | $\frac{3}{5}$ |
| B: | $\frac{4}{5}$ |
| C: | $\frac{4}{3}$ |
| D: | $\frac{3}{4}$ |

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| Topic: | Physics-Section A |
| Item No: | 7 |
| Question ID: | **15477154567** |
| Question Type: | MCQ |
| Question: | A Carnot engine is operating between the two reservoirs of temperature 227 °C and 127 °C respectively. If the engine performs $1.04 \times 10^5$ J work per cycle. Then, the heat absorbed from hot reservoir per cycle will be : |
| A: | $2.08 \times 10^4$ J |
| B: | $1.04 \times 10^5$ J |
| C: | $5.20 \times 10^5$ J |
| D: | $2.36 \times 10^5$ J |

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| Topic: | Physics-Section A |
| Item No: | 8 |
| Question ID: | **15477154568** |
| Question Type: | MCQ |

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| Question: | If the r.m.s speed of oxygen at room temperature is $\sqrt{56}\ ^{m}/_{s}$. The r.m.s speed of nitrogen at the same temperature is _____. |
| A: | $8\sqrt{2}\ ^{m}/_{s}$ |
| B: | $8\ ^{m}/_{s}$ |
| C: | $16\ ^{m}/_{s}$ |
| D: | $7\ ^{m}/_{s}$ |

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| Topic: | Physics-Section A |
| Item No: | 9 |
| Question ID: | **15477154569** |
| Question Type: | MCQ |
| Question: | An oscillating simple pendulum of time period $T_o$ is placed in a lift which is accelerating upwards with $2.5\ ^{m}/_{s^2}$. The time period of pendulum in the lift will be (if $g = 10\ ^{m}/_{s^2}$) |
| A: | $T_o$ |
| B: | $\frac{2}{\sqrt{5}}T_o$ |
| C: | $\frac{2}{\sqrt{3}}T_o$ |
| D: | $\frac{T_o}{4}$ |

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| Topic: | Physics-Section A |
| Item No: | 10 |
| Question ID: | **154771545610** |
| Question Type: | MCQ |
| Question: | A charge q is uniformly distributed along the length L of a rod. It is then bent in the shape of a semicircle. The magnitude of electric field at the centre of semicircle will be : |
| A: | $\frac{q}{2\epsilon_0 L^2}$ |
| B: | $\frac{q}{2\pi\epsilon_0 L^2}$ |
| C: | $\frac{q}{2\pi\epsilon_0 L}$ |
| D: | $\frac{q}{4\pi^2\epsilon_0 L}$ |

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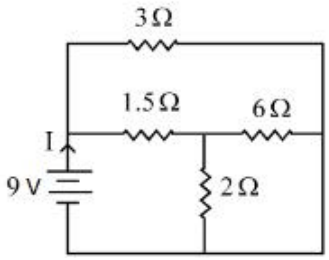
| Topic: | Physics-Section A |
| Item No: | 11 |
| Question ID: | **154771545611** |
| Question Type: | MCQ |
| Question: | The current I drawn out of the battery connected in the given circuit is:<br>  |
| A: | 5 A |
| B: | 6 A |
| C: | 7 A |
| D: | 8 A |

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| Topic: | Physics-Section A |
| Item No: | 12 |
| Question ID: | **154771545612** |
| Question Type: | MCQ |
| Question: | In an A.C circuit , V & I are given by<br>$V = 250 \sin(100\ t)$ volt and<br>$I = 10 \sin(100\ t + \frac{\pi}{3})$ A respectively<br>The power dissipated in the circuit is: |
| A: | 2500 W |
| B: | 625 W |
| C: | 1250 W |
| D: | $625\sqrt{2}$ W |

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| Topic: | Physics-Section A |
| Item No: | 13 |
| Question ID: | **154771545613** |
| Question Type: | MCQ |
| Question: | A plane electromagnetic wave propagating in free space has amplitude of electric field of 900 $\frac{N}{C}$ . The amplitude of magnetic field will be :_____ |
| A: | 9 μT |
| B: | 27 μT |

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| C: | 3 μT |
| D: | 270 GT |

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| Topic: | Physics-Section A |
| Item No: | 14 |
| Question ID: | **154771545614** |
| Question Type: | MCQ |
| Question: | Two poloroids $P_1$ and $P_2$ are placed parallel to each other with common axis.The light of intensity $I_0$ passes through a polaroid sheet $P_1$ and then passes through polaroid $P_2$ . If $P_2$ is now rotated by 60°, then the intensity of the output light from $P_2$ will be: |
| A: | $\frac{I_0}{2}$ |
| B: | $\frac{I_0}{4}$ |
| C: | Zero |
| D: | $\frac{I_0}{8}$ |

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| Topic: | Physics-Section A |
| Item No: | 15 |
| Question ID: | **154771545615** |
| Question Type: | MCQ |
| Question: | A wire of length 8 m is bent to form a circular loop in y-z plane. A current of 0.5 A is flowing in anticlockwise direction in it , the magnetic dipole moment of the loop is: |
| A: | $-8\,\hat{i}$ A m$^2$ |
| B: | $\frac{8}{\pi}\hat{i}$ A m$^2$ |
| C: | $-4\pi\,\hat{i}$ A m$^2$ |
| D: | $4\pi\,\hat{i}$ A m$^2$ |

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| Topic: | Physics-Section A |
| Item No: | 16 |
| Question ID: | **154771545616** |
| Question Type: | MCQ |

