NSO-Style · Original Practice Content

Class 9 | Science Olympiad

40 Questions · With Answer Key
Syllabax Olympiad Series
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Instructions: Each question has one correct answer. Choose the best option (A/B/C/D). Answer key is provided at the end. This paper is for practice only — not an official exam paper. Recommended time: **45 minutes**.

Q1. The Stern-Gerlach experiment demonstrated that electrons have:

A. wave properties

B. quantised orbital angular momentum

C. intrinsic spin (quantised spin angular momentum)

D. no charge

Q2. In organic chemistry, an E2 elimination reaction is favoured by:

A. a weak base and polar protic solvent

B. a strong bulky base and high temperature

C. a weak nucleophile

D. an SN1 mechanism at the same time

Q3. The Wigner-Seitz cell in solid-state physics is the:

A. unit cell that contains atoms at corners only

B. smallest region of a crystal that can generate the entire lattice by translation

C. primitive cell with the minimum number of atoms

D. volume of space closer to a lattice point than to any other

Q4. CRISPR guide RNAs direct Cas9 to cut DNA at a sequence adjacent to a:

A. TATA box

B. CpG island

C. PAM (protospacer adjacent motif) sequence

D. poly-A tail

Q5. The Boltzmann distribution describes the probability that a particle is in a state with energy E as proportional to:

A. e^(E/kT)

B. e^(-E/kT)

C. E/kT

D. kT/E

Q6. In the Standard Model, leptons are:

A. carriers of the strong nuclear force

B. hadrons made of quarks

C. fundamental particles not subject to the strong force (e.g. electron, muon, neutrino)

D. bosons that mediate forces

Q7. The Woodward-Hoffmann rules predict whether a pericyclic reaction is thermally or photochemically:

A. endothermic or exothermic

B. allowed or forbidden based on orbital symmetry

C. fast or slow based on temperature

D. SN1 or SN2

Q8. In population genetics, FST (fixation index) measures:

A. mutation rate between populations

B. migration rate

C. genetic differentiation between populations

D. selection coefficient

Q9. The Josephson effect occurs when two superconductors are separated by a thin insulator, producing:

A. electrical resistance proportional to temperature

B. a tunnelling current with no voltage applied, and oscillating current when voltage is applied

C. complete blocking of current

D. magnetic field generation

Q10. Proofreading activity in DNA polymerase is provided by its:

A. 5'→3' polymerase domain

B. helicase activity

C. 3'→5' exonuclease activity

D. primase domain

Q11. The principle of detailed balance in thermodynamics states that at equilibrium:

A. all reactions stop

B. only forward reactions continue

C. each elementary reaction is balanced by its reverse at the same rate

D. entropy is maximised across all steps

Q12. Synchrotron radiation is produced when:

A. protons collide in a collider

B. electrons oscillate in a crystal lattice

C. relativistic charged particles are accelerated in a curved path

D. nuclear fusion releases gamma rays

Q13. Which of the following correctly describes RNA interference (RNAi)?

A. RNA polymerase is inhibited by small molecules

B. small interfering RNAs (siRNAs) guide cleavage of complementary mRNA

C. ribozymes self-cleave to prevent translation

D. microRNAs enhance translation of target mRNAs

Q14. The anomalous Zeeman effect (splitting of spectral lines in a magnetic field) is explained by:

A. nuclear spin

B. orbital angular momentum only

C. electron spin angular momentum interacting with the field

D. Doppler broadening

Q15. Which of the following best describes the concept of 'fitness landscape' in evolutionary biology?

A. a geographic map of species distributions

B. a multi-dimensional representation of how genotypes map to reproductive fitness

C. the physical terrain used by animals

D. the metabolic pathways conferring maximum energy yield

Q16. The Gibbs-Duhem equation relates changes in chemical potentials in a mixture. It ensures that in a binary mixture at constant T and P:

A. both components must have increasing chemical potential

B. the chemical potentials of the two components change independently

C. $x_1 d\mu_1 + x_2 d\mu_2 = 0$ (the changes are coupled)

D. chemical potentials must equal each other

Q17. Optical tweezers manipulate microscale objects using:

A. magnetic fields

B. electric discharge

C. radiation pressure from a focused laser beam

D. acoustic waves

Q18. The Luria-Delbrück experiment demonstrated that:

A. bacteria do not mutate

B. mutations arise randomly and pre-exist selection pressure (not directed by it)

C. radiation causes all bacterial mutations

D. natural selection is Lamarckian

Q19. Coupled oscillators in physics reach normal modes. In a diatomic molecule, the two normal modes are:

A. oscillation and rotation

B. symmetric stretch and bending

C. symmetric stretch and asymmetric stretch

D. translation and vibration

Q20. Which protein acts as the primary oxygen sensor in the hypoxia response (HIF pathway)?

A. HIF-1α

B. prolyl hydroxylase (PHD)

C. VHL (von Hippel-Lindau protein)

D. p53

Q21. The Rydberg formula calculates the wavelengths of spectral lines in hydrogen. The Lyman series involves transitions to the n = ___ level.

