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SELECTION TEST FOR ADMISSION AT RASHTROTTHANA PU COLLEGES

A network of Rashtrotthana PU colleges is conducting a '***selection cum scholarship test'*** for admission to the Prajna Integrated Course **I/II PU,** which includes coaching for **JEE Main, NEET, and KCET**, for the academic **year 2025-26**. Below are the details of the selection test:

1. Selection test paper consists of **60 multiple** choice questions **(MCQ),** fifteen each from Physics, Chemistry, Mathematics and Biology carrying one mark each.
2. Duration of the test is **1 hour 30** minutes.
3. There is no negative marking for incorrect answers.
4. The important topics for the test are as under.

Physics	Chemistry	Mathematics	Biology
Motion	Matter in Our Surroundings	Real Numbers	Cell: Fundamental Unit of Life
Force and laws of motion	Is Matter Around Us Pure?	Polynomials	Tissues
Gravitation	Atoms and Molecules	Pair of Linear Equations in Two Variables	Improvement in Food Resources
Work, Energy and Power	Structure of the Atom	Quadratic Equations	Life Processes
	Chemical Reactions and Equations	Co-ordinate Geometry	Control and Coordination
	Acids, Bases and Salts	Probability	
		Triangles & Quadrilaterals	

By,
Team PRAJNA

Our Branches:

Rashtrotthana P U College - Davanagere	**Rashtrotthana P U College - Dharwad**	**Rashtrotthana P U College - Udupi**
Opp ESI Hospital Nittuvalli, Davanagere – 577 004, Ph. No: 08192-219068 Mob: 8660576847,7019393765 Email: info.dvg@rpuc.in Web: dvg.rpuc.in	Madhava Nagar, Garag Road, Neeralakatti, Dharwad - 580 011 Ph. No: 94482 84617, 76249 82733 Email: info.dwd@rpuc.in Web: dwd.rpuc.in	1st Floor, Madhuvana Complex, Bramavara Taluk, Udupi District - 576101 Ph. No: 99001 24118 Email: info.udupi@rpuc.in Web: udupi.rpuc.in

PRAJNA

Pursuit for Academic Excellence

MODEL SELECTION TEST PAPER – PCMB

Time: 90 minutes   **Total Marks: 60**

> **Each question carries only one correct choice out of the four given choices and one mark will be awarded for the correct choice made.**

PHYSICS

1. A pebble is dropped into a well of depth h. The splash is heard after time t. If c be the velocity of sound, then

    (A) $t = \dfrac{gh^2}{cv^2}$ (B) $t = \dfrac{c+v}{g}$ (C) $t = \dfrac{c-v}{g}$ (D) $t = \sqrt{\dfrac{2h}{g}} + \dfrac{h}{c}$

    Ans: (D)

    Solution: To go down, the stone takes a time t_1,

    Using $s = ut + at^2$; $h = (0.\, t_1) + \dfrac{1}{2}gt^2{}_1 \Rightarrow t_1 = \sqrt{\dfrac{2h}{g}}$

    The sound takes a time $t_2 = \dfrac{h}{c}$ to reach back to the ear. Total time taken $= (t_1 + t_2) = \sqrt{\dfrac{2h}{g}} + \dfrac{h}{c}$

2. A particle moves so that its acceleration is always twice its velocity. If its initial velocity is 0.1 ms^{-1}, its velocity after it has gone 0.1 m is

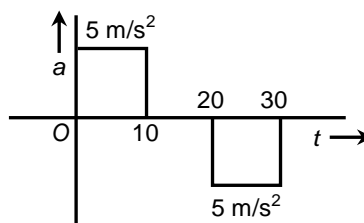   (A) 0.3 m s^{-1} (B) 0.7 m s^{-1} (C) 1.2 m s^{-1} (D) 3.6 m s^{-1}

    Ans: (A)

    Solution: $\dfrac{dv}{dt} = 2v \Rightarrow \dfrac{dv}{dt} = \dfrac{2dx}{dt}$

    dv = 2dx

    $\displaystyle\int_{0.1}^{v} dv = 2\int_{0}^{0.1} dx$

    $(v - 0.1) = 2(0.1) \Rightarrow v = 0.3 \text{ ms}^{-1}$.

3. Find the distance travelled in 30 s by an object starting from rest from the information given in the following graph:

(A) 500 m (B) 1000 m

(C) 250 m (D) More than one of the above

Ans: (B)

Solution: From the graph, from $t = 0$ s to $t = 10$ s,

Area $(v_1) = 5 \times 10 = 50$ m/s

Here, distance $(s_1) = 50 \times 10 = 500$ m

From $t = 20$ s to $t = 30$ s

Area $(v_2) = 5 \times 10 = 50$ m/s

Here, distance $(s_2) = 50 \times 10 = 500$ m

Total distance, $s = s_1 + s_2$

$s = 500 + 500$

$s = 1000$ m

4. A particle of mass m at rest is acted upon by a constant force F for a time t. its kinetic energy after an interval t is

   (A) $\dfrac{F^2 t^2}{m}$ (B) $\dfrac{F^2 t^2}{2m}$ (C) $\dfrac{F^2 t^2}{3m}$ (D) $\dfrac{Ft}{2m}$

Ans: (B)

Solution: Force = mass × acceleration

$a = \dfrac{F}{m}$

Using the equation of motion

$v = u + at$

$v = 0 + \dfrac{F}{m} t$

$v = \dfrac{Ft}{m}$

Kinetic energy $= \dfrac{1}{2} mv^2$

$= \dfrac{1}{2} m \left[\dfrac{Ft}{m} \right]^2$

$= \dfrac{F^2 t^2}{2m}$

So, kinetic energy after time t is $\dfrac{F^2 t^2}{2m}$

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5. Which of the following statement is/are correct regarding momentum?

    (I) It has direction, the same as that of velocity.

    (II) Rate of change of momentum is opposite to the direction of force.