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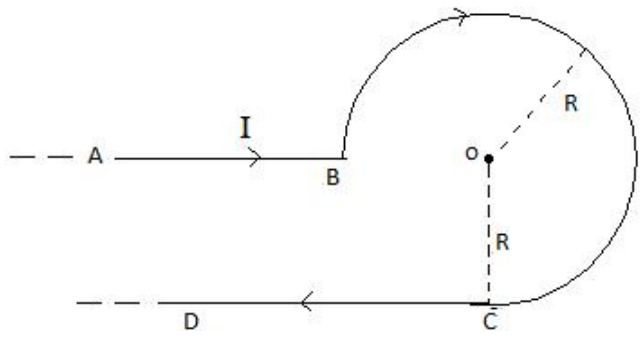
| Question: | In the following loop, magnitude of the magnetic field produced at the centre (O) of the loop is : (Assume AB and CD are infinitely extended):<br>  <br> |
| A: | $\frac{\mu_o I}{4\pi R}\left(\frac{3}{2}\pi\right)$ |
| B: | $\frac{\mu_o I}{2\pi R}$ |
| C: | $\frac{\mu_o I}{4\pi R}\left(\frac{3}{2}\pi+1\right)$ |
| D: | $\frac{\mu_o I}{4\pi R}\left(\frac{3}{2}\pi-1\right)$ |

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| Topic: | Physics-Section A |
| Item No: | 17 |
| Question ID: | **154771545617** |
| Question Type: | MCQ |
| Question: | Using Boh'r model of quantization of angular momentum the relation between the radius 'r' of the $n^{th}$ allowed orbit of quantum number 'n' for an electron in hydrogen atom is: |
| A: | $r \propto n^{\frac{1}{2}}$ |
| B: | $r \propto n^2$ |
| C: | $r \propto \left(\frac{1}{n}\right)^2$ |
| D: | $r \propto \left(\frac{1}{n}\right)^{\frac{1}{2}}$ |

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| Topic: | Physics-Section A |
| Item No: | 18 |
| Question ID: | **154771545618** |
| Question Type: | MCQ |

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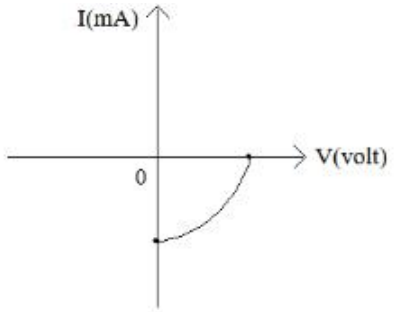
| Question: |  <br>The I-V characteristics given in above figure is related to: |
| A: | Photodiode in reverse bias |
| B: | LED in forward bias |
| C: | Zener diode |
| D: | Solar cell |

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| Topic: | Physics-Section A |
| Item No: | 19 |
| Question ID: | **154771545619** |
| Question Type: | MCQ |
| Question: | The de Broglie wavelength associated with an electron, accelerated through a potential difference of 15056 V, is: |
| A: | 0.1 Å |
| B: | 1 Å |
| C: | 10 Å |
| D: | 100 Å |

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| Topic: | Physics-Section A |
| Item No: | 20 |
| Question ID: | **154771545620** |
| Question Type: | MCQ |
| Question: | An amplitude modulate wave consists of following components :<br>Carrier component = 5 V peak value<br>Lower side band component = 2.5 V peak value<br>Upper side band component = 2.5 V peak value<br>The amplitude of modulating signal is: |
| A: | 1 V |
| B: | 1.25 V |
| C: | 2.5 V |
| D: | 5 V |

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| Topic: | Physics-Section B |

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| Item No: | 21 |
| Question ID: | **154771545621** |
| Question Type: | Numeric Answer |
| Question: | A nuclear physicist performed an experiment on the scattering of alpha particles by thin metal foil of gold. The alpha particles were accelerated up to kinetic energy 3.2 Mev. The estimation of the radius of the nucleus of gold element (Z = 79) by him is _____ $\times 10^{-16}$ m<br>(Take $\frac{1}{4\pi \in_o} = 9 \times 10^9 \frac{Nm^2}{C^2}$) |

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| Topic: | Physics-Section B |
| Item No: | 22 |
| Question ID: | **154771545622** |
| Question Type: | Numeric Answer |
| Question: | A ring is placed at the bottom of a trough containing four immiscible liquids of refractive indices 1.0, 2.0, 3.0 and 4.0 poured one above the other of heights 10 cm, 20 cm, 30 cm, and 40 cm respectively. The apparent depth at which the ring appears, when seen from outside is _____ cm. |

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| Topic: | Physics-Section B |
| Item No: | 23 |
| Question ID: | **154771545623** |
| Question Type: | Numeric Answer |
| Question: | A sinusoidal voltage V(t) = 200 sin2000 t volt is applied to a series LCR circuit in which L = 10 mH, C = 25 μF and R =100 Ω. The impedance of the circuit is _____Ω |

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| Topic: | Physics-Section B |
| Item No: | 24 |
| Question ID: | **154771545624** |
| Question Type: | Numeric Answer |
| Question: | A cell sends a current through a resistance 4 Ω for time t and sends current through another resistance 16 Ω for the same time t.If the same amount of heat is developed in both the resistances , then the internal resistance of the cell is _____Ω |

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| Topic: | Physics-Section B |
| Item No: | 25 |
| Question ID: | **154771545625** |
| Question Type: | Numeric Answer |

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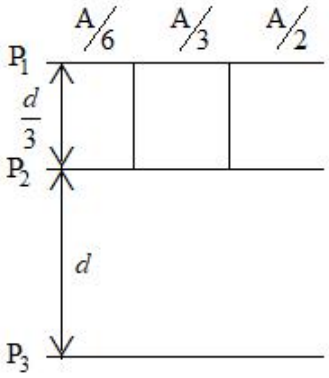
| Question: | Combination of four parallel plate air capacitors is shown in figure. Separation between the plate $P_1$ & $P_2$ is $\frac{d}{3}$ and separation between the plates $P_2$ and $P_3$ is d. The equivalent capacitance of the configuration is _____ μF.<br><br>(Given $\frac{\epsilon_0 A}{d} = 4\mu F$ . Where A=Area of plates)<br><br>  |

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| Topic: | Physics-Section B |
| Item No: | 26 |
| Question ID: | **154771545626** |
| Question Type: | Numeric Answer |
| Question: | A particle executing SHM has its velocity 20 cm $s^{-1}$ at mean position and acceleration of 25 cm $s^{-2}$ at one of its extreme position. The amplitude of the particle will be ____ cm. |

