8th All India RPS OLYMPIAD

Online & Offline Mega Event

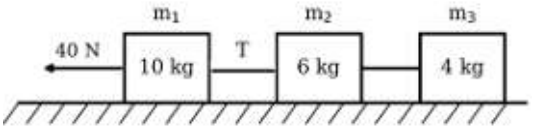
QUESTION PAPER (PHASE – I)

CLASS – IX

RPS SCIENCE LEAGUE

PHYSICS

Q1. Three blocks of masses m_1, m_2 and m_3 are placed on a horizontal frictionless surface. A force of 40 N pulls the system as shown in figure. Calculate the value of Tension (T), if m_1 = 10 kg, m_2 = 6 kg and m_3 = 4 kg.



(A) 40 N (B) 20 N (C) 10 N (D) 5 N

Q2. Resultant of which of the following forces may be equal to zero?

(A) 10 N, 10 N, 30 N (B) 10 N, 20 N, 30 N

(C) 5 N, 10 N, 20 N (D) None of these

Q3. If $|\vec{a} \times \vec{b}| = \sqrt{3}(\vec{a}.\vec{b})$, then $|\vec{a} + \vec{b}|$ is (where $|\vec{a}|=a$ and $|\vec{b}|=b$)

(A) $\sqrt{a^2 + b^2 + 2ab}$ (B) $\sqrt{a^2 + b^2 + \frac{ab}{2}}$

(C) $\sqrt{a^2 + b^2}$ (D) $\sqrt{a^2 + b^2 + ab}$

Q4. A string passing over a smooth massless fixed pulley connects two blocks of masses m_1 and m_2 (vertically). If the acceleration of the system is $\left(\frac{g}{8}\right)$, then the ratio of masses is :

(A) 8 : 1 (B) 9 : 7 (C) 4 : 3 (D) 5 : 3

Q5. A spring of spring constant $5 \times 10^3\ N/m$ is stretched initially by 5 cm from the unstretched position. The work required to further stretch the spring by another 5 cm is.

(a) $6.25\ N-m$ (b) $\frac{12}{50} N-m$

(c) $18.75\ N-m$ (d) $25.00 N-m$

Q6. A pendulum is hanging from the ceiling of a car having an acceleration a_0 with respect to the road. Find the angle (θ) made by the string with vertical at equilibrium.

(A) $tan^{-1}\left(\frac{a_0}{g}\right)$ (B) $tan^{-1}\left(\frac{g}{a_0}\right)$ (C) $sin^{-1}\left(\frac{a_0}{g}\right)$ (D) $cos^{-1}\left(\frac{a_0}{g}\right)$

Q7. One nanometer is equal to –

(A) 10^9 mm (B) 10^{-6} cm (C) 10^{-7} cm (D) 10^{-9} cm

Q8. If the vector $2\hat{i} + 3\hat{j} + 8\hat{k}$ is perpendicular to the vector $4\hat{j} - 4\hat{i} + \alpha\hat{k}$, then the value of α is –

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

Q9. A ball is dropped from a height of 125 m. What will be the time taken and the speed with which it strikes the ground? (Take g = 10 m/s^2)

(A) 5 s, 30 m/s (B) 5 s, 50 m/s (C) 7 s, 50 m/s (D) 7 s, 30 m/s

Q10. The value of $\vec{A}.\left(\vec{A} \times \vec{B}\right)$ is :

(a) $A^2 + AB$ (b) 0 (c) $A^3 - AB$ (d) A^2

Q11. A bullet is moving with a speed of 16 m/s enters a concrete wall and penetrates a distance of 0.4 m before coming to rest. The time taken during the retardation is (assuming constant retardation)

(A) 0.15 s (B) 0.10 s (C) 0.05 s (D) 0.20 s

Q12. A car goes from 20 km/h to 30 km/h in 1.5 s. At the same acceleration, approximately how much time is taken by the car to go from 30 km/h to 36.7 km/h? (assuming constant acceleration)

(A) 4 s (B) 3 s (C) 2 s (D) 1 s

Q13. Direction for question given below, there are two statements marked as Assertion (A) and Reason (R). Mark your answer as per the codes provided below:

Assertion (A): A body can have acceleration even if its velocity is zero at a given instant of time.

Reason (R): In one dimensional motion, a body is momentarily at zero acceleration, when it reverses its direction of motion.

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

(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

(C) Both Assertion (A) and Reason (R) are false.

