



NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE

NSEJS - 2025

DETAILED SOLUTIONS

Paper Code 51 | Questions 1-60 | Final answer key

PAPER CODE

51

QUESTIONS

60

MAX. MARKS

216

SOLUTION BOOKLET

Each question is explained through the central scientific idea, the required calculation or reasoning, and the final option(s).

For Section A-2, every option is examined separately.

The question paper and this solution booklet are supplied as separate files.

FINAL ANSWER KEY

NSEJS 2025 - PAPER CODE 51

Q.	ANSWER	Q.	ANSWER	Q.	ANSWER
1	(b)	21	(c)	41	(c)
2	(b)	22	(c)	42	(d)
3	(d)	23	(d)	43	(d)
4	(c)	24	(b)	44	(b)
5	(b)	25	(c)	45	(c)
6	(a)	26	(b)	46	(b)
7	(c)	27	(d)	47	(b)
8	(c)	28	(c)	48	(c)
9	(a)	29	(a)	49	(b), (d)
10	(a)	30	(d)	50	(b), (c)
11	(c)	31	(c)	51	(b), (c)
12	(b)	32	(c)	52	(c), (d)
13	(c)	33	(c)	53	(b), (c), (d)
14	(b)	34	(b)	54	(b), (c)
15	(c)	35	(d)	55	(a), (d)
16	(c)	36	(a)	56	(c), (d)
17	(d)	37	(b)	57	(b), (c), (d)
18	(d)	38	(d)	58	(a), (b), (c)
19	(d)	39	(b)	59	(a), (b), (c), (d)
20	(d)	40	(c)	60	(a), (c), (d)

Section A-1: Questions 1-48 have one correct option. **Section A-2:** Questions 49-60 may have more than one correct option; all correct choices are shown.

BIOLOGY

SECTION A-1 | QUESTIONS 1-16

QUESTION 1**ANSWER: (b)****CONCEPT: Origin of the name of Similipal National Park**

The word *Similipal* is associated with the *simul* or *semul* tree, *Bombax ceiba*, commonly called the red silk-cotton tree. These trees occur abundantly in the region.

Hence the national park whose name is linked with the abundance of red silk-cotton trees is **Similipal**. Therefore, option **(b)** is correct.

QUESTION 2**ANSWER: (b)****CONCEPT: Symbiotic nitrogen fixation in Azolla**

The aquatic fern *Azolla* contains small cavities in its leaves. These cavities harbour the nitrogen-fixing cyanobacterium *Anabaena azollae*.

Anabaena converts atmospheric nitrogen into usable nitrogen compounds and benefits the fern. Thus the endophytic associate asked for is **Anabaena**, so option **(b)** is correct.

QUESTION 3**ANSWER: (d)****CONCEPT: Ergot disease of rye**

The fungus *Claviceps purpurea* infects rye and replaces grains with dark fungal bodies called sclerotia. These contain ergot alkaloids.

Eating contaminated rye can produce ergotism, historically called St. Anthony's Fire. Therefore, the responsible organism is **Claviceps**, option **(d)**.

QUESTION 4**ANSWER: (c)****CONCEPT: Models of DNA replication**

The Assertion describes **semiconservative replication**: each daughter DNA molecule contains one parental strand and one newly synthesised strand. This statement is true.

The Reason describes the **dispersive model**, in which old and new DNA segments would be mixed within each strand. That is not the normal mechanism of DNA replication and is false.

Therefore, A is true but R is false. The correct choice is **(c)**.

QUESTION 5**ANSWER: (b)****CONCEPT: Leadership of the public Human Genome Project**

Francis Collins led the publicly funded international Human Genome Project during its major sequencing and completion phase. Craig Venter led a separate private sequencing effort, while John Sulston, Bob Waterston and many others made major scientific contributions.

Thus the launching/leading figure intended by the question is **Francis Collins**, option **(b)**.

QUESTION 6**ANSWER: (a)****CONCEPT: Common name of the orangutan**

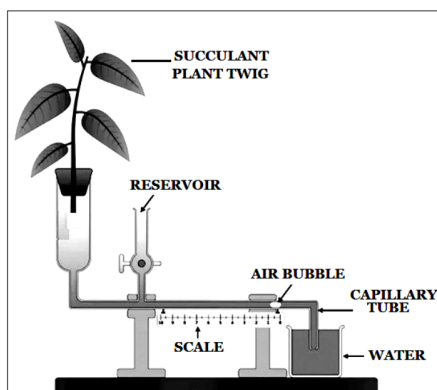
The name *orangutan* comes from Malay words meaning a person or man of the forest. It is therefore commonly referred to as the "Old Man of the Jungle" in such general-knowledge descriptions.

Hence option **(a)**, **Orangutan**, is correct.

QUESTION 7

ANSWER: (c)

CONCEPT: CAM plants and daytime transpiration



Crassula is a CAM plant. CAM plants generally open their stomata at night to take in carbon dioxide and keep them closed during the day to reduce water loss.

In the idealised daytime experiment, water uptake through transpiration is therefore negligible, so the air bubble does not show a measurable movement. The intended answer is **(c)**.

QUESTION 8

ANSWER: (c)

CONCEPT: Important international environmental days

Match each observance with its date:

- M.** International Day of Forests - 21 March (iii)
- N.** International Day for Biological Diversity - 22 May (i)
- O.** World Nature Conservation Day - 28 July (iv)
- P.** International Tiger Day - 29 July (ii).