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| Topic: | Physics-Section B |
| Item No: | 27 |
| Question ID: | **154771545627** |
| Question Type: | Numeric Answer |
| Question: | A water drop of radius 1 cm is broken into eight equal droplets. Surface tension of water is 0.075 N $m^{-1}$. The gain in surface energy is _____ $\times 10^{-7}$ J.<br>(Take $\pi = 3.14$) |

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| Topic: | Physics-Section B |
| Item No: | 28 |
| Question ID: | **154771545628** |
| Question Type: | Numeric Answer |
| Question: | A fly wheel of mass 10 kg and radius 50 cm is rotating at a rate of 360 rpm. Assuming mass to be concentrated at the rim, the constant retarding torque required to stop the rotation of wheel in 6 rotations will be $x\pi$ Nm. The value of $x$ is _____ |

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| Topic: | Physics-Section B |
| Item No: | 29 |
| Question ID: | **154771545629** |
| Question Type: | Numeric Answer |
| Question: | A body moving horizontally on a smooth surface with a speed of 20 $ms^{-1}$ splits into two parts and continue to move in the same direction . The masses of two parts are in the ratio of 1:2. The smaller part moves with a speed of 30 $ms^{-1}$. The fractional change is the kinetic energy is given by $\frac{1}{x}$. The value of $x$ is_____ |

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| Topic: | Physics-Section B |
| Item No: | 30 |
| Question ID: | **154771545630** |
| Question Type: | Numeric Answer |
| Question: | Two projectiles are thrown towards each other at 15° and 45° angles respectively with the horizontal at the same speed. The difference between the horizontal distances traveled by the two projectiles is 80 m. The initial speed of the projectiles is _____$ms^{-1}$<br>[Given g = 10 $ms^{-2}$] |

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| Topic: | Chemistry-Section A |
| Item No: | 31 |
| Question ID: | **154771545631** |
| Question Type: | MCQ |
| Question: | Combination of temperature and pressure causing the greatest deviation from ideal gas behaviour is; |
| A: | 100° C and 8 atm |
| B: | 100° C and 4 atm. |
| C: | – 100° C and 8 atm |
| D: | 0°C and 4 atm |

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| Topic: | Chemistry-Section A |
| Item No: | 32 |
| Question ID: | **154771545632** |
| Question Type: | MCQ |
| Question: | When the kinetic energy of an electron is increased nine times, the wavelength of the de-Broglie wave associated with it would become : |
| A: | One-third |
| B: | Three times |
| C: | Two third |

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| D: | One sixth |

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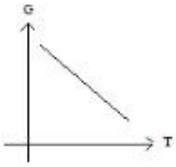
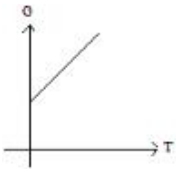
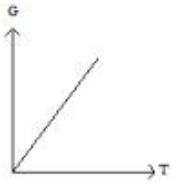
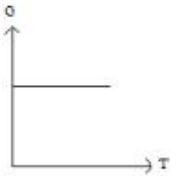
| Topic: | Chemistry-Section A |
| Item No: | 33 |
| Question ID: | **154771545633** |
| Question Type: | MCQ |
| Question: | Which of the following is the plot of Gibb's free energy (G) vs temperature (T), at constant pressure, for a pure substance? |
| A: |   |
| B: |   |
| C: |   |
| D: |   |

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| Topic: | Chemistry-Section A |
| Item No: | 34 |
| Question ID: | **154771545634** |
| Question Type: | MCQ |

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| Question: | Freundlich's adsorption isotherm (in terms of concentration) is given by the expression; $\frac{x}{m}=K\cdot C^{1/n}$. The possible conclusions that can be drawn from the expression are :<br><br>(A) When $1/n=1$, the adsorption is directly proportional to concentration.<br><br>(B) When $1/n=0$, the adsorption is independent of concentration.<br><br>(C) When n = 0, a plot of $x/m$ vs C is a line parallel to x-axis<br><br>(D) When n = 0, a plot of $x/m$ vs C is a curve.<br><br>Choose the correct option from the following : |
| A: | (A) and (B) only |
| B: | (B) and (D) only |
| C: | (B), (C) and (D) only |
| D: | (A), (B) and (C) only |

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| Topic: | Chemistry-Section A |
| Item No: | 35 |
| Question ID: | **154771545635** |
| Question Type: | MCQ |
| Question: | For Periodic Table which of the following statements are TRUE<br><br>A. Shielding increases as we go down in the group.<br><br>B. Shielding increases sharply across the period.<br><br>C. Ionization enthalpy increases down the group.<br><br>D. Metallic character increases down the group.<br><br>E. Electronegativity decreases down the group.<br><br>Choose the correct answer from the following options : |
| A: | B, C and E Only |
| B: | A, D, and E only |
| C: | A, C, D and E only |
| D: | A, D and E only |

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| Topic: | Chemistry-Section A |
| Item No: | 36 |

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| Question ID: | **154771545636** |
| Question Type: | MCQ |
| Question: | Match **List I** with **List II**<br><br>**List I** / **List II**<br>A. Cyanide Process — I. Vapour phase refining<br>B. Froth flotation process — II. Aluminium<br>C. Hall-Heroult process — III. Dressing of ZnS<br>D. Mond process — IV. Extraction of Au<br><br>Choose the correct answer from the options given below : |
| A: | A-IV, B-III, C-II, D-I |
| B: | A-I, B-II, C-III, D-IV |
| C: | A-II, B-III, C-IV, D-I |
| D: | A-III, B-II, C-IV, D-I |

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| Topic: | Chemistry-Section A |
| Item No: | 37 |
| Question ID: | **154771545637** |
| Question Type: | MCQ |
| Question: | The hardness of water is generally expressed in terms of $CaCO_3$ equivalent. The possible reasons are as follows:<br><br>(A) Its molar mass is 100, so the calculations become easier.<br><br>(B) It decomposes at a temperature, 1200 K.<br><br>(C) It is insoluble in water.<br><br>(D) It is moisture insensitive.<br><br>Choose correct option from the following for the reasons. |
| A: | (A) and (B) only |
| B: | (A) and (D) only |
| C: | (B) and (D) only |
| D: | (A), (B), and (C) only |