    (III) Change in momentum does not depend on the duration of force applied.

    (IV) Change in momentum takes place on the application of unbalance force only.

    (A) (I)   (B) (III)

    (C) (IV)   (D) More than one of the above

Ans: (D)

6. A player catches a ball of mass 150 gm moving at a speed of 20 m/s. If the process of catching has to be completed in 0.1 sec, what is magnitude of the impulsive force imparted by the ball to the hands of the player?

    (A) 3000 N   (B) 300 N   (C) 30 N   (D) 0.3 N

Ans (C)

Solution: The correct option is C 30 N

Impulsive force can be obtained from the equation,

$$F = \frac{\Delta p}{\Delta t} = \frac{m(v_f - v_i)}{t} \qquad \text{... (i)}$$

Final velocity of the ball is zero after player catches the ball.

$$\therefore F = \frac{m(0 - 20)}{0.1} = -\frac{0.15 \times 20}{0.1}$$

Impulsive force, $F = -30$ N

Magnitude of impulsive force is 30 N

7. Consider Earth to be a homogeneous sphere. Scientist A goes deep down in a mine and scientist B goes high up in a balloon. The gravitational field measured by

    (A) each decreases at different rates

    (B) each decreases at the same rate

    (C) B goes on decreasing and that by A goes on increasing

    (D) A goes on decreasing and that by B goes on increasing

Ans (D)

Solution: The correct option is D each decreases at different rates

For scientist A which goes down in a mine

$$g' = g\left(1 - \frac{d}{r}\right) \qquad \text{... (i)}$$

For scientist B, which goes up in the air

$$g' = g\left(1 - \frac{2h}{R}\right) \qquad \text{... (ii)}$$

From equation (i) and (ii), it is clear that value of g measured by each will decrease at different rates.

Final answer (D)

8. The radius of earth is about 6400 km and that of mars is 3200 km. The mass of the earth is about 10 times mass of mars. An object weighs 200 N on the surface of earth. Its weight on the surface of mars will be

    (A) 20 N   (B) 8 N   (C) 80 N   (D) 40 N

Ans: (C)

Solution: Given, radius of earth $(R_e) = 6400$ km; radius of mars $(R_m) = 3200$ km; mass of earth $(M_e) = 10\,M_m$ and weight of the object on earth $(W_e) = 200$ N.

$$\frac{W_m}{W_e} = \frac{mg_m}{mg_e} = \frac{M_m}{M_e} \times \left(\frac{R_e}{R_m}\right)^2 = \frac{1}{10} \times (2)^2 = \frac{2}{5}$$

or $W_m = W_e \times \dfrac{2}{5} = 200 \times 0.4 = 80$ N

9. The masses of two planets are in the ratio 1 : 2. Their radii are in the ratio 1 : 2. The acceleration due to gravity on the planets are in the ratio.

    (A) 1 : 2   (B) 2 : 1   (C) 3 : 5   (D) 5 : 3

Ans: (A)

Solution: Acceleration due to gravity is given by:

$$g = \frac{GM}{R^2}$$

For the first planet, acceleration due to gravity is

$$g_1 = \frac{GM_1}{R_1^2}$$

For the second planet, acceleration due to gravity is

$$g_2 = \frac{GM_2}{R_2^2}$$

Taking the ratio,

$$\frac{g_1}{g_2} = \frac{GM_1 / R_1^2}{GM_2 / R_2^2}$$

$$\frac{g_1}{g_2} = \frac{M_1}{M_2} \times \frac{R_2^2}{R_1^2}$$

It's given that $M_2 = 2M_1$ and $R_2 = 2R_1$

On substituting these in the expression, we get

$$\frac{g_1}{g_2} = \frac{1}{2} \times \frac{2^2}{1^2}$$

$$\frac{g_1}{g_2} = \frac{2}{1}$$

10. If the mass of a planet is 10% less than that of the Earth and the radius 20% greater than that of the Earth, the acceleration due to gravity on the planet will be

    (A) $\dfrac{5}{8}$ times that on the surface of the Earth   (B) $\dfrac{3}{4}$ times that on the surface of the Earth

    (C) $\dfrac{1}{2}$ times that on the surface of the Earth   (D) $\dfrac{9}{10}$ that on the surface of the Earth

Ans: (A)

Solution: $g = \dfrac{GM}{R^2}$;

$$g' = \dfrac{G\left(\dfrac{90}{100}M\right)}{\left(\dfrac{120}{100}R\right)^2} = \left(\dfrac{0.9}{1.2^2}\right)\dfrac{GM}{R^2} = \dfrac{5}{8}g.$$

11. **An iron sphere of mass 10 kg and an aluminium sphere of mass 3.5 kg, with the same diameter, are simultaneously dropped from a tower. When they are 10 m above the ground, they experience the same:**

    (A) Potential energy   (B) Momenta   (C) Acceleration   (D) Kinetic energy

Ans: (C)

Solution: The acceleration of both the bodies are same as the acceleration due to gravity, hence both the bodies will have the same acceleration. The mass of both the body is different, hence kinetic, potential energy and momenta will be different.

12. **Given two objects with masses 1×10^{-3} kg and 4×10^{-3} kg having equal momentum, what is the ratio of their kinetic energies?**

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

Ans: (B)

Solution: 4:1

We know that,

$$KE = \dfrac{p^2}{2m}$$

for a constant momentum,

$$KE \propto \dfrac{1}{m}$$

$$\Rightarrow \dfrac{KE_1}{KE_2} = \dfrac{m_2}{m_1}$$

$$\Rightarrow \dfrac{KE_1}{KE_2} = \dfrac{4 \times 10^{-3}}{1 \times 10^{-3}} = \dfrac{4}{1} = 4:1$$

13. Two masses of 1 g & 9 g are moving with equal kinetic energies. The ratio of the magnitudes of their respective linear momentum is

    (A) 3:1   (B) 1:3   (C)1:9   (D) 9:1

Ans: (B)

Solution: As $K = \dfrac{p^2}{2m}$

$\dfrac{p_1^2}{2m_1} = \dfrac{p_2^2}{2m_2} \Rightarrow \dfrac{p_1}{p_2} = \sqrt{\dfrac{m_1}{m_2}} = \sqrt{\dfrac{1g}{9g}} = \dfrac{1}{3}.$

14. A bomb of mass 30 kg at rest explodes into two pieces of masses 18 kg and 12 kg. The velocity of 18 kg mass is 6 m s^{-1}. The kinetic energy of the other mass is

    (A) 324 J   (B) 486 J   (C) 256 J   (D) 524 J

Ans: (B)

Solution: According to law of conservation of linear momentum.

