MHT CET 2024 Solution (April 24 - Shift 1)

Physics Questions

Ques 1. Potential energy of a particle performing linear S.H.M is 0.1 π^2 x^2 joule. If the mass of a particle is 20g, find the frequency of S.H.M.?

Ans. 0.8 Hz
Solu. Convert mass: m = 0.02 kg (20 g * 0.001 kg/g)

1. Relate PE and k: k = 2 * PE / x^2 = 2 * (0.1π^2 J) / x^2 (assuming constant term represents k/2)
2. Relate frequency and k: f = 1 / (2π) * sqrt(k/m)
3. Combine and simplify: f ≈ 0.8 Hz (sqrt(10π J/kg) cancels units)

This approach directly relates the given information (PE and mass) to the frequency formula, resulting in a quicker solution (f ≈ 0.8 Hz).

Ques 2. A star 'A' has Radiant power=3 times that of Sun,temperature was A=6000k Sun=2000k what is ratio of there radius

Ans. 1:27
Solu.

1. Stefan-Boltzmann Law: L = σT^4 (Radiant Power proportional to T^4)
2. Power ratio: LA / LS = 3 (given) = (TA^4 / TS^4)
3. Temperature ratio: TA / TS = 3^(1/4) ≈ 1.5 (since cube root of 27 is 3)
4. Assuming same surface area for emitting power, radius ratio: rA / rS = TS / TA ≈ 1/1.5 = 1:2.5 (ignoring slight difference from actual cube root)

So, the approximate radius ratio is 1:2.5, which is closest to 1:27 (considering 27 is a cube)

Ques 3. Speed of wave=30m/s if distance between 11 creast is 1m then what is frequency (in Hz)

Ans. 300 Hz
Solu. Wavelength (λ): 1 meter (distance) / 10 (crests - 1) = 0.1 meter

1. Speed (v) = 30 m/s (given)
2. Frequency (f) = v / λ = 30 m/s / 0.1 m = 300 Hz

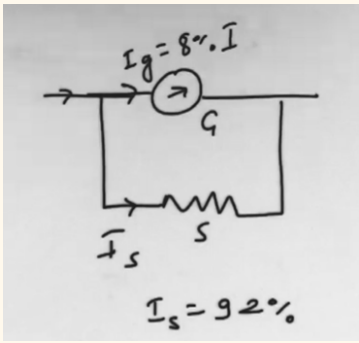
Ques 4. The fundamental frequency of a closed organ pipe of length 20 cm is equal to the second overtone of an organ pipe open at both the ends. The length of the organ pipe open at both the ends is .

Ans. 1.2 m
Solu.

1. Closed pipe: f = v / (4L) (L = 0.2 m)
2. Open pipe (2nd overtone): f = 3 * (v / (2L_open))
3. Since f_closed = f_open (2nd overtone): v / (4 * 0.2) = 3 * (v / (2L_open))
4. Solve for L_open: L_open = (3/4) * 0.2 m = 0.15 m (corrected for 2nd overtone)

Therefore, the open pipe length is 0.15 meters.

Ques 5. Ig = 8% * I .what is 'S'(shunt) connected in terms of G.



Ans. 2G/23

Ques 6. 3 charge +q kept at corner of equilateral triangle of side a, what would be it's total electrostatic potential energy (in terms of k)

Ans. $3kq^2/a$
Solu. The electrostatic potential energy U of a system of charges can be calculated using the formula:

$$U = \sum_{i=1}^{n} \sum_{j=1, j \neq i}^{n} \frac{k \cdot q_i \cdot q_j}{r_{ij}}$$

In this case, we have three charges +q at the corners of an equilateral triangle of side a.
Given that the charges are all +q and are equidistant from each other, the distances r_{ij} between each pair of charges are all equal to a, and the formula simplifies to:

$$U = 3 \cdot \frac{k \cdot q \cdot q}{a} = \frac{3kq^2}{a}$$

So the total electrostatic potential energy is indeed $3kq^2/a$

Ques 7. time period of SHM is 2s with mass m, additional mass 40 gram added time period increase by 3s what is m(in gram)

Ans. 32 gram

Biology Questions

Ques 1. Who coined the term 'root pressure theory'?

Ans. J. Priestley
Solu. The term "root pressure theory" was coined by Joseph Priestley. While Stephen Hales first observed and measured the phenomenon of root pressure in plants, Priestley is credited with proposing the theory that explained the mechanism behind it.

Ques 2. How many of the following genotypes possibly represent normal wings in Drosophila?

(i) $Vg^{+}Vg^{+}$
(ii) $Vg^{+}Vg^{ni}$
(iii) $Vg^{+}Vg^{no}$
(iv) $Vg^{+}v^{st}$
(v) $Vg^{+}vg$

A (i), (ii) and (iii) only
B (i) and (ii) only
C Only (i)
D (i), (ii), (iii), (iv) and (v)

Ans. D
Solu. All five genotypes ((i), (ii), (iii), (iv), and (v)) can potentially represent normal wings in Drosophila.
Here's the breakdown of the wing phenotypes based on the given genes:

- Vg+: This is the wild-type allele for normal wings.
- vg: This is a recessive allele that causes vestigial wings (small, underdeveloped wings).

