MET 2022 Question Paper

Time Allowed :2 Hours	Maximum Marks :200	Total Questions :50

General Instructions

Read the following instructions very carefully and strictly follow them:

- Check the question paper for completeness and correctness of printing. In case of any discrepancy, inform the Invigilator immediately.
- The question paper consists of three sections: Physics, Chemistry, and Mathematics.
- Each section contains both Multiple Choice Questions (MCQs) and Numerical Answer Type questions.
- All MCQs have four options, out of which only one is correct.
- For numerical answer type questions, write the correct numerical value as the answer.
- Each correct answer carries 4 marks.
- There is negative marking of 1 for incorrect answers in MCQs.
- Attempt all questions within the given time limit.
- Use of calculators, mobile phones, smart watches, or any electronic devices is strictly prohibited.
- Rough work should be done only in the space provided in the question booklet.
- Do not leave the examination hall before the completion of the exam.
- Follow all instructions given by the Invigilator.

PART I - PHYSICS

1. The time period of a mass suspended from a spring is T. If the spring is cut into three equal parts and connected in parallel. The same mass is suspended from these parallel springs, then the new time period of the mass will be
(A) $\frac{T}{4}$
(B) T
(C) $\frac{T}{3}$
(D) $3T$

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2. The work done by all the forces (external and internal) on a system is equal to change in

(A) total energy
(B) kinetic energy
(C) potential energy
(D) None of these

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3. A wire in the form of semi-circle of radius r rotates about its diameter with angular velocity ω in a magnetic field B. The axis of rotation is perpendicular to the field. The total resistance of the circuit is R. If the mean power generated per period of rotation is $\frac{(B\pi r^2\omega)^2}{xR}$, then the value of x is

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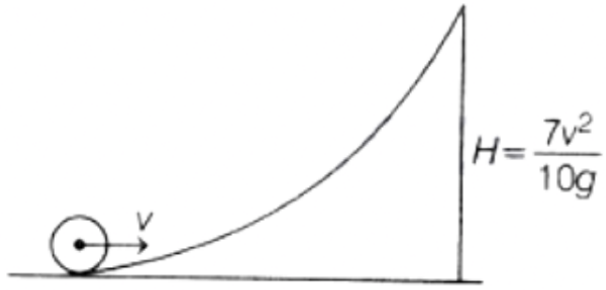
4. A small object of uniform density rolls up a curved surface with an initial velocity v. It reaches upto a maximum height of $\frac{7v^2}{10g}$ with respect to initial position. Then the object is



(A) ring
(B) solid sphere
(C) hollow sphere
(D) disc

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5. If the radius of a planet is three times the radius of the earth. Both have same mass-densities. v_P and v_E are the escape velocities of the planet and the earth respectively, then
(A) $v_P = 1.5v_E$
(B) $v_P = 3v_E$
(C) $v_E = 2v_P$
(D) $v_P = 2v_E$

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6. The stress that has to be applied to the ends of a steel wire of length 20 cm to keep its length constant, when its temperature is raised by $100°C$ is 2.2×10^x Pa. The value of x is
(Given $Y = 2 \times 10^{11}\,\mathrm{Nm}^{-2}$, $\alpha = 1.1 \times 10^{-5}\,°C^{-1}$)

7. A vessel contains oil (Density = $0.8\,\mathrm{g/cm^3}$) over mercury (density = $13.6\,\mathrm{g/cm^3}$). A homogeneous sphere floats with half of its volume immersed in mercury and the other half in oil. The density of the material of the sphere is $x\,\mathrm{g/cm^3}$. The value of x is

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8. At which temperature, magnitude of $^\circ C$ and $^\circ F$ are equal?
(A) 273
(B) 40
(C) -40
(D) -273

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9. The potential at a point at a distance r from the centre of an electric dipole is proportional to
(A) $\frac{1}{r}$
(B) $\frac{1}{r^2}$
(C) $\frac{1}{r^3}$
(D) r^2

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10. The electric resistance of a wire is R. If the length of the wire is increased to double by stretching it, then the new resistance of the wire is
(A) $2R$
(B) $4R$
(C) R
(D) $16R$