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| Topic: | Chemistry-Section A |
| Item No: | 38 |
| Question ID: | **154771545638** |
| Question Type: | MCQ |

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| Question: | The correct option for relative covalent nature of compounds is |
| A: | $KF > KI$ |
| B: | $SnCl_4 > SnCl_2$ |
| C: | $KF > LiF$ |
| D: | $NaCl > HCl$ |

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| Topic: | Chemistry-Section A |
| Item No: | 39 |
| Question ID: | **154771545639** |
| Question Type: | MCQ |
| Question: | The $E^{\circ}$ (volt) values are : $Al^{3+}$ / Al, – 1.66, $Sc^{3+}$/Sc, –2.08, $Fe^{3+}/Fe^{2+}$, +0.77, $Hg_2^{2+}$/Hg, +0.79. Arrangement of cations, $Al^{3+}$, $Sc^{3+}$, $Fe^{3+}$ and $Hg_2^{2+}$ in decreasing order of oxidizing strength is |
| A: | $Al^{3+} > Sc^{3+} > Fe^{3+} > Hg_2^{2+}$ |
| B: | $Hg_2^{2+} > Fe^{3+} > Sc^{3+} > Al^{3+}$ |
| C: | $Hg_2^{2+} > Fe^{3+} > Al^{3+} > Sc^{3+}$ |
| D: | $Sc^{3+} > Al^{3+} > Fe^{3+} > Hg_2^{2+}$ |

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| Topic: | Chemistry-Section A |
| Item No: | 40 |
| Question ID: | **154771545640** |
| Question Type: | MCQ |
| Question: | In low and high spin octahedral $Co^{3+}$ complexes the number of electrons in $t_{2g}$ level respectively will be . (given At. no. of Co, 27) |
| A: | 6 and 3 |
| B: | 6 and 4 |
| C: | 3 and 4 |
| D: | 4 and 6 |

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|---|---|
| Topic: | Chemistry-Section A |
| Item No: | 41 |
| Question ID: | **154771545641** |
| Question Type: | MCQ |
| Question: | Which of the following is not a component of photochemical smog? |
| A: | Ozone |
| B: | Peroxyacetyl nitrate |
| C: | Nitric oxide |

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| D: | Sulphur dioxide |

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| Topic: | Chemistry-Section A |
| Item No: | 42 |
| Question ID: | **154771545642** |
| Question Type: | MCQ |
| Question: | Glycerol can be separated from spent-lye on industrial scale by using |
| A: | TLC technique |
| B: | Distillation under reduced pressure |
| C: | Differential Extraction |
| D: | Crystallization |

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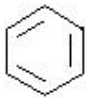
| Topic: | Chemistry-Section A |
| Item No: | 43 |
| Question ID: | **154771545643** |
| Question Type: | MCQ |
| Question: | Which of the following is unstable? |
| A: | |
| B: | |
| C: | |
| D: |  |

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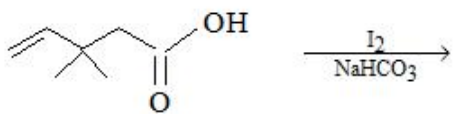
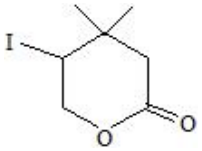
| Topic: | Chemistry-Section A |
| Item No: | 44 |
| Question ID: | **154771545644** |
| Question Type: | MCQ |
| Question: | Major product of the following reaction is   |
| A: |   |

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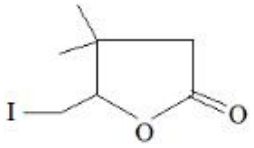
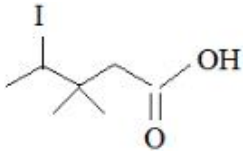
| B: |  |
| C: |  |
| D: | |

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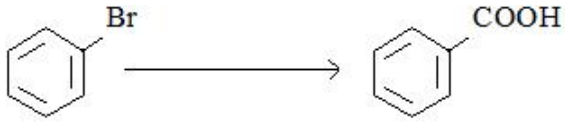
| Topic: | Chemistry-Section A |
| Item No: | 45 |
| Question ID: | **154771545645** |
| Question Type: | MCQ |
| Question: |  <br>For the above conversion, the correct sequential addition of reagents is- |
| A: | (i) Mg (ii) $CO_2$, dry ether (iii) $H_2O$ |
| B: | (i) NaOH (ii) $C_2H_5OH$ (iii) HCl |
| C: | (i) NaCN (ii) $H_2O$ (iii) HCl |
| D: | (i) $KMnO_4$ (ii) HCl |

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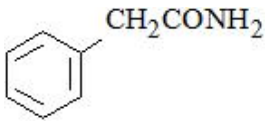
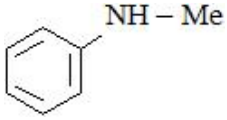
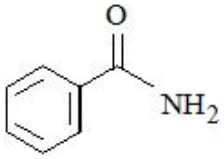
| Topic: | Chemistry-Section A |
| Item No: | 46 |
| Question ID: | **154771545646** |
| Question Type: | MCQ |
| Question: | Which one of the following compounds can be prepared in good yield by Hoffmann bromamide degradation reaction? |
| A: |  |
| B: |  |
| C: |  |

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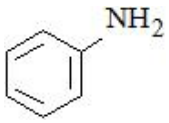
| D: |  |

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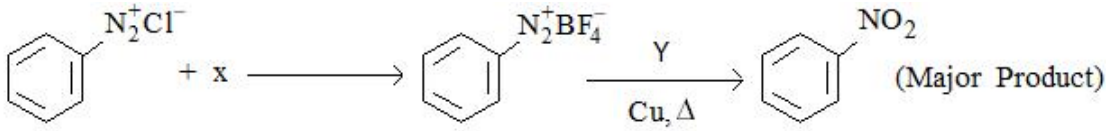
| Topic: | Chemistry-Section A |
| Item No: | 47 |
| Question ID: | **154771545647** |
| Question Type: | MCQ |
| Question: |  Consider the given chemical reaction, identify X and Y |
| A: | $X = BF_3 \quad Y = HNO_3$ |
| B: | $X = HBF_4 \quad Y = NaNO_2$ |
| C: | $X = HBF_4 \quad Y = HNO_3$ |
| D: | $X = BF_3 \quad Y = NaNO_2$ |