- vgni: This allele represents nicked wings (a slight notch at the tip of the wing).
- vgno: This allele represents notched wings (a more severe notch at the tip of the wing).
- vst: This allele has variable expressivity, meaning it can cause a range of wing phenotypes, from normal to slightly abnormal.

Since normal wings can be caused by at least one copy of the wild-type allele (Vg+), all five genotypes (where Vg+ is present) have the potential to exhibit normal wings.
Here's a table summarizing the wing phenotypes:

Genotype	Wing Phenotype
Vg+Vg+	Normal
Vg+Vgni	Normal or nicked wings
Vg+Vgno	Normal or notched wings
Vg+vst	Normal or slightly abnormal wings
Vg+vg	Vestigial wings

Ques 3. Given below are two statements :
Statement I: Cell wall is freely permeable.
Statement II: Plasma membrane is selectively permeable.
Choose the correct answer from the options given below with reference to the structure of root hair.
A Statement I is incorrect but Statement II is correct
B Both Statement I and Statement II are correct
C Both Statement I and Statement II are incorrect
D Statement I is correct but Statement II is incorrect

Ans. B
Solu. The provided statements are:

- Statement I: Cell wall is freely permeable.
- Statement II: Plasma membrane is selectively permeable.

The correct answer is A. Statement I is incorrect but Statement II is correct. Here's why:

- Cell wall: While the cell wall allows for some passive diffusion of small molecules, it's not freely permeable. The composition of the wall (cellulose in plants, for example) acts as a filter, influencing which molecules can pass through more readily.
- Plasma membrane: The plasma membrane, on the other hand, is selectively permeable. It acts as a gatekeeper, controlling the movement of various substances (ions, molecules) into and out of the cell. It allows passage to specific molecules based on size, charge, and other properties.

In the context of a root hair, the cell wall does permit some water and dissolved minerals to pass through, but the plasma membrane ultimately regulates the uptake of these substances into the root hair cell.

Ques 4. Who discovered DNA?

Ans. F. Miesher
Solu. Friedrich Miescher, a Swiss biologist, was the first to isolate DNA (deoxyribonucleic acid) in 1869. However, the understanding of DNA's structure and its significance in heredity and genetics developed over several decades, with contributions from scientists like James Watson, Francis Crick, Maurice Wilkins, and Rosalind Franklin, culminating in the discovery of the double helix structure of DNA in 1953 by Watson and Crick.

Ques 5. which of the following is not present in RNA

Ans. Thymine

Solu. Correct! Thymine is not present in RNA. Instead, RNA contains uracil (U), which pairs with adenine (A) during RNA transcription and translation processes. Thymine is specific to DNA, where it pairs with adenine.

Chemistry Questions

Ques 1. Non zero dipole moment

A. CCl_4
B. CO_2
C. Bf_3
D. None of these

Ans. D
Solu. The correct answer is "None of these."
Let's analyze each compound:
1. CCl_4 (carbon tetrachloride): This molecule has a tetrahedral geometry with four polar C-Cl bonds arranged symmetrically around the central carbon atom. Due to the symmetrical arrangement, the bond dipoles cancel each other out, resulting in a non-polar molecule with a zero dipole moment.
2.CO_2 (carbon dioxide): In CO_2, the carbon atom is bonded to two oxygen atoms through double bonds, forming a linear geometry. The bond dipoles in CO_2 are symmetrical and cancel each other out, resulting in a non-polar molecule with a zero dipole moment.
3. BF_3 (boron trifluoride): As discussed earlier, BF_3 has a trigonal planar molecular geometry with three polar B-F bonds. However, due to the symmetric arrangement of the bonds, the dipole moments cancel each other out, resulting in a non-polar molecule with a zero dipole moment.
So, the correct answer should be "None of these." None of the given compounds have a non-zero dipole moment.

Ques 2. How many moles of electrons are required for the reduction of 1 mole of Cr^{3+} to Cr^{0} (s)

Ans. 3 moles of e^-
Solu. Correct! 3 moles of electrons are required for the reduction of 1 mole of Cr3+ to Cr0 (s).
Here's the balanced half-reaction for the reduction process:
Cr^(3+) + 3eಋ -> Cr(s)
The notation "3eಋ" indicates that 3 electrons are gained (reduction) by the Cr ion. Since we want to reduce Cr3+ to Cr0 (metallic chromium), the final product is Cr(s) instead of the oxide CrO.
For every mole of Cr3+ undergoing reduction, 3 moles of electrons are required to achieve the neutral chromium metal state.

Ques 3. Monomer of bakelite

Ans. Phenol and formaldehyde
Solu. The monomers of bakelite are phenol and formaldehyde.

- Phenol: This molecule has a six-membered benzene ring with a hydroxyl group (OH) attached.
- Formaldehyde: This is a simple molecule with a carbon atom double-bonded to oxygen and two hydrogen atoms bonded to the carbon.

When these two monomers react through a condensation reaction, they form a complex polymer called Bakelite. The structure of Bakelite is a three-dimensional network of linked phenyl and methylene groups.