8th All India RPS OLYMPIAD

Online & Offline Mega Event

QUESTION PAPER (PHASE – I)

CLASS – X

RPS SCIENCE LEAGUE

Physics

Q1. The distance of an object from the focus of a convex mirror of radius of curvature 'a' is 'b'. Then the distance of the image from the focus is:

(A) $\frac{b^2}{4a}$ (B) $\frac{a}{b^2}$

(C) $\frac{a^2}{4b}$ (D) none of these

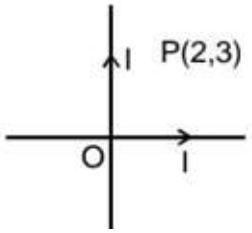
Q2. A concave mirror of radius of curvature 20 cm forms image of the sun. The diameter of the sun subtends an angle 1° on the earth. Then the diameter of the image is (in cm):

(A) $\frac{2\pi}{9}$ (B) $\frac{\pi}{9}$ (C) 20 (D) $\frac{\pi}{18}$

Q3. Two bulbs, one of 200 volts; 60 watt and the other of 200 volts; 100 watt, are connected in series to a 200 volt supply. The power consumed will be:

(A) 37.5 watt (B) 160 watt (C) 62.5 watt (D) 110 watt

Q4. Two mutually perpendicular insulated long conducting wires carry equal currents I , intersect at origin. Then the resultant magnetic induction at point P (2 m, 3 m) will be:



(A) $\frac{\mu_0 I}{5a}$ (B) $\frac{5\mu_0 I}{2\pi}$ (C) $\frac{\mu_0 I}{12\pi}$ (D) 0

Q5. A resistor is connected to a battery of 12 V emf and internal resistance 2Ω. If the current in the circuit is 0.6 A, the terminal voltage of the battery is:

(A) 10 V (B) 1.2 V (C) 12 V (D) 10.8 V

Q6. **A wire of resistance R is cut into 8 equal pieces. From these pieces two equivalent resistances are made by adding four of these together in parallel. Then these two sets are added in series. The net effective resistance of the combination is:**

(A) $\frac{R}{16}$ (B) $\frac{R}{8}$ (C) $\frac{R}{64}$ (D) $\frac{R}{32}$

Q7. A heater A dissipates out 300 W of heat when connected to a 200 V d.c. supply. Another heater B dissipates 600 W when connected to a 200 V d.c. supply. If a series combination of the two heaters is connected to a 200 V d.c. supply, the heat output will be:

(A) 100 W (B) 450 W (C) 300 W (D) 200 W

Q8. Two wires A and B each of radius of cross section r but of different materials are connected together end to end (in series). If the densities of charge carriers in the two wires A and B are in the ratio 1 : 4, the drift velocity of electrons in the two wires will be in the ratio (V_A / V_B)

(A) 1 : 2 (B) 2 : 1 (C) 4 : 1 (D) 1 : 4

Q9. An electron having kinetic energy K is moving in a circular orbit of radius R perpendicular to a uniform magnetic induction $\vec{B}$. If kinetic energy is doubled and magnetic induction tripled, the radius will become:

(A) $\frac{3R}{2}$ (B) $\sqrt{\frac{3}{2}}R$ (C) $\sqrt{\frac{2}{9}}R$ (D) $\sqrt{\frac{4}{3}}R$**Q10.**

A wire of resistance 10 Ω is stretched to four times its original length, keeping its volume constant. The new resistance of the wire is:

(A) 20 Ω (B) 40 Ω (C) 80 Ω (D) 160 Ω

Q11. A piece of Copper and another of Germanium are cooled from room temperature to 80 K. The resistance of:

(A) each of them increases

(B) each of them decreases

(C) Copper increases and Germanium decreases

(D) Copper decreases and Germanium increases

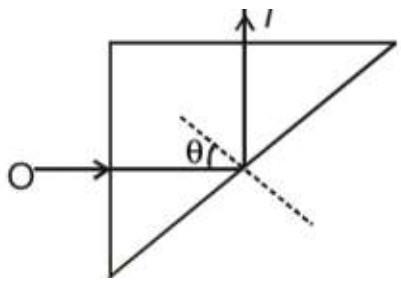
Q12. In order to increase the resistance of a given wire of uniform cross section to four times its value, a fraction of its length is stretched uniformly till the full length of the wire becomes $\frac{3}{2}$ times the original length. What is the value of this fraction?