Thus the matching is M-(iii), N-(i), O-(iv), P-(ii), which is option **(c)**.

QUESTION 9

ANSWER: (a)

CONCEPT: Vitamins as components of coenzymes

Vitamin B₂ (riboflavin) forms the flavin coenzymes FMN and FAD. Vitamin B₅ (pantothenic acid) is an essential part of coenzyme A.

These coenzymes participate centrally in oxidative metabolism and transfer of reducing equivalents or activated acyl groups. The pair intended in the question is therefore **B₂ and B₅**, option **(a)**.

QUESTION 10

ANSWER: (a)

CONCEPT: Diagnostic features of animal phyla

The correct associations are:

Gelatinous mesogloea - Cnidaria (iii); syncytial epidermis - Nematoda (i); parapodia - Annelida (v); parenchymatous tissue - Platyhelminthes (ii); radula - Mollusca (iv).

Hence V-iii, W-i, X-v, Y-ii and Z-iv, giving option **(a)**.

QUESTION 11

ANSWER: (c)

CONCEPT: Analogous storage organs called crop

A crop is a temporary food-storage chamber. It occurs in the alimentary canal of a leech, in the foregut of a cockroach, and as an enlargement of the oesophagus in birds.

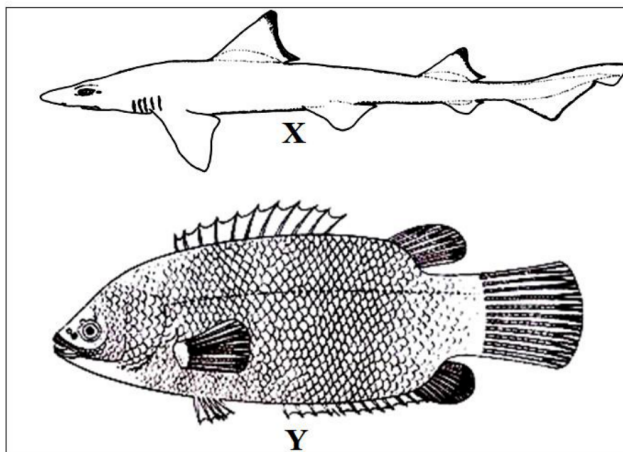
These animals are distantly related, yet each possesses a structure called a crop with a storage function. Therefore, option **(c)** is correct.

QUESTION 12

ANSWER: (b)

CONCEPT: Fish scales

Animal X is a shark, a cartilaginous fish. Sharks have **placoid scales**, also called dermal denticles.



Animal Y is a bony fish of the type shown with rough, comb-edged scales. Such scales are **ctenoid**. Hence X-placoid and Y-ctenoid, option **(b)**.

QUESTION 13

ANSWER: (c)

CONCEPT: Nitrogenous structural polysaccharides

Chitin is a polymer of N-acetylglucosamine. The nitrogen-containing acetamido group makes it a nitrogenous polysaccharide. It forms the exoskeleton of arthropods and the cell walls of many fungi.

Among the given choices, the abundant nitrogenous structural biopolymer is **chitin**. Therefore, option **(c)** is the intended answer.

Exam note: Cellulose is normally described as the most abundant biopolymer overall. Chitin is the most abundant nitrogen-containing polysaccharide and is the intended answer among these options.

QUESTION 14

ANSWER: (b)

CONCEPT: Fibonacci pattern in phyllotaxis

Leaves are often arranged around a stem in spirals that can be described by ratios of successive Fibonacci numbers. This arrangement, called phyllotaxis, helps reduce overlap and improves exposure to light.

Therefore, the Fibonacci series is commonly observed in the arrangement of **leaves**, option **(b)**.

QUESTION 15

ANSWER: (c)

CONCEPT: Heartwood and natural dyes

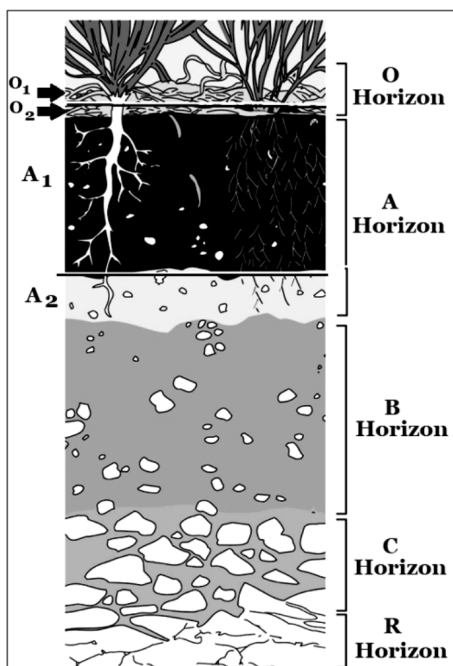
Duramen is the non-living, inner heartwood of an older stem. It often contains deposited tannins, resins, oils and coloured substances.

Santalin, brasilin and haematoxylin are examples of coloured compounds obtained from heartwood. Hence the correct answer is **duramen**, option **(c)**.