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|---|---|
| Topic: | Chemistry-Section A |
| Item No: | 48 |
| Question ID: | **154771545648** |
| Question Type: | MCQ |
| Question: | Given below are two statements:<br><br>**Statement I:** In Nylon 6, the monomer unit is caprolactam.<br><br>**Statement II:** The monomer unit in Nylon 6 is synthesized from cyclohexanone.<br><br>In the light of the above statements, choose the most appropriate answer from the options given below: |
| A: | Both Statement I and Statement II are correct |
| B: | Both Statement I and Statement II are incorrect |
| C: | Statement I is correct but Statement II is incorrect |
| D: | Statement I is incorrect but Statement II is correct |

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|---|---|
| Topic: | Chemistry-Section A |
| Item No: | 49 |
| Question ID: | **154771545649** |
| Question Type: | MCQ |

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| Question: | Given below are two statements:<br><br>**Statement I:** Glycogen is highly branched polysaccharide and commonly known as animal starch due to its similarity with amylopectin.<br><br>**Statement II:** Amylose is water insoluble and constitutes about 15-20% of starch.<br><br>In the light of the above statements, choose the most appropriate answer from the options given below: |
| A: | Both Statement I and Statement II are correct |
| B: | Both Statement I and Statement II are incorrect |
| C: | Statement I is correct but Statement II is incorrect |
| D: | Statement I is incorrect but Statement II is correct |

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|---|---|
| Topic: | Chemistry-Section A |
| Item No: | 50 |
| Question ID: | **154771545650** |
| Question Type: | MCQ |
| Question: | In the ring test of $NO_3^-$ ion what is the oxidation number of iron in the complex (brown ring) $[Fe(H_2O)_5NO]SO_4$ ? |
| A: | +2 |
| B: | +1 |
| C: | +3 |
| D: | +5 |

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|---|---|
| Topic: | Chemistry-Section B |
| Item No: | 51 |
| Question ID: | **154771545651** |
| Question Type: | Numeric Answer |
| Question: | The density of 4 molal solution of NaOH is 1.160 g $mL^{-1}$. The molarity of the solution is<br>_____ M. (Given : Molar mass of NaOH = 40g $mol^{-1)}$ (nearest integer) |

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| Topic: | Chemistry-Section B |
| Item No: | 52 |
| Question ID: | **154771545652** |
| Question Type: | Numeric Answer |
| Question: | On the basis of MO. theory, the number of molecules from the following which have bond order two, is _____.<br><br>$O_2$, $O_2^+$, $N_2^{2-}$, $C_2$, $B_2$ |

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|---|---|
| Topic: | Chemistry-Section B |
| Item No: | 53 |
| Question ID: | **154771545653** |
| Question Type: | Numeric Answer |
| Question: | 31 g of ethylene glycol is mixed with 500 g of water. The freezing point of the aqueous solution is _____ K.<br>(in nearest integer)<br>($K_f$ of water = 1.86 K kg $mol^{-1}$)<br>[Molar mass of C, H, O are 12, 1, 16 $gmol^{-1}$] |

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|---|---|
| Topic: | Chemistry-Section B |
| Item No: | 54 |
| Question ID: | **154771545654** |
| Question Type: | Numeric Answer |
| Question: | 50 mL of 0.1 M $CH_3COOH$ is titrated against 0.1 M NaOH solution. When 10 mL of NaOH is added, the pH of the solution becomes _____ $\times 10^{-1}$. (nearest integer)<br><br>Given: pKa ($CH_3COOH$) = 4.8, log 2 = 0.3 |

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| Topic: | Chemistry-Section B |
| Item No: | 55 |
| Question ID: | **154771545655** |
| Question Type: | Numeric Answer |
| Question: | For the given cell $Zn(s) \mid Zn^{2+}(C_1, M) \parallel Zn^{2+}(C_2\ M) \mid Zn(s)$ the change in Gibbs energy ($\Delta G$) will be zero when $\frac{C_1}{C_2}$ is equal to _____. |

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| Topic: | Chemistry-Section B |
| Item No: | 56 |
| Question ID: | **154771545656** |
| Question Type: | Numeric Answer |
| Question: | $X \rightarrow Y + Z$<br><br>X decomposes at 700 K to give Y and Z. The results of two measurements are :<br><br>Initial concentration of X / (mol/L) : 6.0 : 12.0<br>Half life / s : 1.0 : 2.0<br><br>The rate constant for the reaction is _____ (in appropriate unit) |

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| Topic: | Chemistry-Section B |
| Item No: | 57 |
| Question ID: | **154771545657** |
| Question Type: | Numeric Answer |
| Question: | Consider the molecules / ions given below<br><br>$XeO_3$, $BF_4^-$, $I_3^-$, $SF_6$, $PCl_5$<br><br>The ratio of number of molecules having $sp^3d$ hybridisation to those having $sp^3$ hybridisation is _____ |

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|---|---|
| Topic: | Chemistry-Section B |
| Item No: | 58 |
| Question ID: | **154771545658** |
| Question Type: | Numeric Answer |
| Question: | The number of coloured and paramagnetic ions from the following in aqueous solution are _____.<br>$Ti^{3+}$, $Co^{2+}$, $Ni^{2+}$, $Cu^{2+}$, $Cu^{+}$, $Ti^{4+}$, $Zn^{2+}$, $Sc^{3+}$<br>Given Atomic no.<br>Sc, 21; Ti, 22; Co, 27; Ni, 28; Cu, 29; Zn, 30 |