(A) $\frac{1}{4}$ (B) $\frac{1}{8}$ (C) $\frac{1}{16}$ (D) $\frac{1}{6}$

Q13. A watch shows the time as 3 : 25. What will be the time that appears when seen through a plane mirror?

(A) 8 : 35 (B) 9 : 35 (C) 7 : 35 (D) 8 : 25

Q14. A triangular prism of glass is shown in figure. A ray incident normally on one face is totally reflected. If θ is 45°, the refractive index of glass is:



(A) Less than $\sqrt{2}$ (B) Equal to $\sqrt{2}$

(C) Greater than $\sqrt{2}$ (D) None of the above.

Q15. An object of heigh 1 mm is kept along the principal axis of a convex lens of focal length 10 cm. The object is at 15 cm from the lens. The height of the image is:

(A) 1 mm (B) 4 mm (C) 2 mm (D) 8 mm

Q16. Two parallel, long wires carry currents i_1 and i_2 with $i_1 > i_2$. When the current are in the same direction, the magnetic field at a point midway between the wires is 10 μT. If the direction of i_2 is reversed, the field becomes 30 μT. The ratio $\frac{i_1}{i_2}$ is:

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

Q17. A proton of mass $1.67 \times 10^{-27}\ kg$ and charge $1.6 \times 10^{-19}\ C$ is projected with a speed of $2 \times 10^{6}\ m/s$ at an angle of 60° to the x-axis. If a uniform magnetic field of 0.104 T is applied along the y-axis, the path of the proton is:

(A) A circle of radius 0.2 m and time period $\pi \times 10^{-7}\ s$

(B) A circle of radius 0.1 m and time period $2\pi \times 10^{-7}\ s$

(C) A helix of radius 0.1 m and time period $2\pi \times 10^{-7}\ s$

(D) A helix of radius 0.2 m and time period $4\pi \times 10^{-7}\ s$

Q18. Two concentric coils X and Y of radii 16 cm and 10 cm respectively lie in the same vertical plane containing N–S direction. X has 20 turns and carries 16 A. Y has 25 turns and carries 18 A. X has current in anticlockwise direction and Y has current in clockwise direction for an observer, looking at the coils facing the west. The magnitude of net magnetic field at their common centre is:

(A) $5\pi \times 10^{-4}\ T\ towards\ west$ (B) $13\pi \times 10^{-4}\ T\ towards\ east$

(C) $13\pi \times 10^{-4}\ T\ towards\ west$ (D) $5\pi \times 10^{-4}\ T\ towards\ east$

Q19. A convex mirror has a focal length $f = 20\ cm$. A convergent beam tending to converge to a point 20 cm behind convex mirror on principal axis falls on it. The image is formed at:

(A) infinity (B) 40 cm (C) 20 cm (D) 10 cm

Q20. A direct current is passing through a wire. It is bent to form a coil of one turn. Now it is further bent to form a coil of two turns but at smaller radius. The ratio of the magnetic induction at the centre of this coil and at the centre of the coil of two turn is:

(A) 1 : 4 (B) 4 : 1 (C) 2 : 1 (D) 1 : 1

Chemistry

Q21. What will happen if a copper piece is dipped in aqueous solution of silver nitrate for quite some time?