$30 \times 10 = 18 \times 6 + 12 \times v$

$\Rightarrow -108 = 12v \Rightarrow v = -9$ m/s.

Negative sign indicates that both fragments move in opposite directions.

K.E. of 12 kg $= \dfrac{1}{2}mv^2 = \dfrac{1}{2} \times 12 \times 81 = 486$ J

15. The force F acting on a body moving in a circle of radius r is always perpendicular to the instantaneous velocity v. The work done by the force on the body in one complete rotation is

    (A) Fv   (B) F.2πr   (C) Fr   (D) 0

Ans: (D)

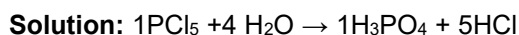**Solution:** As $\dfrac{dW}{dt} = P = \vec{F}.\vec{v} = 0\,(\because \vec{F} \perp \vec{v})$

Rate of doing work = 0, Initially W = 0

$\Rightarrow$ Word done = 0.

CHEMISTRY

16. The correct set of balancing numbers for the equation $PCl_5 + H_2O \rightarrow H_3PO_4 + HCl$ are

    (A) 1,3,4,5   (B) 1,4,1,3   (C) 1,5,1,4   (D) 1,4,1,5

Ans: (D)

Solution: $1PCl_5 + 4 H_2O \rightarrow 1H_3PO_4 + 5HCl$

17. The reaction between nitric oxide and oxygen to give nitrogen dioxide is an example for

    (A) decomposition reaction   (B) oxidation reaction

    (C) combination reaction   (D) both (B) and (C)

Ans: (D)

Solution: $2NO + O_2 \rightarrow 2NO_2$

Both addition of oxygen (NO to NO_2) and combination of reactants (NO+O_2) is happening

18. Which of the following is correct for a reduction reaction?

    (A) addition of oxygen   (B) removal of the electron

    (C) removal of oxygen   (D) both (B) and (C)

Ans: (C)

Solution: Reduction can be defined as removal of oxygen or addition of hydrogen or addition of electrons to a substance

19. A silvery white metal burns with a dazzling white flame to give substance A which on reaction with water gives B. Which of these is not correct about B?

    (A) B is partially soluble in water   (B) B is a metal carbonate

    (C) B has a pH above 7   (D) B can be used as antacid

Ans: (B)

Solution: Mg burns with a bright white flame to give MgO (compound A) . MgO reacts water to give $Mg(OH)_2$ (compound B). B is a metal hydroxide, alkaline in nature and has pH above 7, can be used as an antacid.

20. Which of these is not a correct combination?

    (A) Methyl orange – red in acidic medium

    (B) Universal indicator- green in neutral medium

    (C) Phenolphthalein – pale pink in acidic medium

    (D) Litmus paper – blue in basic medium

Ans: (C)

Solution: Phenolphthalein is colourless in the acidic medium and gives permanent faint pink in the basic medium.

21. Which of these can be used in fire extinguishers?

    (A) Washing soda   (B) Bleaching powder   (C) Caustic soda   (D) Baking soda

Ans: (D)

Solution: Baking soda releases carbon dioxide when heated. This carbon dioxide helps to smother flames.

22. Which of the following is incorrect about the neutralisation reaction?

    (A) Neutralisation is generally exothermic

    (B) H^+ from acid neutralises OH^- from the base during neutralisation to form water

    (C) All neutralisations result in a neutral pH

    (D) Metal carbonates release carbon dioxide upon neutralisation

Ans: (C)

Solution: pH of the solution after neutralisation need not be 7 always as it depends on the type of acid and base used (strong or weak). For example, the neutralization of a strong acid with a weak base can result in a solution that is slightly acidic.

23. Farmers neutralise the effect of acidity of the soil by adding

    (A) slaked lime   (B) quick lime   (C) caustic soda   (D) baking soda

Ans: (A)

Solution: Farmers neutralize the effect of acidity in the soil by adding slaked lime. Slaked lime(calcium hydroxide) helps to increase the pH of acidic soils, making them more suitable for growing crops.

24. Which of these is an example of diffusion?

    (A) Sugar dissolving in hot coffee

    (B) Ice cream melts in a warm room

    (C) Pollen from flowers is blown by the wind

    (D) The smell of cooking spreads through a house

Ans: (D)

Solution: Diffusion is the process where molecules move from an area of higher concentration to an area of lower concentration, which is what happens when the smell of food spreads through the air in a house.

25. Butter is an example for which type of colloid?

    (A) liquid in solid   (B) solid in liquid

    (C) solid in gas   (D) liquid in liquid

Ans: (A)

Solution: In butter, fat (liquid) is dispersed in a solid matrix, which is primarily composed of milk proteins and water.

26. The separation technique that can be adopted to get pure water from seawater is

    (A) evaporation   (B) filtration

    (C) simple distillation   (D) fractional distillation

Ans: (C)

Solution: Simple distillation involves heating seawater to create vapour, which is then condensed back into liquid water, leaving behind salts and impurities.

27. Hydrogen combining with oxygen to give water and hydrogen peroxide is an example for

    (A) Law of conservation of mass   (B) Dalton's law

    (C) Law of multiple proportions   (D) Law of definite proportions

Ans: (C)

Solution: According to law of multiple proportions, when two elements can combine to form more than one compound, the ratios of the masses of one element that combine with a fixed mass of the other element will be in simple whole numbers. In this case, hydrogen and oxygen can form different compounds (water and hydrogen peroxide), illustrating this principle.