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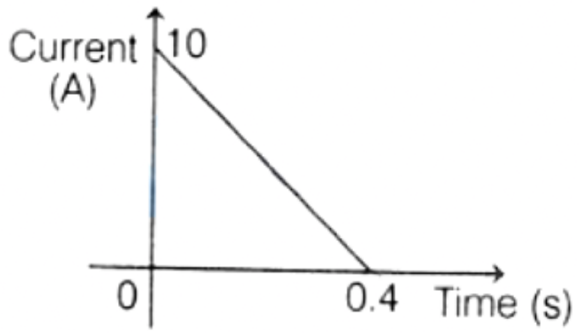
11. In a coil of resistance $150\,\Omega$, a current is induced by changing the magnetic flux through it as shown by figure. The magnitude of flux through the coil is ___ Wb.



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12. A particle of charge q and mass m is moving with a velocity $-2v\hat{i}$ ($v \neq 0$) towards a large screen placed in YZ-plane placed at a distance d. If there is a magnetic field $\vec{B} = B_0\hat{k}$, the maximum value of v for which the particle will not strike the screen is

(A) $\frac{qdB_0}{m}$
(B) $\frac{qdB_0}{2m}$
(C) $\frac{2qdB_0}{m}$
(D) $\frac{qdB_0}{3m}$

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13. The angle of a prism is A. One of its refracting surface is silvered. If light rays falling at an angle of incidence $2A$ on the first surface returns back through the same path after reflection from silvered surface. The refractive index μ of the prism is

(A) $2\sin A$
(B) $2\cos A$
(C) $\frac{1}{2\cos A}$
(D) $\tan A$

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14. An electron, helium ion (He^{++}) and proton having the same kinetic energy. The relation between their respective de-Broglie wavelengths $\lambda_e, \lambda_{He^{++}}$ and λ_p is

(A) $\lambda_e > \lambda_p > \lambda_{He^{++}}$
(B) $\lambda_e > \lambda_{He^{++}} > \lambda_p$
(C) $\lambda_e < \lambda_p < \lambda_{He^{++}}$
(D) $\lambda_e < \lambda_{He^{++}} = \lambda_p$

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15. The electric field of light wave is given as

$$E = 10^3 \cos\left(\frac{2\pi x}{5 \times 10^{-7}} - 2\pi \times 6 \times 10^{14} t\right) \hat{j}\,\text{N/C}$$

This light falls on a metal plate of work function $1.5\,$eV. The stopping potential of the photoelectron is ___ V.
(Energy of photon = $\frac{1240}{\lambda(\text{in nm})}$ eV)

PART II - CHEMISTRY

1. Arrange the following in increasing order of the volume (in L) occupied by them at STP
(i) 1.5 moles of CO_2
(ii) 14 g of N_2

(iii) 10^{21} **molecules of oxygen**

(A) (iii) ¡ (ii) ¡ (i)
(B) (i) ¡ (ii) ¡ (iii)
(C) (ii) ¡ (i) ¡ (iii)
(D) (i) ¡ (iii) ¡ (ii)

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2. According to VSEPR theory, the molecular shapes of XeF_4, XeO_4, XeO_2F_2 **and** $XeOF_4$ **respectively are**
(A) square planar, square planar, see-saw, square pyramidal.
(B) square planar, tetrahedral, trigonal bipyramidal, octahedral.
(C) square planar, tetrahedral, see-saw, square pyramidal.
(D) octahedral, tetrahedral, trigonal bipyramidal, octahedral.

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3. If gas absorbs 150 J of heat and expands by $450\,\mathbf{cm^3}$ **against a constant pressure of** $2 \times 10^5\,\mathbf{N/m^2}$**, then change in internal energy is**
(A) -60 J
(B) 60 J
(C) 240 J
(D) -240 J

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4. What is the first step and the final product formed in the reaction of HBr with $CH_3 - CH(CH_3) - CH = CH_2$**?**
(A) Protonation at more substituted carbon; $CH_3 - C(Br)(CH_3) - CH_2 - CH_3$
(B) Protonation at less substituted carbon; $CH_3 - CH(CH_3) - CHBr - CH_3$
(C) Radical initiation; $CH_3 - CH(CH_3) - CH_2 - CH_2Br$
(D) Protonation followed by hydride shift; $CH_3 - C(Br)(CH_3) - CH_2 - CH_3$

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5. In case of positive deviation from Raoult's law, the intermolecular attractive forces between the solute-solvent molecules as compared to those between the solute-solute and solvent-solvent molecules are
(A) weaker
(B) stronger
(C) same
(D) independent of intermolecular forces between solute-solvent molecules.