(i) Solution will remain colourless

(ii) Solution will turn blue

(iii) Silver will deposit on the copper piece

(iv) Bubbles of brown gas will be formed around the copper piece

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

Q22. What is the ratio of reducing agent to oxidizing agent, if the following reaction is correctly balanced?

$$NH_3 + O_2 \rightarrow NO + H_2O$$

(A) 4 : 5 (B) 5 : 4 (C) 5 : 3 (D) 3 : 5

Q23. A white solid known to be a compound of sodium, gives rise to water vapour and a colourless gas on heating. The residual white powder is dissolved in water and when the solution is added to alum solution, a white gelatinous precipitate is obtained. The original solid was:

(A) Sodium carbonate (B) Sodium bicarbonate

(C) Sodium hydroxide (D) Sodium nitrate

Q24. In the reaction

(i) $BaO_2(s) + O_3(g) \rightarrow BaO(s) + 2O_2(g)$

(ii) $ZnS(s) + 4O_3(g) \rightarrow ZnSO_4(s) + 4O_2(g)$

(A) O_3 is reduced both in (i) and (ii)

(B) O_3 is oxidized both in (i) and (ii)

(C) O_3 is oxidized in (i) and reduced in (ii)

(D) O_3 is reduced in (i) and oxidized in (ii)

Q25. In balancing the reaction,

$xH_2S + 2NaNO_3 + 2HCl \rightarrow yS + zNO + kNaCl + 4H_2O$ **one would get x, y, z and k, respectively, as**

(A) 3, 3, 2 and 2 (B) 2, 2, 3 and 3

(C) 3, 3, 4 and 4 (D) 4, 4, 3 and 3

Q26. The mass of sulphuric acid needed for dissolving 3 g magnesium carbonate is

(A) 3.5 g (B) 7.0 g (C) 1.7 g (D) 17.0 g

Q27. For a sample of pure water,

(A) pH increases and pOH decreases with increase in temperature.

(B) pH decreases and pOH increases with increase in temperature.

(C) both pH and pOH increase with increase in temperature.

(D) both pH and pOH decrease with increase in temperature.

Q28. The pH of 0.005 M NaOH solution is (log 2 = 0.3)

(A) 2.3 (B) 2.7 (C) 11.3 (D) 11.7

Q29. A colourless solid (X) on heating evolved CO_2 and also gave a white residue, soluble in water. The residue also gave CO_2 when treated with dilute acid. X is—

(A) Na_2CO_3 (B) $CaCO_3$ (C) $Ca(HCO_3)_2$ (D) $NaHCO_3$

Q30. Which of the following salts are formed by incomplete neutralisation of acid $NaHSO_4$, Na_3PO_4, NaH_2PO_2, $KHCO_3$, K_2HPO_3, $NaNO_3$?

(A) $NaHSO_4$, NaH_2PO_3, $KHCO_3$, K_2HPO_3

(B) Na_3PO_4, $NaHSO_4$, NaH_2PO_2, $KHCO_3$

(C) $NaHSO_4$, K_2HPO_3, NaH_2PO_2

(D) $KHCO_3$, $NaHSO_4$

Q31. A white compound P was dissolved in water and electricity was passed through it resulting in the formation of a gas Q. This gas was then passed through a slurry of another white compound R. The product obtained from this reaction is commonly used as a germicide. P, Q and R respectively, are

(A) NaCl, Cl_2, $Ca(OH)_2$ (B) Na_2SO_4, SO_2, $Al(OH)_3$

(C) $NaHCO_3$, CO_2, Na_2CO_3 (D) $AlCl_3$, Cl_2, $Al(OH)_3$

Q32. The product formed when

$Mg + CO_2 \xrightarrow{\Delta}$ is

(A) $MgCO_3$ (B) $Mg(CO_3)_2$

(C) MgO + C (D) MgO + CO_2

Q33. Match Column A with Column B and select the correct option.