28. The number of particles in 0.5 moles of ozone is equal to

    (A) 1.5 x Avogadro number of oxygen atoms   (B) ½ x Avogadro number of ozone molecules

    (C) 3 x Avogadro number of oxygen atoms   (D) both A and B

Ans: (D)

Solution: 1 mole of any substance contains Avogadro number of particles. Each ozone(O_3) molecule has three oxygen atoms.

Number of oxygen atoms = $0.5 \times 3 \times$ Avogadro number of atoms

Number of ozone molecules = $0.5 \times$ Avogadro number of atoms

29. The maximum number of electrons found in any shell 'n' is

    (A) n^2 (B) (n^2-1) (C) $2n^2$ (D) $2(n-1)$

Ans: (C)

Solution: The maximum number of electrons in any shell 'n' is $2n^2$

30. **Assertion:** In Rutherford's gold foil experiment 1/3rd of alpha particles are scattered

    Reason: Almost all the atom's mass is concentrated in the nucleus

    (A) Both assertion and reason are true   (B) Assertion is true but reason is false

    (C) Assertion is false but reason is true   (D) Assertion and reason both are false

    Ans: (C)

    Solution: In Rutherford's gold foil experiment, it was found that a very small fraction of alpha particles (about 1 in 8000) were deflected back, not 1/3rd. This means the assertion is false. The reason, stating that almost all the atom's mass is concentrated in the nucleus, is true.

MATHEMATICS

31. The values of p and q for which the system of equations $2x + 3y = 7$ and $(p+q)x + (2p-q)y = 21$

    has infinitely many solutions, are respectively

    (A) 1, 5   (B) 5, 1   (C) 5, 5   (D) 1, 1

    Ans: (B)

    Solution: The given system is $2x + 3y = 7$ and $(p+q)x + (2p-q)y = 21$

    Here $a_1 = 2, b_1 = 3, c_1 = 7$

    and $\quad a_2 = p+q, b_2 = 2p-q, c_2 = 21$

    $\Rightarrow \dfrac{2}{p+q} = \dfrac{3}{2p-q} = \dfrac{7}{21}$ $\quad \left[\because \text{a system has infinitely many solutions if } \dfrac{a_1}{a_2} = \dfrac{b_1}{b_2} = \dfrac{c_1}{c_2} \right]$

    $\Rightarrow \dfrac{2}{p+q} = \dfrac{7}{21} \Rightarrow \dfrac{2}{p+q} = \dfrac{1}{3} \Rightarrow p+q = 6 \qquad \dots (1)$

    And $\dfrac{3}{2p-q} = \dfrac{1}{3} \Rightarrow 2p - q = 9 \qquad \dots (2)$

    Solving (1) and (2) we get,

    $p = 5$ and $q = 1$

32. The solution of the system of equations $\dfrac{x}{a} + \dfrac{y}{b} = 2$ and $ax - by = a^2 - b^2$ is

    (A) -a, b   (B) b, a   (C) a, b   (D) None of these

    Ans: (C)

    Solution: Given, $\dfrac{x}{a} + \dfrac{y}{b} = 2 \Rightarrow bx + ay = 2ab \qquad \dots (1)$

    And $ax - by = a^2 - b^2 \qquad \dots (2)$

    Solving (1) and (2)

    Now, $(1) \times b + (2) \times a$

    $\Rightarrow x(b^2 + a^2) = 2ab^2 + a^3 - b^2 a$

$$\Rightarrow x = \frac{a(b^2 + a^2)}{a^2 + b^2} = a$$

In (1) putting $x = a$ we get,

$$ab + ay = 2ab$$

$$\Rightarrow ay = ab$$

$$\Rightarrow y = b$$

33. For what value of 't' is $x = \frac{2}{3}$ a solution of $7x^2 + tx - 3 = 0$

    (A) $\frac{55}{6}$ (B) $\frac{6}{55}$ (C) 6   (D) None of these

Ans: (A)

Solution: Given $x = \frac{2}{3}$ is solution of $7x^2 + tx - 3 = 0$

$$\therefore 7\left(\frac{2}{3}\right)^2 + t\left(\frac{2}{3}\right) - 3 = 0$$

$$\Rightarrow \frac{2t}{3} = \frac{55}{9}$$

$$\Rightarrow t = \frac{55}{6}$$

34. The sides of a right-angled triangle are $(x+6), x, (x+3)$ units then the sides of the triangle are

    (A) 5, 3, 4   (B) 25, 7, 24   (C) 15, 9, 12   (D) 13, 5, 12

Ans: (C)

Solution: Given $(x+6), x, (x+3)$ are sides of a right-angled triangle.

$$\therefore (x+6)^2 = x^2 + (x+3)^2$$

$$\Rightarrow x^2 - 6x - 27 = 0$$

$$\Rightarrow (x-9)(x+3) = 0$$

$$\Rightarrow x = -3, \text{ or } 9$$

Since x is one of the sides of the triangle, so, it cannot be negative

$$\therefore x = 9$$

Thus, the sides of the triangle are 9+6, 9, 9+3 = 15, 9, 12

35. If α and β are roots of $ax^2 + bx + c = 0$ then the equation whose roots are α^2 and β^2 is

    (A) $cx^2 + bx + a = 0$ (B) $ax^2 + cx + b = 0$

    (C) $a^2x + \left(2ac - b^2\right)x + c^2 = 0$ (D) $a^2x^2 + \left(2ac + b^2\right)x + c^2 = 0$

Ans: (C)