QUESTION 16

ANSWER: (c)

CONCEPT: Horizons of a soil profile



The matches are:

Q. Solum - A + B (iii)

R. Podsollic zone - A_2 (v)

S. Duff - O_2 (i)

T. Melanized region - A_1 (ii)

U. Zone of eluviation - A horizon (iv).

Thus Q-iii, R-v, S-i, T-ii and U-iv, which is option **(c)**.

CHEMISTRY

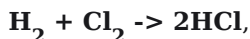
SECTION A-1 | QUESTIONS 17-32

QUESTION 17

ANSWER: (d)

CONCEPT: Gas-volume stoichiometry

Take the final mixture as 100 volume units. It contains 30 volume units of HCl. For the reaction



30 volumes of HCl are produced by 15 volumes each of H_2 and Cl_2 .

Initial $\text{H}_2 = 10 + 15 = 25$ volumes.

Initial $\text{Cl}_2 = 60 + 15 = 75$ volumes.

The fraction of chlorine consumed is $15/75 = 0.20$, exactly the stated 20%. Therefore, $\text{H}_2 = 25\%$ and $\text{Cl}_2 = 75\%$, option (d).

QUESTION 18

ANSWER: (d)

CONCEPT: Converting ion concentration to mass of salt

Mass of Na^+ required = $50 \text{ mL} \times 70.0 \text{ mg mL}^{-1} = 3500 \text{ mg} = 3.50 \text{ g}$.

Each mole of NaNO_3 contains one mole of Na^+ . Therefore,

moles of $\text{Na}^+ = 3.50/23 \text{ mol}$,

mass of $\text{NaNO}_3 = (3.50/23) \times 85 = 12.93 \text{ g}$.

Hence option (d) is correct.

QUESTION 19

ANSWER: (d)

CONCEPT: Hydrated sodium carbonate from CO_2 evolved

Let the crystalline soda be $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$. On reaction with excess HCl, one mole of Na_2CO_3 gives one mole of CO_2 .

At STP, moles of $\text{CO}_2 = 100.8/22400 = 0.0045 \text{ mol}$. Thus 1.287 g of the hydrate represents 0.0045 mol, so its molar mass is

$$1.287/0.0045 = 286 \text{ g mol}^{-1}.$$

$106 + 18x = 286$, so $18x = 180$ and $x = 10$. Therefore, the compound is $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ and option (d) is correct.

QUESTION 20

ANSWER: (d)

CONCEPT: First-stage thermal decomposition of ammonium salts

For ammonium sulfate, the usual first decomposition step is



This does not release free SO_3 .

Ammonium persulfate first loses oxygen and forms a pyrosulfate-type product; it is not represented as direct liberation of SO_3 in the decomposition step intended here.

Hence neither I nor II is counted as releasing SO_3 gas, and the final-key answer is (d) None of these.

The decomposition of sulfate salts can become complex at very high temperatures. This question uses the standard first-stage school-level decomposition pathways reflected in the final key.

QUESTION 21

ANSWER: (c)

CONCEPT: Physical state at a specified temperature

At 10 degrees C, SO_3 is below its melting point (about 16.9 degrees C), so it is solid. Iodine and sodium chloride are also solids at 10 degrees C.

The other groups contain gases or liquids at this temperature: NH_3 and CH_4 are gases; F_2 and Cl_2 are gases; acetone is a liquid.

Therefore, the all-solid group is SO_3 , I_2 and NaCl , option **(c)**.

QUESTION 22

ANSWER: (c)

CONCEPT: Counting constitutional isomers of primary amines

A primary amine $\text{C}_5\text{H}_{13}\text{N}$ has the form $\text{C}_5\text{H}_{11}\text{-NH}_2$. Count the distinct C_5H_{11} groups obtained from the three pentane skeletons.

From n-pentane there are 3 distinct positions; from 2-methylbutane there are 4; from 2,2-dimethylpropane there is 1. Therefore, the total is

$$3 + 4 + 1 = 8.$$

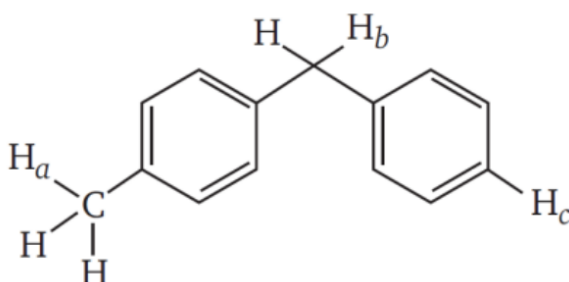
Hence option **(c)** is correct.

QUESTION 23

ANSWER: (d)

CONCEPT: Bond dissociation energy and radical stability

A weaker C-H bond is the one whose homolytic cleavage produces the more stable carbon radical.



Removal of H_b gives a diphenylmethyl radical stabilised by resonance with two benzene rings, so C-H_b is the weakest. Removal of H_a gives a benzyl radical, so it is intermediate. H_c is aryl; an aryl C-H bond is strongest.

Thus the bond-strength order is

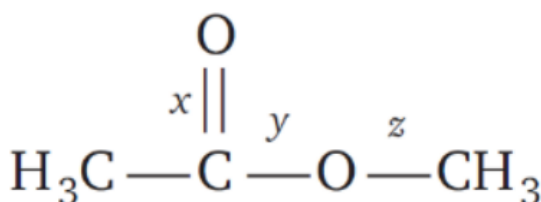
$\text{C-H}_c > \text{C-H}_a > \text{C-H}_b$, option **(d)**.