Column-A (ore)	Column-B (Nature of ore)
(A) Copper glance	(i) Sulphate ore
(B) Calamine	(ii) Halide ore
(C) Rock salt	(iii) Sulphide ore
(D) Epsom salt	(iv) Carbonate ore

(A) A-(i), B-(ii), C-(iii), D-(iv) (B) A-(iv), B-(ii), C-(iii), D-(i)

(C) A-(iii), B-(iv), C-(ii), D-(i) (D) A-(iv), B-(i), C-(ii), D-(iii)

Q34. $XCl_2 + YCl_2$ (excess) $\longrightarrow XCl_4 + Y\downarrow$;

$YO \xrightarrow[>400^0]{\Delta} \frac{1}{2}O_2 + Y$, Ore of Y would be:

(A) Siderite (B) Cinnabar

(C) Malachite (D) Horn silver

Q35. The IUPAC name of the compound having the formula $(CH_3)_3CCH=CH_2$ is—

(A) 3,3,3-Trimethyl-1-propane (B) 1,1,1-Trimethyl-1-butene

(C) 3,3-Dimethyl-1-butene (D) 1,1-Dimethyl-3-butene

Q36. 1 mole of a hydrocarbon 'X' undergoes complete saturation with 1 mole of hydrogen in presence of a heated catalyst. What would be the formula of X?

(A) C_2H_6 (B) C_2H_2 (C) C_5H_{10} (D) C_7H_{16}

Q37. An alcohol (A) on dehydration with conc. H_2SO_4 at a high temperature yields compound (B). On ozonolysis every molecule of compound (B) yields two molecules of acetaldehyde. Which of the following is the starting alcohol (A)?

(A) 1- butanol (B) 2- butanol (C) propanal (D) 2- propanol

Q38. A gaseous hydrocarbon requires 6 times its own volume of O_2 for complete oxidation and produces 4 times its volume of CO_2 at the same pressure and temperature. The formula of the gas is:

(A) C_4H_{10} (B) C_4H_8 (C) C_4H_6 (D) C_8H_{16}

Q39. Three hydrocarbons X, Y and Z are shown below:

X : $CH_3CH_2CH_2CH_2CH_3$

Y : $CH_3–C\equiv C–CH_2CH_3$

Z : $CH_3CH_2–CH=CH–CH_3$

Identify the incorrect statements about these three hydrocarbons.

I. X and Y both differ by a CH_2 unit.

II. X and Z have the same boiling point.

III. All have different general formulae.

IV. Y and Z have different molecular masses.

(A) I and II (B) II and III

(C) I and IV (D) All the statements are incorrect

Q40. In the reaction

$$2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$$

the oxidation state of S is—

(A) Increased (B) Decreased

(C) Remains same (D) None

Biology

Q41. A plant is kept in complete darkness for 24 hours, and its rate of respiration remains unchanged. Which explanation best supports this observation?

(A) Respiration requires sunlight only during the initial breakdown of glucose.

(B) Cellular respiration is an energy-releasing process that does not directly require light.

(C) The plant stops photosynthesis, so respiration also stops using stored oxygen.

(D) Respiration occurs only when photosynthesis produces glucose simultaneously.

Q42. A child is diagnosed with a heart defect in which the valve between the left atrium and the left ventricle does not close completely when the ventricle contracts. Which consequence is most directly expected?

(A) Deoxygenated blood from the right ventricle mixes with oxygenated blood in the left ventricle.

(B) Blood fails to enter the right atrium from the vena cava.

(C) Blood from the pulmonary vein is forced into the right ventricle.

(D) Some oxygenated blood flows back into the left atrium, so less blood is pumped into the aorta with each beat.

Q43. The table gives the concentration (g per 100 mL) of three substances at different stages of urine formation in a healthy person. Read the statements:

I. Protein molecules are too large to be filtered at the glomerulus.

II. Glucose is filtered but is completely reabsorbed later in the nephron.

III. Urea becomes concentrated in urine because water is reabsorbed to a greater extent than urea.

IV. Glucose is destroyed inside the nephron tubule.

Which statements are supported by the data?