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6. From the following molar conductivities at infinite dilution, Λ^0_m**, for** NH_4OH **is**
Λ^0_m **for** $Ba(OH)_2 = 446.8\,\Omega^{-1}\,\mathbf{cm^2\,mol^{-1}}$
Λ^0_m **for** $BaCl_2 = 241.6\,\Omega^{-1}\,\mathbf{cm^2\,mol^{-1}}$
Λ^0_m **for** $NH_4Cl = 130\,\Omega^{-1}\,\mathbf{cm^2\,mol^{-1}}$

7. For the reaction, $N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$, the value of the rate of disappearance of N_2O_5 is given as $5.15 \times 10^{-3}\, mol\, L^{-1}\, s^{-1}$. The rate of formation of NO_2 is

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8. Mond's process is used for refining ___. Whereas van Arkel method is used for refining ___.
(A) lead, zirconium
(B) zirconium, nickel
(C) nickel, lead
(D) nickel, titanium

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9. Out of N, P, As, Sb and Bi, the number of elements that form pentahalides are

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10. The number of oxygen atoms that are directly attached to one chromium in dichromate ion are ___.

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11. Select the correct statement.
(A) $[Ni(CN)_4]^{2-}$ is diamagnetic whereas $[Ni(CO)_4]$ is paramagnetic.
(B) $[Ni(CN)_4]^{2-}$ and $[Ni(CO)_4]$ both are diamagnetic.
(C) $[Ni(CN)_4]^{2-}$ is sp^3 hybridised and square planar whereas $[Ni(CO)_4]$ is dsp^2 hybridised and tetrahedral.
(D) $[Ni(CN)_4]^{2-}$ is paramagnetic and dsp^2 hybridised whereas $[Ni(CO)_4]$ is diamagnetic and sp^3 hybridised.

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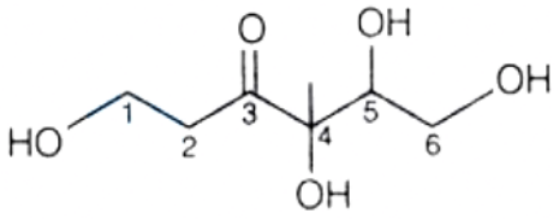
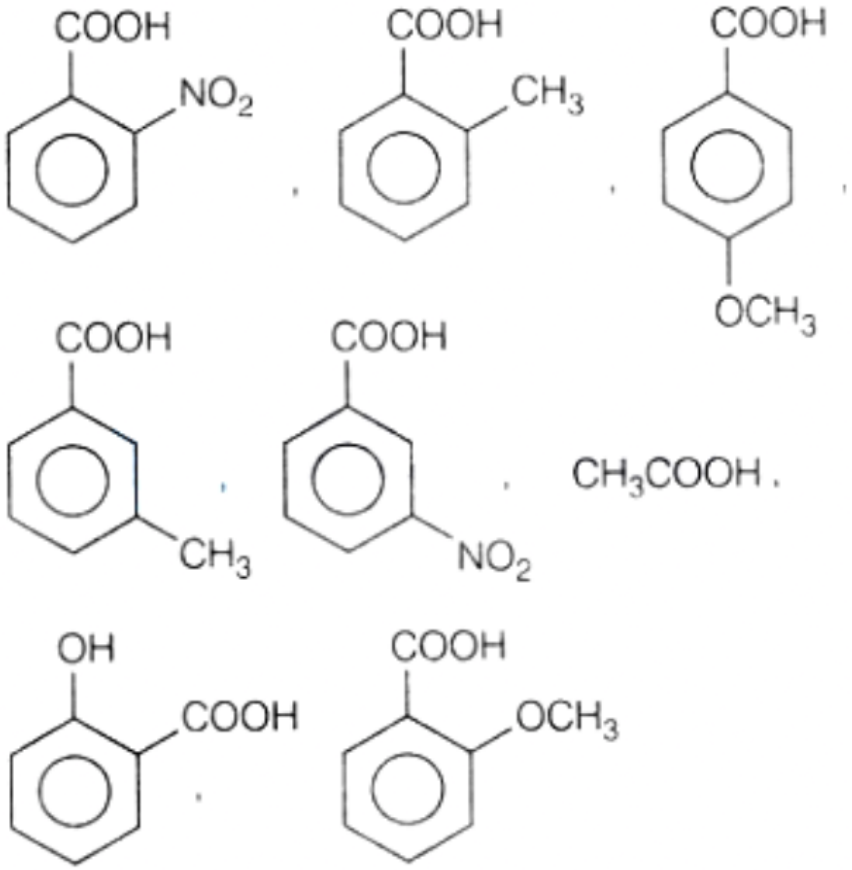
12. Alcoholic group of which position in the given molecule reacts fastest with Lucas' reagent?