Solution: $\alpha^2 + \beta^2 = \left(\alpha + \beta\right)^2 - 2\alpha\beta$

$$\left\{ \because \ \alpha + \beta = -\frac{b}{a}, \ \alpha\beta = \frac{c}{a} \right\} = \left(-\frac{b}{a} \right)^2 - 2 \times \frac{c}{a}$$

$$= \frac{b^2}{a^2} - \frac{2c}{a} = \frac{b^2 - 2ac}{a^2}$$

$$\alpha^2 \beta^2 = (\alpha\beta)^2 = \left(\frac{c}{a} \right)^2 = \frac{c^2}{a^2}$$

$$x^2 - \left(\alpha^2 + \beta^2 \right) x + \alpha^2 \beta^2 = 0$$

$$x^2 - \left(\frac{b^2 - 2ac}{a^2} \right) x + \frac{c^2}{a^2} = 0$$

$$a^2 x^2 - \left(b^2 - 2ac \right) x + c^2 = 0$$

$$a^2 x^2 + \left(2ac - b^2 \right) x + c^2 = 0$$

36. A rectangular field is 20 m long and 14 m wide. There is a path of equal width all around it, having an area of 111 sq m. Find the width of the path.

    (A) 28 m^2 (B) 2.8 m   (C) 1.5 m   (D) none

Ans: (C)

Solution: Let the width of the path be x metres.

Length of the field including the path $= (20 + 2x)$ m

Breadth of the field including the path $= (14 + 2x)$ m

Area of the field including the path $= (20 + 2x)(14 + 2x)$ m^2

Area of the field excluding the path $= (20 \times 14)$ m$^2 = 280$ m^2

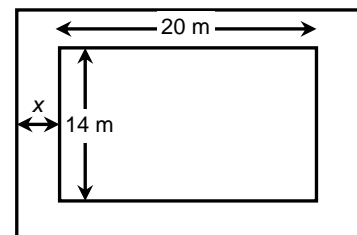$\therefore$ the area of the path $= \left[(20 + 2x)(14 + 2x) - 280 \right]$ m^2

$\therefore (20 + 2x)(14 + 2x) - 280 = 111$

$\Rightarrow 2x(2x + 37) - 3(2x + 37) = 0 \Rightarrow (2x + 37)(2x - 3) = 0$

$\Rightarrow x = -\dfrac{37}{2}$ or $x = \dfrac{3}{2}$

$\Rightarrow x = \dfrac{3}{2} = 1.5$ [$\because$ width can never be negative]

Hence, the width of the path is 1.5 m.

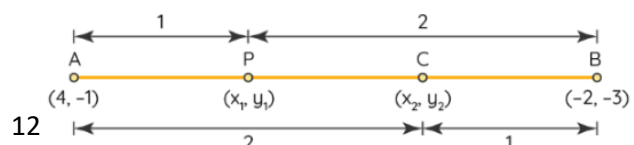37. The coordinates of the points of trisection of the line segment joining (4, - 1) and (- 2, - 3)

    (A) (2, -5/3) & (0, -7/3)   (B) (2, -7/3) & (0, -5/3)

    (C) (2, 0) & (-5/3, -7/3)   (D) (2, 2) & (0, -7/3)

Ans: (A)

Solution: Let the points be A(4, - 1) and B(- 2, - 3). Let P (x_1, y_1) and Q (x_2, y_2) be the points of trisection of the line segment joining the given points.

Then, AP = PC = CB

By Section formula ,

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$$P(x, y) = \left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n} \right) \quad \text{...(1)}$$

Considering A(4, - 1) and B(- 2, - 3), by observation point $P(x_1, y_1)$ divides AB internally in the ratio 1 : 2.

Hence m : n = 1 : 2

By substituting the values in the Equation (1)

x_1 = [1 × (- 2) + 2 × 4] / (1 + 2)= (- 2 + 8) / 3 = 2

y_1 = [1 × (- 3) + 2 × (- 1)] / (1 + 2) = (- 3 - 2) / (1 + 2) = - 5/3

Hence, $P(x_1, y_1)$ = (2, - 5/3)

Now considering A(4, - 1) and B(- 2, - 3), by observation point $C(x_2, y_2)$ divides AB internally in the ratio 2 : 1.

Hence m : n = 2 : 1

By substituting the values in the Equation (1)

x_2 = [2 × (- 2) + 1 × 4] / (2 + 1)= (- 4 + 4) / 3= 0

y_2 = [2 × (- 3) + 1 × (- 1)] / (2 + 1)= (- 6 - 1) / 3= - 7/3

Therefore, $C(x_2, y_2)$ = (0, - 7/3)

38. The coordinates of two points A and B are $(3, 4)$ and $(5, -2)$, respectively. Then the coordinates of

the point say P is _____ if $PA = PB$ & the area of $\triangle PAB$ is 10 sq. unit.

    (A) $(7, 2)$ or $(-1, 0)$ (B) $(-7, -2)$ or $(-1, 0)$ (C) $(2, 7)$ or $(0, 1)$ (D) None of these

Ans: (D)

Solution: Let the coordinates of the point P be (x, y).

Given that $PA = PB$ or $PA^2 = PB^2$

$$\Rightarrow (x-3)^2 + (y-4)^2 = (x-5)^2 + (y+2)^2 \Rightarrow x - 3y - 1 = 0 \quad \text{... (1)}$$

Now area of $\triangle PAB = \pm 10 \Rightarrow \dfrac{1}{2} \begin{vmatrix} x & y \\ 3 & 4 \\ 5 & -2 \\ x & y \end{vmatrix} = \pm 10 \Rightarrow 6x + 2y - 26 = \pm 20$

$\Rightarrow 3x + y - 23 = 0$ ... (2)   or $3x + y - 3 = 0$ ... (3)

Solving (1) and (2), we get $x = 7$, $y = 2$.

By solving (1) and (3), we get $x = 1$, $y = 0$. j

Thus, the coordinates of P can be $(7, 2)$ or $(1, 0)$.