QUESTION 24

ANSWER: (b)

CONCEPT: Bond order and C-O bond length in an ester

Bond x is the carbonyl C=O bond and has the greatest bond order, so it is shortest. Bond y is the acyl C-O bond. Resonance gives it partial double-bond character, making it shorter than a normal C-O single bond.



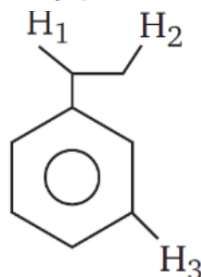
Bond z is the ordinary O-CH_3 single bond and is longest. Therefore,

$x < y < z$, option **(b)**.

QUESTION 25

ANSWER: (c)

CONCEPT: C-H bond energy in benzylic, alkyl and aryl positions



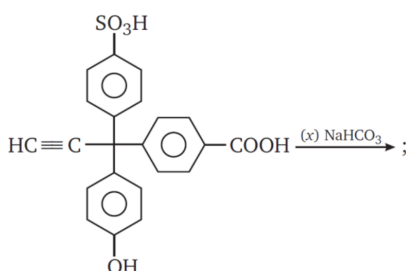
H_1 is benzylic; removal gives a resonance-stabilised benzylic radical, so this bond is weakest. H_2 is an ordinary alkyl C-H bond and has intermediate strength.

H_3 is attached directly to the aromatic ring. An aryl C-H bond is strongest. Therefore, $C-H_3 > C-H_2 > C-H_1$, option **(c)**.

QUESTION 26

ANSWER: (b)

CONCEPT: Acid-base reaction with sodium hydrogen carbonate



$NaHCO_3$ reacts with acids stronger than carbonic acid, producing CO_2 . In the molecule, the $-SO_3H$ group and the $-COOH$ group each consume one mole of $NaHCO_3$.

The phenolic $-OH$ and terminal alkyne hydrogen are not acidic enough to react with $NaHCO_3$ under ordinary conditions.

Therefore, the total consumption is **2 moles**, so option **(b)** is correct.

QUESTION 27

ANSWER: (d)

CONCEPT: Moles and molecules in a drop of water

If 1 mL contains 20 drops, the volume of one drop is $1/20 \text{ mL} = 0.05 \text{ mL}$. Using the density of water as 1 g mL^{-1} , the mass of one drop is 0.05 g.

Moles of water in one drop = $0.05/18$. Therefore, the number of molecules is **(0.05/18) A**, where A is Avogadro's number.

Hence option **(d)** is correct.

QUESTION 28

ANSWER: (c)

CONCEPT: Ionic, covalent and coordinate bonding

In NH_4Cl , NH_4^+ and Cl^- are ionically associated; N-H bonds are covalent, and one N-H bond is conventionally described as formed by donation of the nitrogen lone pair to H^+ .

KNO_3 has ionic bonding between K^+ and NO_3^- , covalent N-O bonding within nitrate, and coordinate-bond representation in the ion. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ contains ionic, covalent and metal-water coordinate bonds.

Thus all three bond types occur in every compound of set **(c)**.

QUESTION 29

ANSWER: (a)

CONCEPT: Bond dissociation energy of alkane C-H bonds

Homolytic cleavage of a tertiary C-H bond produces a tertiary radical. Hyperconjugation and the +I effect of three alkyl groups stabilise this radical more than a secondary or primary radical.

Greater radical stability means less energy is required to break the original bond. Therefore, the **3 degree C-H bond** has the lowest bond dissociation energy, option **(a)**.

QUESTION 30

ANSWER: (d)

CONCEPT: Lewis structure of I_3^-

I_3^- has 22 valence electrons: 3×7 from iodine plus one extra electron. Two I-I single bonds use 4 electrons, leaving 18 electrons as lone-pair electrons.

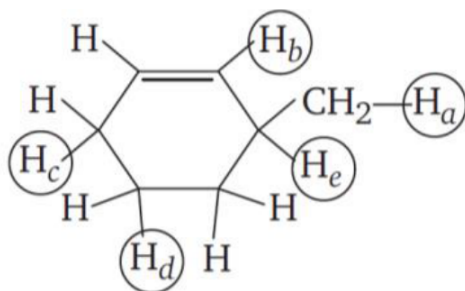
These 18 electrons form 9 lone pairs: three lone pairs on each iodine atom. Therefore, the total number of lone pairs is **9**, option **(d)**.

QUESTION 31

ANSWER: (c)

CONCEPT: Selective hydrogen abstraction in halogenation

Hydrogen abstraction is easiest when it forms the most stable radical. H_e gives the most substituted allylic radical; H_c gives a less substituted allylic radical; H_d gives an ordinary secondary radical.



H_a gives a primary radical, while H_b is vinylic and is the least readily abstracted. Therefore, **$e > c > d > a > b$** , which is option **(c)**.

QUESTION 32

ANSWER: (c)

CONCEPT: Detergents in hard water

Soap anions such as palmitate or stearate form insoluble calcium and magnesium salts in hard water. This removes the surfactant and suppresses foam.

Potassium n-dodecylbenzene sulphonate is a synthetic detergent. Its calcium and magnesium salts remain sufficiently soluble, so it forms foam in hard water.