(D) Assertion (A) is true but Reason (R) is false.

Q14. The ratio of the amplitudes of two coherent waves is 5:11. The ratio of their respective intensities is

(A) 121:25 (B) 11:5 (C) 5:11 (D) 25:121

Q15. A body of mass 1 kg moves along a straight line with a velocity $v = 2x^2$ (Where v is in m/s and x is in m). The work done by the body during displacement from x=0 to 5m is _____ J.

(A) Zero (B) 250 (C) 1250 (D) 1000

Q16. The area under 'Velocity-time' graph represents

(a) distance (b) displacement

(c) acceleration (d) force

Q17. The weight of an object in a coal mine and at sea level are W_1 and W_2 respectively. Then

(A) $W_2 < W_1$ (B) $W_1 = W_2$ (C) $W_1 < W_2$ (D) $W_1 = 2W_2$

Q18. The height above the surface of the Earth where the value of acceleration due to gravity is one-fourth of that at the surface is (R_e = radius of the Earth)

(A) $\frac{R_e}{4}$ (B) $\frac{R_e}{2}$ (C) $\frac{3R_e}{4}$ (D) R_e

Q19. The torque (in Nm) due to the force $(2\hat{i} + \hat{j} + 2\hat{k})$ N about the origin, acting on a particle whose position vector is $(\hat{i} + \hat{j} + \hat{k})$ m, would be

(A) $\hat{i} - \hat{j} + \hat{k}$ (B) $\hat{i} + \hat{k}$ (C) $\hat{i} - \hat{k}$ (D) $\hat{j} - \hat{k}$

Q20. A stone is dropped into a well which is 19.6 m deep. If the echo is heard 2.06 s after the stone is dropped, then the velocity of sound is (Take g = 9.8 m/s^2)

(A) 332.6 m/s (B) 326.7 m/s (C) 300.4 m/s (D) 290.5 m/s

CHEMISTRY

Q21. Which technique is used to separate different pigments or colors from an ink sample?

(A) Chromatography (B) Centrifugation

(C) Fractional distillation (D) Crystallization

Q22. A mixture of two or more miscible liquids with a boiling point difference of less than 25°C can be separated by using:

(A) Simple distillation (B) Fractional distillation

(C) Decantation (D) Filtration

Q23. The process of settling down of heavier, insoluble solid particles in a solid-liquid mixture is known as:

(A) Decantation (B) Filtration (C) Sedimentation (D) Evaporation

Q24. Which separation technique is commonly used in dairies to separate cream from milk?

(A) Centrifugation (B) Filtration

(C) Distillation (D) Chromatography

Q25. Iodine can be separated from a mixture of iodine and sand by which of the following process?

(A) Filtration (B) Sublimation (C) Evaporation (D) Decantation

Q26. Rutherford's alpha-particle scattering experiment led to the discovery of the:

(A) Electron (B) Proton (C) Atomic Nucleus (D) Neutron

Q27. Which subatomic particle has a nearly negligible mass and carries a single negative charge?

(A) Proton (B) Electron (C) Neutron (D) Alpha particle

Q28. An element has an atomic number (Z) of 13. What is the correct electronic configuration of this atom?

(A) 2, 8, 1 (B) 2, 8, 3 (C) 2, 8, 2 (D) 8, 2, 3

Q29. If an atom has 11 protons and 12 neutrons in its nucleus, what is its mass number A?

(A) 11 (B) 12 (C) 23 (D) 1

Q30. Atoms of the same element having the same atomic number but different mass numbers are known as:

(A) Isobars (B) Isotopes (C) Isotones (D) Isomers

Q31. An atom of a specific element forms a stable trivalent cation M^{3+}. If the electronic configuration of this cation in its ground state is [Ar] $3d^5$, what is the atomic number (Z) of the neutral element?

(A) 23 (B) 25 (C) 26 (D) 28

Q32. Two atomic species, X and Y, are classified as isobars. Which of the following statements must be true regarding these two species?

(A) They possess the same number of neutrons but different numbers of protons.

(B) They exhibit identical chemical properties and react at the same rates.

(C) The sum of protons and neutrons in X is equal to the sum of protons and neutrons in Y.

(D) They contain the same number of valence electrons in their outermost shells.

Q33. An element has a total of 6 electrons in its fourth principal energy level (n=4) in its ground state. What is the total number of d electrons present in a single atom of this element?