39. A bag contains white, black and red balls only. A ball is drawn at random from the bag. If the probability of getting a white ball is $3/10$ and that of a black ball is $2/5$ then find the probability of getting a red ball. If the bag contains 20 black balls then find the total number of balls in the bag.

    (A) 35   (B) 50   (C) 40   (D) 30

Ans: (B)

Solution: Let E be the event of getting a red ball. Then,

P (getting a white ball) + P (getting a black ball) + P(E) = 1

$$\Rightarrow \frac{3}{10} + \frac{2}{5} + P(E) = 1 \Rightarrow \frac{7}{10} + P(E) = 1$$

$$\Rightarrow P(E) = 1 - \frac{7}{10} = \frac{3}{10}$$

$$\Rightarrow P(\text{getting a red ball}) = \frac{3}{10}$$

Since, P (getting a white ball) = P (getting a red ball), so the number of white balls is equal is equal to the number of red balls, say x.

$$\therefore \ P(\text{getting a red ball}) = \frac{x}{x + 20 + x} = \frac{x}{2x + 20}$$

$$\therefore \ \frac{x}{2x + 20} = \frac{3}{10} \Rightarrow 10x = 6x + 60 \Rightarrow 4x = 60 \Rightarrow x = 15$$

Hence, the total number of balls in the bag

$= 2x + 20 = 2 \times 15 + 20 = 50$.

40. On a morning walk, three persons step off together and their steps measure 40 cm, 42 cm and 45 cm respectively. Then the minimum distance each should walk so that each can cover the same distance and complete steps is

    (A) 2540   (B) 2620   (C) 2520   (D) 2420

Ans: (C)

Solution: Each person will cover the same distance in complete steps if the distance covered in cm is the LCM of 40, 42 and 45.

Now,

$$40 = 2^3 \times 5, \ 42 = 2 \times 3 \times 7 \text{ and } 45 = 3^2 \times 5$$

$\therefore$ LCM of 40, 42 and 45 is $2^3 \times 3^2 \times 5 \times 7 = 8 \times 9 \times 5 \times 7 = 2520$

Hence, minimum distance each should walk = 2520 cm.

41. Let a, b, c, d be positive rationales such that $a + \sqrt{b} = c + \sqrt{d}$, then which of the following is correct
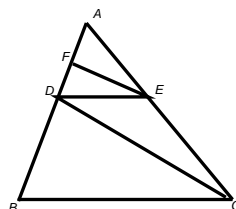
    (A) If $a = c$ then b=d   (B) If $a = c$ then b ≠ d

    (C) If $a \neq c$ then b=d   (D) None of these

Ans: (A)

Solution: If $a = c$, then

$$a + \sqrt{b} = c + \sqrt{d} \Rightarrow \sqrt{b} = \sqrt{d} \Rightarrow b = d.$$

42. In Fig., $DE \parallel BC$ and $CD \parallel EF$. Then

14

(A) $AD^2 = AB \times AF$

(B) $AD^2 = AB \times AF$

(C) $AD^2 = AB \times AF$
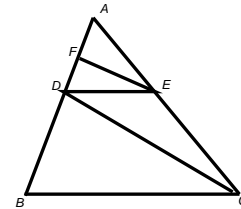
(D) $AD^2 = AB \times AF$

Ans: (B)

Solution: In $\triangle ABC$, we have

$\Rightarrow \dfrac{AB}{AD} = \dfrac{AC}{AE}$ ...(i)

In $\triangle ADC$, we have

$FE \parallel DC$

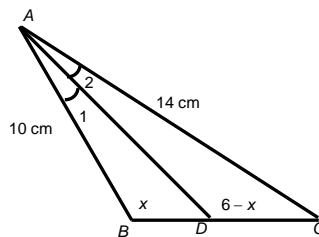$\Rightarrow \dfrac{AD}{AF} = \dfrac{AC}{AE}$ ...(ii)

From (i) and (ii), we get

$\dfrac{AB}{AD} = \dfrac{AD}{AF}$

$\Rightarrow AD^2 = AB \times AF$

43. In Fig., AD is the bisector of $\angle BAC$. If $AB = 10\ cm.$ $AC = 14\ cm$ and $BC = 6cm$, then BD is

(A) $BD = 3.5$ cm   (B) $\Rightarrow BD = 4.5$ cm   (C) $BD = 5.5$ cm   (D) $BD = 2.5$ cm

Ans: (D)

Solution: Let $BD = x\ cm.$ Then, $DC = (6 - x)$ cm.

Since AD is the bisector of $\angle A$.

$\therefore \quad \dfrac{AB}{AC} = \dfrac{BD}{DC}$

$\Rightarrow \dfrac{10}{14} = \dfrac{x}{6 - x}$

$\Rightarrow \dfrac{5}{7} = \dfrac{x}{6 - x}$
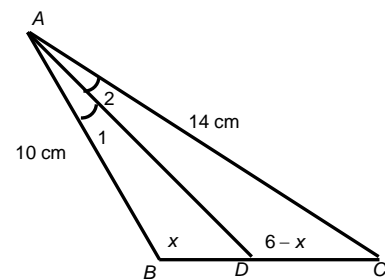
$\Rightarrow 30 - 5x = 7x$ $[\because AC = 5.6]$

$\Rightarrow 12x = 30$

$\Rightarrow x = \dfrac{5}{2} = 2.5$ cm

$\Rightarrow BD = 2.5$ cm

44. The diagonal BD of a parallelogram $ABCD$ intersects the segment AE at the point F, where E is any point on the side BC. Then

(A) $ED \times EF = FB \times FA$ (B) $DF \times EF = FB \times FA$

(C) $CF \times EF = FB \times FA$ (D) None of these

Ans: (B)

Solution: In $\triangle AFD$ and $\triangle BFE$, we have

$\angle 1 = \angle 2$ [Vertically opposite angles]

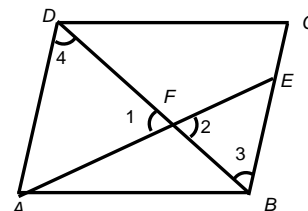$\angle 3 = \angle 4$ [Alternate angles]