Hence option **(c)** is correct.

PHYSICS

SECTION A-1 | QUESTIONS 33-48

QUESTION 33

ANSWER: (c)

CONCEPT: Minimum speed and tangency condition

Take the student's starting point as $x = 0$. The bus is initially 16 m ahead and starts from rest with acceleration 2 m s^{-2} . Thus

$$x_{\text{bus}} = 16 + (1/2)(2)t^2 = 16 + t^2.$$

If the student runs at constant speed v , then $x_{\text{student}} = vt$. Catching requires $t^2 - vt + 16 = 0$. For the minimum possible speed, this quadratic has one repeated root, so its discriminant is zero:

$$v^2 - 64 = 0.$$

Therefore, $v = 8.0 \text{ m s}^{-1}$, option (c).

QUESTION 34

ANSWER: (b)

CONCEPT: Tension before and after a string breaks

Before the string breaks, the block is stationary, so the tension balances its weight:

$$T = mg = 2.0 \times 9.8 = 19.6 \text{ N}.$$

Immediately after the string breaks, a broken string cannot transmit tension, so $T = 0$. The change in tension is $19.6 - 0 = 19.6 \text{ N}$. Hence option (b) is correct.

QUESTION 35

ANSWER: (d)

CONCEPT: Static friction on driven and freely rolling wheels

The rear wheel is driven by the pedals. The applied torque tends to make its contact point slip backward, so the ground exerts a **forward** friction force on the rear wheel.

The front wheel is not driven. Its axle is pulled forward, and a **backward** friction force at the contact point supplies the torque needed to increase its angular speed.

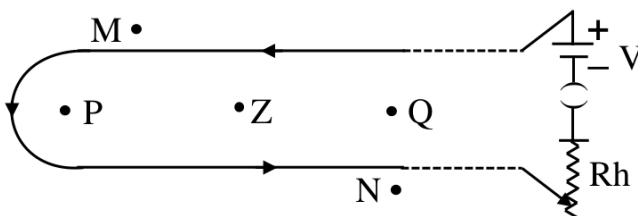
Thus friction is backward on the front wheel and forward on the rear wheel, option (d).

QUESTION 36

ANSWER: (a)

CONCEPT: Magnetic field of parallel current-carrying arms

The upper straight arm carries current to the left, and the lower straight arm carries current to the right. Apply the right-hand thumb rule to each arm.



At any point between the two arms, including P, Q and Z, the fields due to both arms are directed **out of the plane of the paper**, so they add.

Therefore, the statement about point P is correct and option (a) is the answer.

QUESTION 37

ANSWER: (b)

CONCEPT: Efficiency of a pump

Mass flow rate = $240 \text{ kg min}^{-1} = 4 \text{ kg s}^{-1}$. Useful output power is the rate of gain of gravitational potential energy:

$$P_{\text{out}} = m \cdot g \cdot h = 4 \times 9.8 \times 10 = 392 \text{ W.}$$

Efficiency = $P_{\text{out}} / P_{\text{in}} \times 100 = 392/500 \times 100 = 78.4\%$. Hence option **(b)** is correct.

QUESTION 38

ANSWER: (d)

CONCEPT: Heating powers of parallel filaments

Let Q be the heat needed to boil the fixed amount of water. With only F_1 , $P_1 = Q/4$. With both filaments, $P_1 + P_2 = Q/3$.

Therefore,

$$P_2 = Q/3 - Q/4 = Q/12.$$

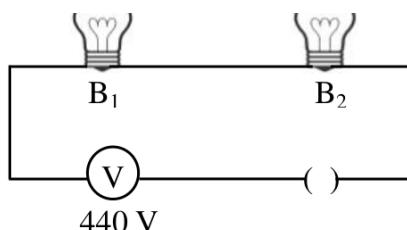
When only F_2 is used, $t_2 = Q/P_2 = 12 \text{ min.}$

Hence option **(d)** is correct.

QUESTION 39

ANSWER: (b)

CONCEPT: Rated resistance and power of bulbs in series



Rated resistances are

$$R_1 = 220^2/100 = 484 \text{ ohm,}$$

$$R_2 = 220^2/60 = 806.7 \text{ ohm.}$$

In series across 440 V, $I = 440/(484 + 806.7) = \text{about } 0.341 \text{ A}$. Hence $V_1 = IR_1 = \text{about } 165 \text{ V}$, while $V_2 = \text{about } 275 \text{ V}$.

The 100 W bulb is below its rated voltage, but the 60 W bulb is substantially over its rated voltage and will fuse. Thus option **(b)** is correct.

QUESTION 40

ANSWER: (c)

CONCEPT: Free surface of an accelerating liquid

For horizontal acceleration a , the liquid surface satisfies $\tan \theta = a/g$. Across the 4 m length, the difference in liquid level is

$$\Delta h = (a/g)L = (1.96/9.8) \times 4 = 0.8 \text{ m.}$$

Because the container was initially full, the spilled portion is a triangular prism. Its volume is

$$V = (1/2)(4)(0.8)(4) = 6.4 \text{ m}^3.$$

Therefore, option **(c)** is correct.