(A) 10 (B) 20 (C) 24 (D) 30

Q34. Chlorine (Atomic no. 17) exists in nature as two stable isotopes, Cl^{35} and Cl^{37} with an average atomic mass of 35.5 u. If a sample contains 400 Chlorine atoms, how many neutrons are present in total across all the atoms in this sample?

(A) 7,200 (B) 7,400 (C) 7,600 (D) 8,000

Q35. What is the correct chemical formula for the ionic compound Aluminium oxide?

(A) AlO (B) Al_3O_2 (C) Al_2O_3 (D) AlO_3

Q36. Which of the following molecules contains a double covalent bond?

(A) Hydrogen gas (H_2) (B) Oxygen gas (O_2)

(C) Nitrogen gas (N_2) (D) Methane gas (CH_4)

Q37. During the formation of an ionic bond, a metal atom undergoes:

(A) Loss of electrons to form a positively charged cation

(B) Gain of electrons to form a negatively charged anion

(C) Sharing of electrons to achieve stability

(D) Loss of protons to form an isotope

Q38. If 9 grams of pure water is completely decomposed chemically, it always yields:

(A) 1 g of Hydrogen and 8 g of Oxygen

(B) 8 g of Hydrogen and 1 g of Oxygen

(C) 2 g of Hydrogen and 7 g of Oxygen

(D) 4.5 g of Hydrogen and 4.5 g of Oxygen

Q39. Calculate the molecular mass of Nitric acid (HNO_3). (Atomic mass: H = 1 u, N = 14 u, O = 16 u)

(A) 31 u (B) 63 u (C) 48 u (D) 65 u

Q40. Which of the following chemical compounds contains a pure ionic bond?

(A) Water (H_2O) (B) Carbon dioxide (CO_2)

(C) Magnesium oxide (MgO) (D) Hydrogen chloride (HCl)

BIOLOGY

Q41. Two crops are developed using biotechnology:

*** Crop P produces an insecticidal protein.**

*** Crop Q has improved nutritional content due to an introduced gene.**

Which pairing is correct?

(A) P—biofortification; Q—insect resistance

(B) P—insect resistance; Q—nutritional enhancement

(C) P—disease diagnosis; Q—gene therapy

(D) P—PCR; Q—cloning

Q42. A microbial culture produces a large amount of a desired compound during the first 24 hours. Production then declines, even though living cells remain present. Which investigation would be the most informative first step?

(A) Assume that all cells have permanently lost their DNA.

(B) Add an antibiotic immediately to every culture.

(C) Check nutrient availability, pH, oxygen conditions and product accumulation.

(D) Conclude that living microorganisms cannot produce compounds after 24 hours.

Q43. Mutation causes lysosomal enzymes to become non-functional. Consider the following statements:

(1) Undigested materials may accumulate inside the cell.

(2) The breakdown and recycling of certain damaged organelles may be impaired.

(3) Mitochondria will necessarily stop producing ATP immediately.

(4) Intracellular waste management may become less efficient.

Which combination is correct?

(A) 1 and 2 only

(B) 2 and 3 only

(C) 1, 2 and 4 only

(D) 1, 2, 3 and 4

Q44. A student measures the characteristics of three muscle tissues.

Feature	Tissue P	Tissue Q	Tissue R
Striations	Absent	Present	Present
Control	Involuntary	Voluntary	Involuntary
Cell shape	Spindle-shaped	Long, cylindrical	Branched
Nuclei	One	Many	Usually one

Which tissue is responsible for rhythmic contraction of the heart?

(A) P only. (B) Q only.

(C) R only. (D) Both P and R

Q45. Human insulin is produced using genetically engineered bacteria. However, the insulin gene alone is not sufficient to ensure the production of functional human insulin. Which additional requirement is most important?

(A) The bacteria must develop chloroplasts to synthesise insulin.

(B) The gene must be expressed, and the insulin produced must be processed correctly to become functional.

(C) The bacteria must undergo meiosis before producing insulin.

(D) The insulin gene must be converted into a gene for digestive enzymes.

Q46. A student removes the bark from a narrow ring around the stem of a woody plant without damaging the inner xylem. After several days, sugars accumulate above the removed ring, while the roots gradually weaken.

Which explanation is most accurate?

(A) Xylem transport is blocked, preventing sugar movement.

(B) Epidermal tissue stops water absorption by roots.

(C) Sclerenchyma stops photosynthesis in the leaves.