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|---|---|
| Topic: | Chemistry-Section B |
| Item No: | 59 |
| Question ID: | **154771545659** |
| Question Type: | Numeric Answer |
| Question: | The number of isomeric compounds (structural isomers only) possible with the molecular formula $C_5H_{10}O_2$, which do not react with metallic sodium is _____. |

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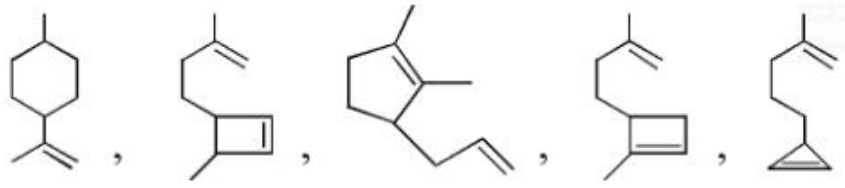
| Topic: | Chemistry-Section B |
| Item No: | 60 |
| Question ID: | **154771545660** |
| Question Type: | Numeric Answer |
| Question: | Among the following, how many hydrocarbon (s) with formula $C_{10}H_{16}$ which on reaction with acidic potassium permagenate yield(s) same product ? _____<br>  |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 61 |
| Question ID: | **154771545661** |
| Question Type: | MCQ |
| Question: | Let $f: \mathbb{R}-\{5\} \to \mathbb{R}$ be defined as $f(x)=\frac{2x^2+3x-2}{x-5}$. Then $f$ is |
| A: | one-one and onto |
| B: | one-one but not onto |
| C: | onto but not one-one |
| D: | neither one-one nor onto |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 62 |
| Question ID: | **154771545662** |
| Question Type: | MCQ |
| Question: | Let $z_1 = 1+2i, z_2 = 2+i$, $\frac{1}{z_1}+\frac{1}{z_2}=\frac{6}{w}$, and $z=\frac{iw}{2-\bar{w}}$.<br><br>Consider the statements<br><br>$(S_1)$ $\lvert z\rvert = \frac{5}{\sqrt{17}}$<br><br>$(S_2)$ $\arg(z)+\arg(w)=tan^{-1}\left(\frac{5}{3}\right)$.<br><br>Then |
| A: | both $(S_1)$ and $(S_2)$ are wrong |
| B: | only $(S_1)$ is correct |
| C: | only $(S_2)$ is correct |
| D: | both $(S_1)$ and $(S_2)$ are correct |

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| Topic: | Mathematics-Section A |
| Item No: | 63 |
| Question ID: | **154771545663** |
| Question Type: | MCQ |

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|---|---|
| Question: | If the system of linear equations<br>$\lambda x + y - z = -1$<br>$x - y - 3z = 2$<br>$-x + y + z = \mu$<br>has infinitely many solutions, then the equation of the line passing through the points $(\lambda + 2\mu, 2\lambda + \mu)$ and $(1, \lambda\mu)$ is |
| A: | $4x - 6y = -5$ |
| B: | $2x - 2y = 5$ |
| C: | $2x - 2y = -1$ |
| D: | $4x + 6y = 5$ |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 64 |
| Question ID: | **154771545664** |
| Question Type: | MCQ |
| Question: | Let $A$ be a matrix and $\begin{bmatrix}1 & 2\\0 & 1\end{bmatrix}A\begin{bmatrix}2 & 0\\-1 & 1\end{bmatrix}=\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$. If $\lvert A \rvert$ and $\lvert A^2 \rvert$ are the roots of the quadratic equation $ax^2 + bx + 3 = 0$, then $a + b - ab$ is equal to |
| A: | $-34$ |
| B: | 50 |
| C: | $-390$ |
| D: | 438 |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 65 |
| Question ID: | **154771545665** |
| Question Type: | MCQ |
| Question: | The sum of all values of $n$, for which $^{n-1}C_4 - {}^{n-1}C_3 - \frac{5}{4}\,{}^{n-2}P_2 < 0$, is |
| A: | 40 |
| B: | 45 |
| C: | 55 |
| D: | 56 |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 66 |
| Question ID: | **154771545666** |

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|---|---|
| Question Type: | MCQ |
| Question: | The coefficient of $x^{1011}$ in the expression $(1+2x)^{2022} + 2x\,(1+2x)^{2021} + (2x)^2\,(1+2x)^{2020} + \ldots + (2x)^{2022}$ is |
| A: | ${}^{2022}C_{1011}$ |
| B: | ${}^{2022}C_{1011} \times (2)^{1011}$ |
| C: | ${}^{2023}C_{1011} \times (2)^{1011}$ |
| D: | ${}^{2023}C_{1011}$ |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 67 |
| Question ID: | **154771545667** |
| Question Type: | MCQ |
| Question: | For $\lvert\alpha\rvert \geq 1$, let $5^{4-2\alpha}$, 63, $5^{2\alpha-1}$ be in A.P. with the common difference d. Let $S_n$ denote the sum of the first n terms of an A.P., whose first term is $\alpha^2$ and the common difference is d. If $S_{30} - S_{15} = 30k$, then k is equal to |
| A: | 715 |
| B: | 695 |
| C: | 684 |
| D: | 683 |

| | |
|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 68 |
| Question ID: | **154771545668** |
| Question Type: | MCQ |
| Question: | $2\sum_{n=2}^{\infty}\frac{n(2n^2+3)}{(n+1)!}$ is equal to |
| A: | 2 (e + 7) |
| B: | 2e + 1 |
| C: | 2e + 9 |
| D: | 2 (e + 1) |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 69 |
| Question ID: | **154771545669** |
| Question Type: | MCQ |