Substance	Blood plasma	Glomerular filtrate	Urine
Protein	7.00	0	0
Glucose	0.10	0.10	0
Urea	0.03	0.03	2.00

(A) I and II only

(B) II and III only

(C) I, II and III only

(D) I, II, III and IV

Q44. A developing mango fruit receives sugar made in leaves several metres away. On a very cold night, sugar movement to the fruit slows markedly, while water movement upward in the same branch is hardly affected. Which explanation fits best?

(A) Sucrose moves in the xylem by simple diffusion, and cold reduces diffusion only in the fruit.

(B) Translocation in phloem needs energy to load sucrose and build the pressure gradient, and this falls during the cold, whereas xylem flow is largely driven by transpiration pull.

(C) Sugar moves in the phloem only by gravity, which is weaker at night.

(D) Cold closes the xylem vessels but keeps the phloem tubes fully open.

Q45. A patient's bile duct is blocked by a stone, but the pancreatic duct is open. After a fatty meal, which outcome is most likely?

(A) Fat is not broken into fine droplets and the intestinal medium is less alkaline, so lipase acts poorly.

(B) Starch digestion stops completely because pancreatic amylase cannot act without bile.

(C) Pepsin cannot act in the stomach because bile normally activates it.

(D) Absorption of amino acids stops because the villi lose their blood supply.

Q46. In a patient, the ventral root of a spinal nerve supplying the right hand is damaged, while the dorsal root and the brain are intact. Which finding is expected?

(A) The patient cannot feel the pinprick but can move the hand voluntarily.

(B) The patient can neither feel the pinprick nor move the hand.

(C) Voluntary movement is normal, but reflex withdrawal is lost while feeling remains.

(D) The patient feels a pinprick on the hand but cannot move the hand muscles in response.

Q47. Three identical maize seedlings are kept in a dark box with light entering only from the right. In P the tip is removed, in Q the tip is covered with an opaque cap, and in R the tip is uncovered but the stem below the tip is wrapped in black foil. Which outcome is expected?

(A) P, Q and R all bend towards the right.

(B) Q and R bend towards the right, while P grows straight.

(C) R bends towards the right, while P and Q grow straight.

(D) Only P bends, because removal of the tip stops auxin from being made.

Q48. Assertion (A): A touch-me-not (*Mimosa*) leaf droops within seconds of being touched, although plants have no nerve cells.

Reason (R): Signals reach the cells at the leaf joint, which quickly lose water, so their turgor changes and the leaf folds.

(A) Both A and R are true, and R is the correct explanation of A

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

(C) A is true, but R is false

(D) A is false, but R is true

Q49. A species has 12 chromosomes in its body cells. Which row correctly gives the chromosome number in (i) a sperm, (ii) the zygote, and (iii) each cell of the four-celled embryo produced by two mitotic divisions of the zygote?

(A) 12, 12, 6 (B) 6, 12, 12 (C) 6, 12, 24 (D) 12, 24, 12

Q50. Read the statements:

I. A copper-T placed in the uterus act as hormone free, long term method of birth control.

II. Oral contraceptive pills change the hormonal balance so that eggs are not released.

III. In vasectomy the vas deferens is blocked, but the testes continue to make testosterone.

IV. In tubectomy the ovaries stop releasing eggs.

Which are correct?

(A) I, II and III only

(B) II and IV only

(C) I, III and IV only

(D) III and IV only

Q51. Which statement about the human placenta is incorrect?

(A) Villi on the embryo's side increase the surface area for exchange.

(B) It supplies oxygen and glucose to the embryo and carries away carbon dioxide and nitrogenous waste.

(C) It lets maternal and fetal blood mix freely, so the baby's blood group always matches the mother's.

(D) It is a disc-like tissue embedded in the uterine wall.

Q52. A farmer grows a whole banana plantation by vegetative propagation from a single high-yielding variety. A new fungal disease to which this variety is susceptible appears. Which statement best explains why the whole plantation is at risk, and why the farmer chose this method?

(A) Clones gain new mutations in every generation, so disease spreads faster; the method increases genetic variation.

(B) Vegetative propagation produces fresh gene combinations each time, but fungal spores overcome all of them.