A. 3

B. 2

C. 4

D. 1

Q22. In polymer chemistry, the degree of polymerisation is:

A. the number of monomers in a polymer chain

B. the temperature at which a polymer melts

C. the branching factor

D. the ratio of polymer to monomer at equilibrium

Q23. What is the correct description of the Bohr magneton?

A. the magnetic moment of a proton

B. the natural unit of nuclear magnetic moment

C. the natural unit of electron magnetic moment

D. the unit of spin angular momentum

Q24. In cell biology, the unfolded protein response (UPR) is triggered by:

A. DNA damage in the nucleus

B. accumulation of misfolded proteins in the endoplasmic reticulum

C. mitochondrial dysfunction

D. ribosome stalling during translation

Q25. The Clausius-Clapeyron equation relates the vapour pressure of a substance to:

A. its molecular mass

B. its surface tension

C. its solubility in water

D. temperature and enthalpy of vaporisation

Q26. In mass spectrometry, the base peak is:

A. the peak of the molecular ion

B. the heaviest fragment observed

C. the most abundant ion, assigned relative intensity 100

D. the lightest fragment

Q27. According to the Pauli Exclusion Principle applied to Hund's Rule, electrons fill degenerate orbitals:

A. by pairing in the lowest energy orbital first

B. in randomly selected orbitals

C. one electron per orbital with parallel spins before pairing occurs

D. in descending order of energy

Q28. In comparative genomics, synteny refers to:

A. similar DNA sequences in different species

B. the conservation of gene order across different species' chromosomes

C. identical proteins across species

D. the presence of orthologous genes

Q29. Feynman diagrams are used in quantum electrodynamics to represent:

A. the electronic structure of atoms

B. perturbative calculations of particle interaction amplitudes

C. spectral lines of hydrogen

D. the paths of planets

Q30. The Henderson-Hasselbalch equation pH = pKa + log([A^-]/[HA]) shows that a buffer is most effective when:

A. pH >> pKa

B. [HA] >> [A^-]

C. pH = pKa (equal concentrations of acid and conjugate base)

D. pH << pKa

Q31. In evolutionary biology, kin selection explains altruistic behaviour using Hamilton's rule: rB > C, where r is:

A. reproductive rate

B. relatedness between individuals

C. rate of mutation

D. resistance to selection

Q32. The concept of 'emergent properties' in biology means:

A. genes emerging during development

B. properties of a system that arise from interactions between components and cannot be predicted from the parts alone

C. new species emerging by evolution

D. mutations creating new traits

Q33. Ultrafast spectroscopy (femtosecond lasers) is used to study:

A. slow geological processes

B. intramolecular dynamics and chemical bond formation/breaking in real time

C. the structure of proteins by X-ray diffraction

D. galaxy formation

Q34. In neuroscience, long-term potentiation (LTP) is associated with memory and requires:

A. GABA receptors

B. serotonin

C. NMDA receptor activation and AMPA receptor insertion

D. dopamine release

Q35. Gravitational waves, predicted by general relativity, were first detected in 2015 by:

A. Hubble Space Telescope

B. LIGO (Laser Interferometer Gravitational-Wave Observatory)

C. CERN

D. ESA Gaia mission

Q36. In combinatorial chemistry, a split-and-pool synthesis generates:

A. one compound at a time

B. a library of many compounds simultaneously

C. isotopically labelled compounds

D. polymers with defined sequences

Q37. The concept of 'metabolic flux' refers to:

A. the concentration of metabolites

B. the number of enzymes in a pathway

C. the rate of flow through a metabolic pathway

D. the energy stored in ATP

Q38. Which of the following describes quantum entanglement?

A. two particles sharing the same location

B. two particles having opposite charges

C. a state where measuring one particle instantly determines the correlated state of the other, regardless of distance

D. two particles oscillating at the same frequency

Q39. In ecology, the 'intermediate disturbance hypothesis' proposes that:

A. the most stable ecosystems have no disturbance

B. maximum biodiversity occurs at very high disturbance

C. biodiversity is highest at intermediate levels of disturbance

D. disturbance always reduces species richness

Q40. The Dirac equation, unlike the Schrödinger equation, is consistent with:

A. Newtonian mechanics

B. classical thermodynamics

C. special relativity and predicted the existence of antimatter

D. general relativity only

Answer Key

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Q1: C    Q2: B    Q3: D    Q4: C    Q5: B    Q6: C    Q7: B    Q8: C    Q9: B    Q10: C
Q11: C   Q12: C   Q13: B   Q14: C   Q15: B   Q16: C   Q17: C   Q18: B   Q19: C
Q20: B   Q21: D   Q22: A   Q23: C   Q24: B   Q25: D   Q26: C   Q27: C   Q28: B
Q29: B   Q30: C   Q31: B   Q32: B   Q33: B   Q34: C   Q35: B   Q36: B   Q37: C
Q38: C   Q39: C   Q40: C
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