QUESTION 41

ANSWER: (c)

CONCEPT: Relative motion on a circular track

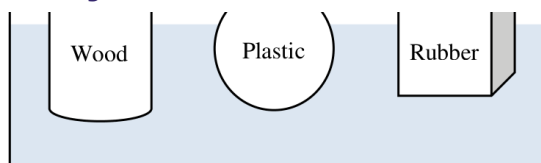
The relative speed of A with respect to B is $8 - 6 = 2 \text{ m s}^{-1}$. To overtake B, A must gain one complete track length L .

Time to gain L is $t = L/2$. In this time, A runs $8(L/2) = 4L$, which is **4 laps**. Hence option **(c)** is correct.

QUESTION 42

ANSWER: (d)

CONCEPT: Archimedes principle for floating bodies



Every body floats at rest, so its upward buoyant force equals its weight. The three bodies have the same mass M , and therefore each has the same weight Mg .

Their immersed fractions differ because their densities and shapes differ, but the buoyant force on each is still Mg . Hence the buoyant force is equal on all three, option **(d)**.

QUESTION 43

ANSWER: (d)

CONCEPT: Vertical motion with opposite initial directions

Let the well depth be h . For the downward throw,

$$h = ut_1 + (1/2)gt_1^2.$$

For the upward throw, taking downward as positive, the initial velocity is $-u$:

$$h = -ut_2 + (1/2)gt_2^2.$$

Equating the two expressions and simplifying gives

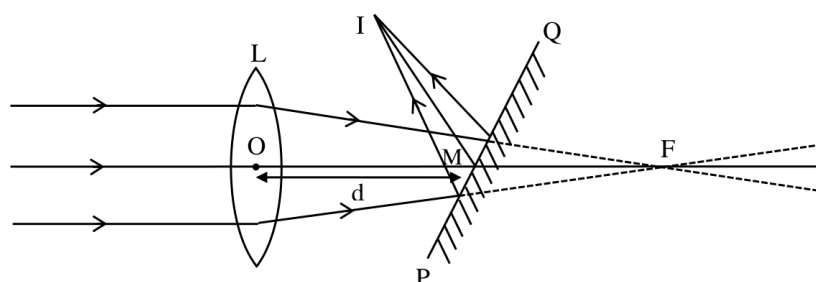
$$u = (g/2)(t_2 - t_1). \text{ Therefore, option (d) is correct.}$$

QUESTION 44

ANSWER: (b)

CONCEPT: Image of a focus in an inclined plane mirror

Without the mirror, rays parallel to the principal axis would meet at F , where $OF = f = 20$ cm. The plane mirror reflects the converging beam, so the final image I is the mirror image of F in the mirror line.



Let $OM = OI = d$ and let the mirror make 60 degrees with the axis. Reflection geometry gives $OI^2 = 3d^2 - 3df + f^2$.

Since $OI = d$,

$$2d^2 - 3fd + f^2 = 0,$$

so $d = f$ or $f/2$. The root $d = f$ places the mirror at the original focus and does not give the distinct reflected image shown. Therefore $d = f/2 = 10$ cm, option **(b)**.

QUESTION 45

ANSWER: (c)

CONCEPT: Perfectly inelastic collision

Conservation of momentum gives the common speed after collision:

$$v = (80 \times 10 + 20 \times 0)/(80 + 20) = 8 \text{ m s}^{-1}.$$

$$\text{Initial kinetic energy} = (1/2)(80)(10^2) = 4000 \text{ J.}$$

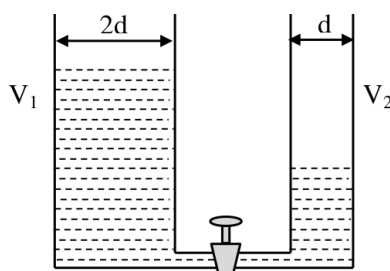
$$\text{Final kinetic energy} = (1/2)(100)(8^2) = 3200 \text{ J.}$$

Loss = 800 J, so percentage loss = $800/4000 \times 100 = 20\%$. Hence option (c) is correct.

QUESTION 46

ANSWER: (b)

CONCEPT: Conservation of liquid volume



The cross-sectional areas are proportional to the squares of the diameters. Thus $A_1:A_2 = (2d)^2:d^2 = 4:1$.

Conservation of volume gives

$$4Ah_1 + Ah_2 = (4A + A)h.$$

Therefore,

$$h = (4h_1 + h_2)/5.$$

Hence option (b) is correct.

QUESTION 47

ANSWER: (b)

CONCEPT: Two objects producing an overlapping image

Let the common image be at a distance x on the side of the 9 cm pin. For the 9 cm object the image is virtual, whereas for the 18 cm object it is real.

Thus,

$$1/f = 1/9 - 1/x$$

and

$$1/f = 1/18 + 1/x.$$

Equating gives $1/18 = 2/x$, so $x = 36$ cm. Then

$$1/f = 1/18 + 1/36 = 1/12,$$

hence $f = 12$ cm. A positive focal length means a convex lens. Therefore, option (b) is correct.

QUESTION 48

ANSWER: (c)

CONCEPT: Round trip with assisting and opposing wind

The effective speeds are $5 + v$ on the onward trip and $5 - v$ on the return trip. Therefore,

$$1200/(5+v) + 1200/(5-v) = 500.$$

Combining the fractions gives $12000/(25 - v^2) = 500$. Hence $12000 = 12500 - 500v^2$, so $v^2 = 1$.