(A) 1
(B) 4
(C) 5
(D) 6

13. Out of the given compounds, the number of compounds which are weaker acids than benzoic acid are



14. In the following sequence of reactions, the compound C formed would be

$$CH_3CH_2CONH_2 \xrightarrow{LiAlH_4} A \xrightarrow{HNO_2} B \xrightarrow{CrO_3} C$$

(A) 2-propanol
(B) propanol
(C) propanoic acid
(D) propanal

15. Polystyrene is a ___ polymer whereas dacron is a ___ polymer.
(A) step growth, chain growth
(B) chain growth, step growth
(C) condensation, addition
(D) thermoplastic, thermosetting

PART III - MATHEMATICS

1. If $\left|z+\frac{2}{z}\right|=2$, then the minimum value of $|z|$ is
(A) $1+\sqrt{2}$
(B) $1+2\sqrt{2}$
(C) $3\sqrt{3}+1$
(D) $1-\sqrt{3}$

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2. The number of 4 letter words (with or without meaning) that can be formed from the eleven letters of the word 'EXAMINATION' is
(A) 2454
(B) 3025
(C) 3462
(D) 4096

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3. If α,β,γ are in AP and $\tan^{-1}\alpha,\tan^{-1}\beta,\tan^{-1}\gamma$ are also in AP, then
(A) $\alpha-\beta-\gamma=0$
(B) $\alpha=\beta=\gamma$
(C) $\alpha+\beta=\gamma$
(D) $2\alpha=3\beta=\gamma$

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4. The coefficient of the middle term in the binomial expansion in powers of x of $(1+\alpha x)^4$ and $(1-\alpha x)^6$ is the same, if α is equal to
(A) $-\frac{5}{3}$
(B) $\frac{10}{3}$
(C) $-\frac{3}{10}$
(D) $\frac{3}{5}$

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5. The differential equation of all circles passing through the origin and having their centre on the X-axis is
(A) $x^2=y^2+xy\frac{dy}{dx}$
(B) $x^2=y^2+3xy\frac{dy}{dx}$
(C) $y^2=x^2+2xy\frac{dy}{dx}$
(D) $y^2=x^2-2xy\frac{dy}{dx}$

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6. The value of $\lim_{x\to 0}\frac{\int_0^{x^2}\sec^2 t\,dt}{x\sin x}$ is
(A) 3
(B) 2

(C) 1
(D) -1

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7. $\lim_{x\to 2} \frac{x^2+2^2-5}{2^{x-2}-2}$ **is equal to** ____
(A) $\frac{2}{\ln 2}$
(B) $\frac{4}{\ln 2}$
(C) $4 \ln 2$
(D) $2 \ln 2$

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8. If $\sum_{i=1}^{10}(x_i - 3) = 7$ **and** $\sum_{i=1}^{10}(x_i - 3)^2 = 27$**, then the standard deviation of the 10 items is**
(A) 2.547
(B) 1.87
(C) 14.86
(D) 1.486