So, by $AA -$ criterion of similarity, we have

$\triangle FBE \sim \triangle FDA$

$\Rightarrow \dfrac{FB}{FD} = \dfrac{FE}{FA}$

$\Rightarrow \dfrac{FB}{DF} = \dfrac{EF}{FA}$

$\Rightarrow DF \times EF = FB \times FA$

45. If α and β are the zeroes of the quadratic polynomial $f(x) = x^2 - x - 2$, then the polynomial whose zeroes are $2\alpha + 1$ and $2\beta + 1$ is

(A) $k(x^2 - 4x - 5)$ (B) $k(x^2 + 4x - 5)$ (C) $k(x^2 - 4x + 5)$ (D) None of these

Ans: (A)

Solution: It is given that α and β are the zeroes of the polynomial $f(x) = x^2 - x - 2$

$\therefore \alpha + \beta = -\left(-\dfrac{1}{1}\right) = 1$ and $\alpha\beta = \dfrac{-2}{1} = -2$

Let S and P denote respectively the sum and the product of zeroes of the required polynomial. Then,

$$S = (2\alpha + 1) + (2\beta + 1) = 2(\alpha + \beta) + 2 = 2 \times 1 + 2 = 4 \qquad [\because \alpha + \beta = 1]$$

and, $P = (2\alpha + 1)(2\beta + 1) = 4\alpha\beta + 2\alpha + 2\beta + 1 = 4\alpha\beta + 2(\alpha + \beta) + 1$

$$= 4 \times -2 + 2 \times 1 + 1 = -8 + 2 + 1 = -5 \qquad [\because \alpha + \beta = 1 \text{ and } \alpha\beta = -2]$$

Hence, required polynomial $g(x)$ is

$$g(x) = k\{x^2 - Sx + P\} = k(x^2 - 4x - 5), \text{ where k is any non-zero constant.}$$

BIOLOGY

46. A researcher intends to test the effects of several growth hormones on the sample plant. Through his experiments following interpretations are listed. Pick the correct interpretation/s according to the functions of specific hormones.

     I.   Cytokinin specially help in delaying senescence

     II.   Auxins are involved in regulating apical dominance

III.   Ethylene is especially useful in enhancing seed germination

IV.   Gibberellins are responsible for immature falling of leaves

(A) I and III   (B) II and I   (C) II and III   (D) I and IV

Ans: (B)

Explanation: Interpretations III and IV are incorrect as ethylene is more commonly associated with fruit ripening and leaf abscission, rather than seed germination. It can sometimes promote germination in certain species, but it is not its primary role and gibberellins are primarily involved in promoting stem elongation, breaking seed dormancy, and other growth processes, but they are not typically responsible for leaf drop. Leaf abscission is usually regulated by ethylene and abscisic acid.

47. When a neuron is resting, i.e., not conducting any impulse, the axonal membrane is

    (A) impermeable to both Na^+ and K^+ ions

    (B) equally permeable to both Na^+ and K^+ ions

    (C) comparatively more permeable to Na+ ions and nearly impermeable to K+ ions

    (D) comparatively more permeable to K+ ions and nearly impermeable to Na+ ions

Ans: (D)

Explanation: The axonal membrane is selectively permeable. During the resting phase,

- the membrane is more permeable to K+ ions because there are more open K+ channels (leak channels) at rest, allowing potassium ions to flow out of the cell.

- the membrane is nearly impermeable to Na+ ions at rest because most of the Na+ channels are closed, preventing significant sodium ion movement into the cell.

48. In a laboratory condition, if a cell is treated such that oxygen cannot diffuse into the cell. In this scenario, which of the cell organelles is directly affected?

    (A) Mitochondria   (B) Chloroplast   (C) Golgi body   (D) Lysosome

Ans: (A)

Explanation: Mitochondria are the organelles responsible for cellular respiration, a process that requires oxygen to produce ATP (energy). If oxygen cannot diffuse into the cell, the ATP production is hindered which directly affects energy production.

49. Choose one of the following statements given below which correctly explains the process of osmosis.

    (A) Movement of water from the region of concentrated to dilute solutions

    (B) The passage of solute through a selectively permeable membrane from a region of low solute concentration to a region of high solute concentration.

    (C) The passive transport of solvent through a selectively permeable membrane from a region of low solute concentration to a region of high solute concentration.

    (D) Energy-dependent transport of a solvent through a selectively permeable membrane from a region of low solute concentration to a region of high solute concentration.

Ans: (C)

Explanation: Osmosis is the movement of water (the solvent) through a selectively permeable membrane, from an area of low solute concentration (high water potential) to an area of high solute concentration (low water potential). It is a passive process, meaning no energy is required.

50. Given the average duplication time of *E. coli* is 20 minutes, how much time will two *E. coli* cell take to form 1024 daughter cells?

(A) 120 minutes   (B) 200 minutes   (C) 180 minutes   (D) 160 minutes

Ans: (C)

Explanation: The number of cells doubles every 20 minutes. Starting with 1 cell, it takes 10 divisions to reach 1024 cells (since 2^{10} = 1024). Therefore, 10 divisions × 20 minutes = 200 minutes. Since we are considering 2 *E. coli* as the starting point. Hence, the time taken is 200 minutes – one division (20 min) = 180 minutes.

51. In green plants, the oxygen evolved comes from

(A) H_2O (B) CO_2 (C) Atmospheric O_2 (D) Both a and b.

Ans: (A)

Explanation: In green plants, during photosynthesis, oxygen is produced through the splitting of water molecules (H_2O) in a process called photolysis, which occurs in light-dependent reactions. This takes place in the chloroplasts, specifically in the thylakoid membranes. The water molecules are split into oxygen (O_2), protons (H^+), and electrons. The oxygen is then released as a byproduct.