Therefore, $v = 1.0 \text{ m s}^{-1}$, option (c).

SECTION A-2 - BIOLOGY

QUESTIONS 49-52 | EVALUATE EVERY OPTION

QUESTION 49

ANSWER: (b), (d)

CONCEPT: Sarcomere bands and myofilaments

(a) Correct statement. A bands are anisotropic and I bands are isotropic under polarised light.

(b) Incorrect statement. The dimensions and identification given for actin filaments are wrong. Thin actin filaments are not 120 angstrom thick and 18 angstrom long.

(c) Correct statement. A Z line bisects each I band and forms the boundary of a sarcomere.

(d) Incorrect statement. The lighter central part of the A band is the **H zone**; the M line lies at its centre. Therefore, the incorrect options are **(b) and (d)**.

QUESTION 50

ANSWER: (b), (c)

CONCEPT: Sympathetic and parasympathetic effects

The first effect in each option refers to the sympathetic system and the second to the parasympathetic system.

(a) Not correct: sympathetic activity dilates the pupil, not constricts it.

(b) Correct: sympathetic activity reduces salivation; parasympathetic activity contracts the bladder wall.

(c) Correct: sympathetic stimulation promotes adrenaline release; the rest-and-digest state favours storage of glucose as glycogen.

(d) Not correct: sympathetic activity dilates the bronchi rather than constricting them.

Hence the correct options are **(b) and (c)**.

QUESTION 51

ANSWER: (b), (c)

CONCEPT: X-linked inheritance of haemophilia

(a) True: an affected grandfather may transmit the allele through his daughter to a grandson, producing the criss-cross pattern.

(b) False: haemophilia is generally an X-linked recessive trait, not a Y-linked dominant trait.

(c) False: it is much more common in males than in females.

(d) True: it is historically called the royal disease because it occurred in several European royal families.

The question asks for the incorrect statements, so the answers are **(b) and (c)**.

QUESTION 52

ANSWER: (c), (d)

CONCEPT: Cheiropterophily or bat pollination

Cheiropterophilous flowers are adapted for pollination by bats. In the standard examples intended here, sausage tree and Kadamb are placed among bat-pollinated plants.

Coral tree is classically associated with bird pollination, and silk cotton is treated as non-cheiropterophilous in the classification used by this question.

Therefore, the trees that do not show cheiropterophily are **(c) Coral tree** and **(d) Silk Cotton**.

Some plants may receive visits from more than one animal group in nature. For this examination item, the standard textbook examples and the final key are used.

SECTION A-2 - CHEMISTRY

QUESTIONS 53-56 | EVALUATE EVERY OPTION

QUESTION 53

ANSWER: (b), (c), (d)

CONCEPT: Electrons in the outermost principal shell

- (a) **Na, Sr:** Na has $3s^1$, while Sr has $5s^2$; not equal.
 (b) **Se, Te:** both have ns^2np^4 ; each has 6 outermost-shell electrons.
 (c) **Mn, Fe:** both have $4s^2$ in the outermost principal shell; each has 2 there.
 (d) **As, Bi:** both have ns^2np^3 ; each has 5.

Hence the correct pairs are **(b), (c) and (d)**.

QUESTION 54

ANSWER: (b), (c)

CONCEPT: Very dilute acids and bases; hydrolysis; basicity of H_3PO_2

- (a) **False.** At 10^{-8} M NaOH, water autoionisation cannot be ignored. Solving the equilibrium gives pH about 7.02, not 8.
 (b) **True.** A 10^{-8} M HCl solution has $[H^+]$ slightly greater than 10^{-7} M after including water, so pH is slightly below 7 (about 6.98).
 (c) **True.** Fe^{3+} strongly hydrolyses water and releases H^+ , so aqueous $FeCl_3$ is acidic.
 (d) **False.** H_3PO_2 is monobasic; only its O-H hydrogen is ionisable. The remaining P-H hydrogens are not neutralised by NaOH, so NaH_2PO_2 does not form Na_2HPO_2 by ordinary acid-base reaction.

Therefore, the correct statements are **(b) and (c)**.

QUESTION 55

ANSWER: (a), (d)

CONCEPT: Hydrogen spectrum series

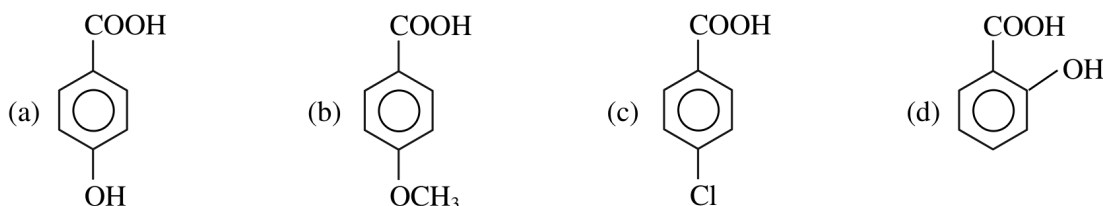
- (a) **Correct.** Balmer lines terminate at $n_1 = 2$, so the upper level satisfies $n_2 > 2$.
 (b) **Incorrect.** The displayed $1/3^2$ term corresponds to the Paschen series. The Pfund series terminates at $n = 5$.
 (c) **Incorrect.** In the Humphreys series, the lower level is $n_1 = 6$ and the upper level has $n_2 > 6$; n_1 itself is not greater than 6.
 (d) **Correct.** Paschen lines lie in the infrared region. Hence the correct options are **(a) and (d)**.