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|---|---|
| Question: | Let $f(x)=\begin{cases}\dfrac{\sin(ax+3x)+\sin x}{x}, & x<0\\ 2, & x=0\\ \dfrac{(x+6bx^2)^{\frac{1}{3}}-x^{\frac{1}{3}}}{3x^{4/3}}, & x>0\end{cases}$ be continuous at $x=0$. If $(1-k)\,f\left(\frac{7}{18}\right)=ab$, then $k$ is equal to |
| A: | $-6$ |
| B: | 15 |
| C: | $-13$ |
| D: | 8 |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 70 |
| Question ID: | **154771545670** |
| Question Type: | MCQ |
| Question: | If $y(x)=\tan x-\int_0^{2x}(x^2-xt+1)\sin t\,dt$, then at $x=\frac{\pi}{3}$, the value of $2y'''-y''$ is equal to |
| A: | 158 |
| B: | $159-4\sqrt{3}$ |
| C: | 126 |
| D: | $127-4\sqrt{3}$ |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 71 |
| Question ID: | **154771545671** |
| Question Type: | MCQ |
| Question: | Let $A_k=\int_{k\pi}^{(k+1)\pi}e^{-x}\sin x\,dx$, $k=0, 1, 2, ..., 20$. Then $\sum_{k=0}^{20}\lvert A_k\rvert$ is equal to |
| A: | $\left(\frac{e^{\pi}+1}{e^{\pi}-1}\right)\left(1-e^{-20\pi}\right)$ |

| | |
|---|---|
| B: | $\frac{1}{2}\left(\frac{e^{\pi}+1}{e^{\pi}-1}\right)\left(1-e^{-21\pi}\right)$ |
| C: | $\left(\frac{e^{\pi}+1}{e^{\pi}-1}\right)\left(1-e^{-21\pi}\right)$ |
| D: | $\frac{1}{2}\left(\frac{e^{\pi}+1}{e^{\pi}-1}\right)\left(1-e^{-20\pi}\right)$ |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 72 |
| Question ID: | **154771545672** |
| Question Type: | MCQ |
| Question: | $\lim\limits_{n\to\infty}\sum\limits_{k=1}^{n}\frac{n\left(n^2+k^2\right)}{\left(n^4+n^2k^2+k^4\right)}$ is equal to |
| A: | $\frac{\pi}{\sqrt{3}}$ |
| B: | $\frac{2\pi}{3\sqrt{3}}$ |
| C: | $\frac{\pi}{2\sqrt{3}}$ |
| D: | $\frac{\pi}{3}$ |

| | |
|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 73 |
| Question ID: | **154771545673** |
| Question Type: | MCQ |
| Question: | If $y=y(x)$ satisfies the differential equation $xdy+\left(x\tan\left(\frac{y}{x}\right)-y\right)dx=0$, $x>0$, and $y(1)=\frac{\pi}{2}$, then a value of $y(\sqrt{2})$ is |
| A: | $\frac{\pi}{3\sqrt{2}}$ |
| B: | $\frac{3}{2\sqrt{2}}$ |
| C: | $\frac{1}{2\sqrt{2}}$ |
| D: | $\frac{3\pi}{2\sqrt{2}}$ |

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|---|---|
| Topic: | Mathematics-Section A |

| | |
|---|---|
| Item No: | 74 |
| Question ID: | **154771545674** |
| Question Type: | MCQ |
| Question: | Let the area enclosed by the solution curve $y = y(x)$ of the differential equation $\frac{dy}{dx} + \frac{x-2}{y-b} = 2$, b > 0, y(5) = 0 is $13\pi$. Let $y = y(x)$ intersect the $y$-axis at the points $P$ and $Q$. If the tangents to $y = y(x)$ at $P$ and $Q$ meet at $T$, then the area of $\Delta PTQ$ is |
| A: | 13.5 |
| B: | 13 |
| C: | 14.5 |
| D: | 15 |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 75 |
| Question ID: | **154771545675** |
| Question Type: | MCQ |
| Question: | If foci of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{12} = 1$ and the ellipse $\frac{x^2}{25} + \frac{y^2}{9} = 1$ coincide, then the eccentricity of the hyperbola, with foci $\left(0, \pm\sqrt{10}\right)$ passing through the point $(a, a+1)$, is |
| A: | 2 |
| B: | $\sqrt{2}$ |
| C: | $\frac{3}{\sqrt{5}}$ |
| D: | $\sqrt{\frac{5}{2}}$ |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 76 |
| Question ID: | **154771545676** |
| Question Type: | MCQ |
| Question: | Let the curves $y^2 = kx$ and $xy = -1$ have a common tangent, whose slope is $\frac{1}{2}$. Then $k$ can **NOT** lie in the interval |
| A: | $(2, 4]$ |
| B: | $(-3, -1)$ |
| C: | $[-4, -3)$ |
| D: | $(1, 3)$ |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 77 |
| Question ID: | **154771545677** |
| Question Type: | MCQ |
| Question: | Let $ax + by + cz + 3 = 0$ be the plane which bisects the acute angle between the planes $2x - y - 2z + 3 = 0$ and $3x - 2y + 6z + 8 = 0$. Then $a + b + c$ is equal to |
| A: | $-31$ |
| B: | $28$ |
| C: | $\frac{14}{15}$ |
| D: | $-28$ |

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|---|---|
| Topic: | Mathematics-Section A |
| Item No: | 78 |
| Question ID: | **154771545678** |
| Question Type: | MCQ |
| Question: | If the mean and median of the data<br><table><tr><td>$x$</td><td>0 – 10</td><td>10 – 20</td><td>20 – 30</td><td>30 – 40</td><td>40 – 50</td><td></td></tr><tr><td>$f$</td><td>3</td><td>6</td><td>2</td><td>$x$</td><td>y</td><td>$\sum f = 20$</td></tr></table><br>are equal, then $xy^2$ is equal to |
| A: | $54$ |
| B: | $80$ |
| C: | $100$ |
| D: | $108$ |

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| Topic: | Mathematics-Section A |
| Item No: | 79 |
| Question ID: | **154771545679** |
| Question Type: | MCQ |
| Question: | The angle of elevation of the top P of a vertical tower for a person standing at a point A on the horizontal ground due north of the tower is $45^\circ$. Another person B is standing 50 m west of A on the ground. If the angle of elevation of P at B is $30^\circ$ then the height (in meters) of the tower is |
| A: | $25\sqrt{2}$ |
| B: | $50\sqrt{2}$ |
| C: | $25\sqrt{6}$ |