52. From the following statements, choose the correct statement/s.

     I.   All cells do not have a plasma membrane that is selectively permeable

     II.   Animal cells contain centrioles but not plant cells

     III.   Golgi apparatus which aids in protein folding and packaging is found in plant cells only

     IV.   Chloroplast which is the site of photosynthesis is found in plant cells but not in prokaryotic cells

     V.   Mitochondria is present in both animal and plant cells

(A) I and II   (B) I only   (C) V and III   (D) II and V

Ans: (D)

Explanation: Animal cells contain centrioles, but plant cells do not and Mitochondria are present in both animal and plant cells are correct statements. However, other options are incorrect: All cells do not have a cell wall but have a plasma membrane i.e., selectively permeable, and the Golgi apparatus is present in both plant and animal cells, not just in plants.

53. John has just finished eating a large meal containing rice, bread, and fruit, which are all high in carbohydrates. After the meal, his blood glucose levels rise. Which hormone is primarily responsible for helping his body lower blood glucose levels by allowing his cells to absorb the extra sugar from the bloodstream?

(A) Glucagon   (B) Adrenaline   (C) Insulin   (D) Thyroxine

Ans: (C)

Explanation: Insulin, produced by the pancreas, facilitates the uptake of glucose by cells from the bloodstream, thereby lowering blood glucose levels.

54. Unmyelinated nerve fibre is:

(A) Axon is not surrounded by myelin sheath as the Schwann cells are absent

(B) Surrounded by a Schwann cell that does not form a myelin sheath.

(C) Surrounded by oligodendrocytes, not Schwann cells

(D) This is not found in the autonomous or somatic nervous systems.

Ans: (B)

Explanation: Unmyelinated fibres are surrounded by Schwann cells, but these Schwann cells do not produce the myelin sheath that is present in myelinated fibres.

55. During a routine check-up, a doctor listens to Emma's heartbeat using a stethoscope. The doctor explains that the first heart sound is caused by the closure of certain valves in her heart. Which of the following describes the source of the first heart sound?

(A) "Lub" during the closure of semilunar valves

(B) "Lub" during the closure of atrioventricular valves

(C) "Dub" during the closure of semilunar valves

(D) "Dub" during the closure of atrioventricular valves

Ans: (B)

Explanation: The first heart sound ("Lub") is produced by the closure of the atrioventricular (AV) valves (tricuspid and mitral) at the start of ventricular systole.

56. Choose the pair which is the correct match:

(A)	DCT	Glomerulus and Bowman's capsule
(B)	Ultrafiltration	Reabsorption of water
(C)	Henle's Loop	Reabsorption of 70-80% of electrolytes
(D)	PCT	Reabsorption of glucose and amino acids

Ans: (D)

Explanation: The proximal convoluted tubule (PCT) is where most of the reabsorption of glucose, amino acids, and other solutes occurs in the nephron. Ultrafiltration occurs in the glomerulus; therefore, it is also called glomerular filtration. Reabsorption of water and reabsorption of 70- 80% of electrolytes occurs in Henle's loop and DCT respectively.

57. Read the following statements and choose the incorrect statement/s:

I.   Conduction of water in the xylem is always unidirectional from roots to aerial parts of the plants whereas translocation of the photosynthetic product i.e., starch is translocated by phloem only in the opposite direction as that of xylem.

II.   Xylem tissue consists of xylem fibres, parenchyma, vessels and tracheids and tracheids do not possess a perforated cell wall

III. Systole results in entry of deoxygenated blood into the lungs

IV.   Diastole results in exit blood from the heart

(A) I and II   (B) I, II and IV   (C) II and III   (D) I and IV

Ans: (D)

Explanation: Statements II and III is correct, but the other three statements are incorrect because diastole results in entry of the blood into the heart, translocation in phloem is multidirectional and xylem tissue does not contain companion cells.

58. A farmer in India is planning the cultivation of both Kharif and Rabi crops on his farmland. However, he faces challenges related to the unpredictable onset of the monsoon and varying water availability. Given the following crops and their specific growing seasons, which strategy would be the most effective for the farmer to ensure a balanced production cycle throughout the year, while also considering water management?

(A) Growing wheat during the Kharif season and rice during the Rabi season to manage water resources efficiently.

(B) Growing maize and mustard together in both Kharif and Rabi seasons to maximize yield.

(C) Cultivating rice during the Kharif season and wheat during the Rabi season to align with monsoon and winter conditions.

(D) Planting soybeans during the Rabi season and barley during the Kharif season for balanced water use.

Ans: (B)

Explanation: Rice is a Kharif crop that requires abundant water, typically grown during the monsoon season, while wheat is a Rabi crop grown in the winter, requiring less water.

Questions 59 and 60, consist of two statements each: Assertion (A) and reason (R). To answer this question, mark the correct alternative as directed below.

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

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

(C) A is true but R is false

(D) Both A and R are false

59. **Assertion:** Plasmolysis occurs when the plant cells are placed in highly concentrated sugar or salt solution.

Reason: Highly concentrated sugar or salt solution acts as hypotonic solution which results in exosmosis

Ans: (C)

Explanation: Plasmolysis occurs when plant cells are placed in a highly concentrated solution (hypertonic solution), causing water to move out of the cell. This results in the shrinking of the cell membrane away from the cell wall, which is plasmolysis. A highly concentrated sugar or salt solution is not a hypotonic solution but a hypertonic solution. A hypertonic solution has a higher solute concentration than the cell's internal environment, which causes water to move out of the cell (exosmosis), leading to plasmolysis. A hypotonic solution, on the other hand, would have a lower solute concentration and cause water to enter the cell, resulting in swelling rather than plasmolysis.

60. **Assertion:** During inspiration, the space in the chest cavity increases and the lungs expand

Reason: Diaphragm contracts and flattens.

Ans: (A)

Explanation: During inspiration, the diaphragm contracts and flattens, increasing the volume of the thoracic cavity and causing the lungs to expand, allowing air to enter.

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