QUESTION 56

ANSWER: (c), (d)

CONCEPT: Substituent effects on the acidity of benzoic acids

Electron-withdrawing groups stabilise the benzoate ion and increase acidity; electron-donating groups destabilise it and decrease acidity.



(a) p-OH and **(b) p-OCH₃** donate electron density by resonance and are not stronger than benzoic acid in the required comparison.

(c) **p-Cl** has a strong -I effect that increases acidity. (d) **o-OH** is salicylic acid; the ortho effect and intramolecular stabilisation make it appreciably stronger than benzoic acid.

Therefore, the stronger acids are **(c) and (d)**.

SECTION A-2 - PHYSICS

QUESTIONS 57-60 | EVALUATE EVERY OPTION

QUESTION 57

ANSWER: (b), (c), (d)

CONCEPT: Momentum conservation for a man walking on a trolley

Let the trolley velocity relative to ground be V eastward. The man walks west at 1 m s^{-1} relative to the trolley, so his ground velocity is $V - 1$.

With initial momentum zero,

$$240V + 60(V - 1) = 0,$$

giving $V = +0.2 \text{ m s}^{-1}$. The man's ground velocity is -0.8 m s^{-1} , not -1 m s^{-1} . Thus (a) is false and (b) is true.

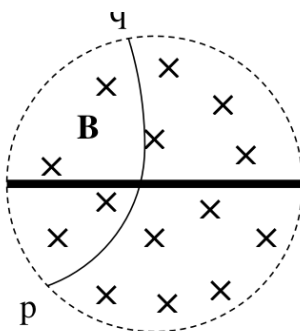
His speed relative to the trolley is 1 m s^{-1} , so crossing 20 m takes 20 s; (c) is true. In that time the trolley moves $0.2 \times 20 = +4.0 \text{ m}$; (d) is true.

Therefore, the correct options are **(b), (c) and (d)**.

QUESTION 58

ANSWER: (a), (b), (c)

CONCEPT: Direction of magnetic deflection



The magnetic field is into the paper. For a positive charge moving from p to q, $q(\mathbf{v} \times \mathbf{B})$ points toward the centre of curvature shown, so a proton can trace the path. An alpha particle has the same sign of charge and can also trace it, with a radius determined by its momentum.

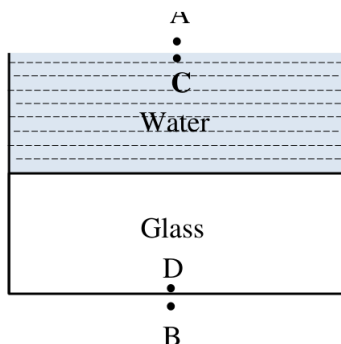
An electron has negative charge. If it travels along the same track in the reverse direction, from q to p, reversing both the direction of motion and the sign of charge gives the required curvature.

A neutron has zero charge and would not be bent by the magnetic field. Hence **(a), (b) and (c)** are correct.

QUESTION 59

ANSWER: (a), (b), (c), (d)

CONCEPT: Apparent thickness through layered media



For normal viewing, a layer of thickness t and refractive index μ appears from a medium of index μ_0 with thickness $t(\mu_0/\mu)$.

Observer A in air: $8/(4/3) + 9/(3/2) = 6 + 6 = 12$ cm.

Observer B in air: the same two apparent contributions give 12 cm.

Observer C in water: $8 + 9[(4/3)/(3/2)] = 8 + 8 = 16$ cm.

Observer D in glass: $9 + 8[(3/2)/(4/3)] = 9 + 9 = 18$ cm.

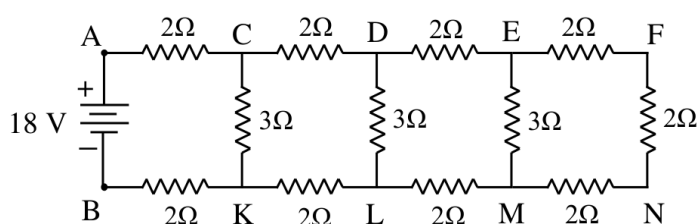
All four statements are correct: **(a), (b), (c) and (d)**.

QUESTION 60

ANSWER: (a), (c), (d)

CONCEPT: Reduction of a symmetrical resistor ladder

Start from the right. Between E and M, the direct $3\ \Omega$ branch is in parallel with the series path E-F-N-M of resistance $2 + 2 + 2 = 6\ \Omega$. Therefore, the equivalent between E and M is $3 \parallel 6 = 2\ \Omega$.



The same pattern repeats one section to the left. Hence the equivalent between D and L is also $2\ \Omega$, and then the equivalent between C and K is $2\ \Omega$.

The total resistance is therefore

$R_{AB} = 2 + 2 + 2 = 6\ \Omega$, so (a) is true. Total current is $18/6 = 3$ A, which is also the current through AC; (c) is true.

Total power is $V^2/R = 18^2/6 = 54$ W, so (b) is false. The potentials at C and K are 12 V and 6 V, so current through CK is $(12 - 6)/3 = 2$ A; (d) is true.

Thus the correct options are **(a), (c) and (d)**.