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| D: | $\frac{50}{\sqrt{3}-1}$ |

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| Topic: | Mathematics-Section A |
| Item No: | 80 |
| Question ID: | **154771545680** |
| Question Type: | MCQ |
| Question: | Which of the following is a contradiction? |
| A: | $((\sim p) \vee q) \Rightarrow \sim (p \Rightarrow q)$ |
| B: | $(\sim (p \Rightarrow q)) \wedge (\sim p)$ |
| C: | $(p \Rightarrow q) \wedge p$ |
| D: | $(\sim p) \wedge (\sim q)$ |

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| Topic: | Mathematics-Section B |
| Item No: | 81 |
| Question ID: | **154771545681** |
| Question Type: | Numeric Answer |
| Question: | The number of solutions of the equation $\|x^2 + 3x + 2\| + \|x + 5\| - 2 = 0, x \in \mathbb{R}$, is _____. |

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| Topic: | Mathematics-Section B |
| Item No: | 82 |
| Question ID: | **154771545682** |
| Question Type: | Numeric Answer |
| Question: | If $p_1$ and $p_2$, respectively, are the second largest and the fourth largest prime numbers in the factorization of the coefficient of $x^{30}$ in the expansion of $\left(x^2+2+\frac{1}{x^2}\right)^{-5}\left(1+x^2\right)^{40}$, then $p_1 + p_2$ is equal to _____ |

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| Topic: | Mathematics-Section B |
| Item No: | 83 |
| Question ID: | **154771545683** |
| Question Type: | Numeric Answer |
| Question: | The number of integral values of $b$ for which $2x^3 - 3x^2 - 12x + b = 0$ has three distinct real roots is _____. |

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| Topic: | Mathematics-Section B |
| Item No: | 84 |
| Question ID: | **154771545684** |

| Question Type: | Numeric Answer |
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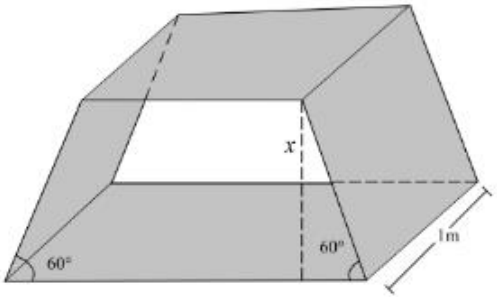
| Question: | An air duct is made of a thick metallic sheet. The duct is open from front and back. Its cross-section is a trapezium of base angles $60^\circ$ and area 1.5 $m^2$. Its length is 1 m. (see the figure). If its height $x = x_0$ (in metres) so that the area of the metallic sheet used for its construction is minimum, then $16\,(x_0)^4$ is equal to _____.<br>  |

| Topic: | Mathematics-Section B |
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| Item No: | 85 |
| Question ID: | **154771545685** |
| Question Type: | Numeric Answer |
| Question: | If the area enclosed by the curves $y = x^2,\ y^3 = x,\ x = -1$ and $y = x^2,\ y^3 = x,\ x = 1$, above the line $x = 2y$ is $\frac{n}{n+1}$, then $n$ is equal to _____. |

| Topic: | Mathematics-Section B |
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| Item No: | 86 |
| Question ID: | **154771545686** |
| Question Type: | Numeric Answer |
| Question: | Let $A\,(0, a+2)$, $B\,(0, a)$, $C\,(-2, 0)$ and $D\,(2, 0)$ be four points and the lines $AD$ and $BC$ intersect at $P\,(x, y)$. If the locus of $P$ is the curve $f\,(x, y) = 0$ and the tangent at the point $(4, \gamma)$ on this curve is $\frac{x}{\alpha} + \frac{y}{\beta} = 1$, then $\alpha\,(\beta - \gamma)$ is equal to_____. |

| Topic: | Mathematics-Section B |
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| Item No: | 87 |
| Question ID: | **154771545687** |
| Question Type: | Numeric Answer |
| Question: | Let $L_1$ be a line in the $yz$ - plane with $y$ and $z$ intercepts $\frac{1}{4}$ and $\frac{1}{C}$ $(C > 0)$ respectively. Let $L_2$ be the line in the $xz$ - plane with $x$ and $z$ intercepts $\frac{1}{3}$ and $-\frac{1}{C}$ respectively. If the shortest distance between $L_1$ and $L_2$ is $\frac{1}{5}$, then $C^2$ is equal to _____. |

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| Topic: | Mathematics-Section B |
| Item No: | 88 |
| Question ID: | **154771545688** |
| Question Type: | Numeric Answer |
| Question: | Let $OABC$ be a parallelogram, $O$ be the origin, $A$ (2, 4, –5) and $C$ (b, 2, 3). If $P(a, a, a)$ and $Q(9-a^2, 3, a-1)$, $a \in \mathbb{N}$, are two points such that the projection of $\overrightarrow{OP}$ on $\overrightarrow{OB}$ is 2 and $\overrightarrow{OQ}$ makes acute angles with all three co-ordinate axes, then $\left\|\overrightarrow{OB}\right\|^2 + \left\|\overrightarrow{AC}\right\|^2$ is equal to _____. |

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| Topic: | Mathematics-Section B |
| Item No: | 89 |
| Question ID: | **154771545689** |
| Question Type: | Numeric Answer |
| Question: | The probability distribution of a random variable $X$ is $P(X=i)=\frac{1}{2^i}$, $i = 1, 2, 3, \ldots\ldots$ The variance of $X$ is equal to _____. |

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| Topic: | Mathematics-Section B |
| Item No: | 90 |
| Question ID: | **154771545690** |
| Question Type: | Numeric Answer |
| Question: | Let $S=\left\{\theta \in [0, 2\pi] - \left\{\frac{\pi}{2}, \frac{3\pi}{2}\right\} : \sin^{-1}(\sin\theta) + \cos^{-1}(\cos\theta) + \tan^{-1}(\tan\theta) = \frac{4\pi}{5}\right\}$. Then $\frac{30}{\pi}\sum_{\theta \in S}\theta$ is equal to _____. |