(D) Phloem transport is interrupted, reducing sugar supply to roots.

Q47. Grass stem elongates by the activity of:

(A) Primary meristem. (B) Intercalary meristem

(C) Secondary meristem. (D) apical meristem

Q48. A cell continues to receive glucose and oxygen, but a chemical selectively inhibits the function of its mitochondria. Which combination of effects is most likely?

(A) ATP production by aerobic respiration decreases, affecting energy-dependent processes.

(B) Protein synthesis stops immediately because ribosomes are destroyed.

(C) DNA is instantly removed from the nucleus.

(D) Osmosis stops because the plasma membrane becomes completely impermeable to water.

Q49. A Cell has an internal solute concentration of 0.3 mol/L. It is placed separately in three solutions:

Solution	External solute concentration
P	0.1 mol/L
Q	0.3 mol/L
R	0.6 mol/L

Assume the solute cannot cross the membrane and temperature is constant.

Which option correctly predicts the net movement of water?

(A) P: out of cell; Q: no net movement; R: into cell.

(B) P: no net movement; Q: into cell; R: out of cell.

(C) Water moves into all three cells.

(D) P: into cell; Q: no net movement; R: out of cell.

Q50. Modern biotechnology may involve genetic engineering, DNA analysis and molecular techniques.

(1) Every traditional biotechnology process is uncontrolled and scientifically unreliable.

(2) Every genetically modified organism necessarily produces a useful product.

(3) Both traditional and modern biotechnology can use living organisms or biological systems to obtain useful products.

Which option contains all the correct statements?

(A) Only 1 and 2 **(**B) Only 2 and 3

(C) Only 3 **(**D) 1, 2, and 3

Q51. In human spermatogenesis, one primary spermatocyte normally produces:

(A) Two diploid spermatids (B) Four haploid spermatids

(C) Four diploid spermatozoa (D) Two haploid spermatozoa

Q52. Which of the following is developed by parthenogenesis:

(A)Drones (B) queen honey bee

(C) worker honey bee (D) both B and C

Q53. Which of these statements is not true about ribosomes?

(A) They are bound by a single membrane

(B) They are composed of RNA and proteins

(C) They were first observed by George Palade

(D) The small subunit of the prokaryotic ribosome is 30S

Q54. A few statements with regard to sexual reproduction are given below:

i. Sexual reproduction does not always require two individuals

ii. Sexual reproduction generally involves gametic fusion

iii. Meiosis never occurs during sexual reproduction

iv. External fertilisation is a rule during sexual reproduction

Choose the correct statements from the options below:

(A) i and iv (B) i and ii (C) ii and iii (D) i and iv

Q55. The acrosome of a human sperm is derived from which cell organelle?

(A) Mitochondria (B) Golgi apparatus

(C) Endoplasmic reticulum (D) Vacuole

Q56. Consider the following statements about contraception:

(1) Condoms can reduce the risk of many sexually transmitted infections.

(2) Oral contraceptive pills primarily prevent pregnancy by interfering with hormonal regulation of ovulation.

(3) All contraceptive methods protect against sexually transmitted infections.

Which option is correct?

(A) 1 only (B) 1 and 2 only

(C) 2 and 3 only (D) 1, 2 and 3

Q57. Which statement correctly distinguishes Gram-positive from Gram-negative bacteria?

(A) Gram-positive bacteria lack plasma membranes.

(B) Gram-negative bacteria lack cell walls.

(C) Gram-positive bacteria generally have a thick peptidoglycan layer, while Gram-negative bacteria have a thinner layer and an outer membrane.

(D) Gram-negative bacteria always have 80S ribosomes.

Q58. Which feature best distinguishes sieve tube elements from xylem vessels in a typical flowering plant?

(A) Sieve tube elements are dead at maturity.

(B) Xylem vessels transport sugars from leaves.

(C) Sieve tube elements are living at maturity but lack a nucleus.

(D) Xylem vessels always contain a nucleus.

Q59. The joint between the first metacarpal and the carpal bone of the thumb is a:

(A) Hinge joint (B) Saddle joint

(C) Pivot joint (D) Fixed joint

Q60. Identify the incorrect statement.

(A) In asexual reproduction, the offspring produced are morphologically and genetically identical to the parent

(B) Zoospores are sexual reproductive structures

(C) In asexual reproduction, a single parent produces offspring with or without the formation of gametes

(D) Conidia are asexual structures in *Penicillium*