(C) Plants raised vegetatively are haploid and weak, but they flower earlier.

(D) All plants are genetically identical clones and share the susceptibility; the method preserves desirable traits and works for plants that rarely/do not make viable seeds.

Q53. Arrange these events of sexual reproduction in a flowering plant in the correct order:

P. The ovary ripens into the fruit

Q. The pollen tube grows through the style towards the ovule

R. A pollen grain lands on the stigma

S. The male gamete fuses with the egg

T. The zygote divides to form an embryo

(A) R, Q, S, T, P

(B) R, S, Q, T, P

(C) Q, R, S, P, T

(D) R, Q, S, P, T

Q54. The table gives the concentration of a pesticide in different organisms of a lake food chain. Which inference is correct?

Organism	Pesticide (ppm)
Lake water	0.0002
Algae	0.02
Zooplankton	0.2
Small fish	1.0
Large fish	3.0
Fish-eating bird	25

(A) The value is highest in algae because producers absorb the most chemical from water.

(B) The pesticide is non-biodegradable and not easily excreted, so it accumulates and is magnified at each higher trophic level, being highest in the bird.

(C) The bird has the highest value because it eats the greatest biomass of algae.

(D) The values rise because the energy available increases at each higher trophic level.

Q55. Read the statements:

I. Ozone forms in the stratosphere when UV radiation splits oxygen molecules into atoms that combine with other oxygen molecules.

II. Chlorine released from CFCs speeds up the breakdown of ozone.

III. Ozone depletion is confined to the equator because of high temperature.

IV. The ozone layer mainly absorbs infrared radiation from the Sun.

Which are correct?

(A) I and II only

(B) II and III only

(C) I, III and IV only

(D) III and IV only

Q56. A sealed aquarium receives light and contains producers, herbivores and carnivores, but no decomposers. Over several months, which outcome is most likely?

(A) Energy is recycled within the aquarium, so producers no longer need light.

(B) Excreta from herbivores return all nutrients, so the ecosystem is unaffected.

(C) Dead matter accumulates and nutrients are not returned for reuse, so the producers eventually decline.

(D) Carnivores increase in number because dead matter is converted into usable energy.

Q57. A pure tall, round-seeded plant (TTRR) is crossed with a dwarf, wrinkled-seeded plant (ttrr). From 320 F2 plants, which row gives the expected number of tall plants with wrinkled seeds and the number of plants heterozygous for both genes?

(A) 60 and 40 (B) 20 and 80 (C) 180 and 80 (D) 60 and 80

Q58. Read the statements:

I. For every child, the chance of being a girl is 50% regardless of the sex of earlier children.

II. The sex of a child depends on the type of sperm that fertilises the egg.

III. Human females produce two types of eggs, X-bearing and Y-bearing.

IV. A Y-bearing sperm fusing with an egg gives a male child.

Which are correct?

(A) I and III only (B) I, II and IV only

(C) II, III and IV only (D) I, II, III and IV

Q59. A ground beetle population is split by a newly formed river into two groups living in slightly different conditions. After many thousands of generations, beetles from both the two sides can no longer produce fertile offspring. Which combination of processes best accounts for this?

(A) Beetles of each group acquired traits during their lifetime and passed them on to offspring.

(B) River water caused mutations in all beetles, producing a new species in a single generation.

(C) Natural selection acted on only one group while the other stayed unchanged.

(D) No gene flow between the groups, and different variations accumulated through sexual reproduction, selection and genetic drift in each group.

Q60. A small beetle population on a bush has red and blue individuals, with blue being fewer. A large animal tramples the bush and kills most beetles by chance, and the survivors happen to be mostly red. Later the population is largely red, though red is no better than blue for survival. This is best explained by:

(A) Genetic drift, a chance event that changed gene frequencies in a small population.

(B) Natural selection, because red beetles evade predators better.

(C) Acquired traits, because beetles turned red during their lifetime.

(D) Mutation, because the blue gene changed to red in response to trampling.