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9. If $A = \{1, 2\}, B = \{1, 2, 3, 4\}, C = \{5, 6\}, D = \{5, 6, 7, 8\}$**, then state which of the following is true?**
(A) $(A \times C) \subset (B \times D)$
(B) $A \times B \subset C \times D$
(C) $(A \times B) \subset (A \times D)$
(D) $A \times C \subset B \times D$

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10. If A **is an** $n \times n$ **non-singular matrix such that** $AA^T = A^{-1}A$ **and** $B = A^{-1}A^T$**, then** BB' **is equal to**
(A) $I + B$
(B) I
(C) B^{-1}
(D) $(B^{-1})'$

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11. Let $f(x) = \sqrt{1 + x^2}$**, then**
(A) $f(xy) = f(x) \cdot f(y)$
(B) $f(xy) \geq f(x) \cdot f(y)$
(C) $f(xy) \leq f(x) \cdot f(y)$
(D) $f(xy) = f(x) - f(y)$

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12. For what value of θ **lying between** 0 **and** π **which satisfy inequality** $\sin\theta \cos^3\theta > \sin^3\theta \cos\theta$

(A) $\theta \in (\pi/4, \pi/2)$
(B) $\theta \in (0, \pi/4)$
(C) $\theta \in (0, \pi/2)$
(D) None of these

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13. If $\int f(x)\,dx = g(x)$, then $\int x^9 f(x^5)\,dx$ is equal to
(A) $\frac{1}{5}(x^5 g(x^9) - 4\int g(x^9)\,dx) + C$
(B) $\frac{1}{5}[x^9 g(x^5) - \frac{1}{5}\int x^4 g(x^5)\,dx] + C$
(C) $\frac{1}{5}[g(x^9) + \int g(x^5)\,dx]$
(D) $\frac{x^5}{5} g(x^5) - \int x^4 g(x^5)\,dx + C$

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14. The area of the region bounded by the curves $y = |x-2|$, $x = 1$, $x = 3$ and the x-axis is
(A) 1 sq unit
(B) 2 sq units
(C) 3 sq units
(D) 4 sq units

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15. The area of the region described by $A = \{(x, y) : x^2 + y^2 \leq 1$ and $y^2 \leq 1 - x\}$ is
(A) $\frac{\pi}{2} + \frac{4}{3}$
(B) $\frac{\pi}{2} - \frac{1}{2}$
(C) $\frac{\pi}{4} + \frac{2}{3}$
(D) $\frac{\pi}{2} + \frac{2}{3}$

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16. If

$$\begin{vmatrix} a & a^2 & 1+a^3 \\ b & b^2 & 1+b^3 \\ c & c^2 & 1+c^3 \end{vmatrix} = 0$$

and vectors $(1, a, a^2), (1, b, b^2), (1, c, c^2)$ are non-coplanar, then the product abc is ___.

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17. If the lines $\frac{x-2}{1} = \frac{y-3}{1} = \frac{z-4}{-k}$ and $\frac{x-1}{2k} = \frac{y-3}{2} = \frac{z-5}{1}$ are coplanar, then k can have
(A) exactly one value, $k = \frac{1}{2}$
(B) exactly one value, $k = \frac{1}{4}$
(C) exactly two values, $k = \frac{1}{2}, -\frac{3}{2}$
(D) any value

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18. If the foot of the perpendicular drawn from the point $(0, 2, 1)$ on a line passing through $(a, 5, 1)$ is $\left(\frac{5}{3}, \frac{7}{3}, \frac{15}{3}\right)$, then a is equal to ___.

19. A multiple choice examination has 5 questions. Each question has 4 alternatives of which exactly one is correct. The probability that a student will get 4 or more correct answer just by guessing is

(A) $\frac{1}{4^5}$

(B) $\left(\frac{3}{4}\right)^4$

(C) $\frac{1}{4^3}$

(D) $\frac{3}{4^5}$

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20. If the probability that a randomly chosen 6-digit number formed by using digits 1 and 8 only is a multiple of 21 is p, then $96p$ is equal to ___.
