

FIITJEE

INDIAN OLYMPIAD QUALIFIER IN JUNIOR SCIENCE (IOQJS)

PART – 1 (NSEJS)

Held on: March 06, 2022

ANSWER KEY

1. C	2. C	3. D	4. A
5. C	6. C	7. D	8. C
9. C	10. D	11. C	12. B
13. D	14. C	15. B	16. C
17. A	18. A	19. C	20. C
21. B	22. D	23. B	24. B
25. ABCD	26. ABC	27. ABD	28. ACD
29. ABC	30. AB	31. AD	32. BD
33. B			

HINTS & SOLUTIONS

1. C

$$1. \quad Z = A \left(\frac{R}{R+u} \right)^3$$

$$Z = A \left(\frac{1}{1 + \frac{u}{R}} \right)^3 = A \left(1 + \frac{u}{R} \right)^{-3}$$

as $\frac{u}{R} \ll 1$ using Binomial

$$Z = A \left(1 - \frac{3u}{R} \right)$$

$$Z = \frac{-3A}{R} u + A$$

$$y = mx + c$$

2. C

$$2. \quad P = \rho gh$$

$$P_1 = P_2$$

$$P(9.8) 200 = P(3.7) h$$

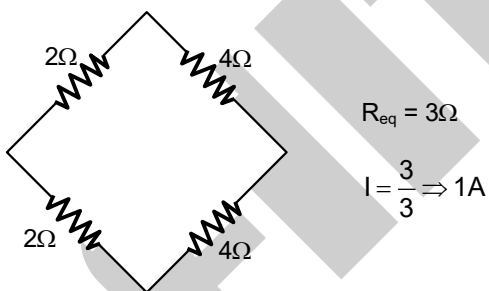
$$h = 530 \text{ m}$$

3. D

3. at extreme position, potential energy is maximum.

4. A

4. Wheatstone



5. C

5. Wheel A

16 teeth

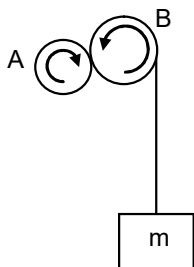
6 Revolution
per second

Wheel B

24 teeth

4 Revolution
per second

So in $\frac{1}{2}$ second wheel B completes 2 revolution in anticlockwise direction.

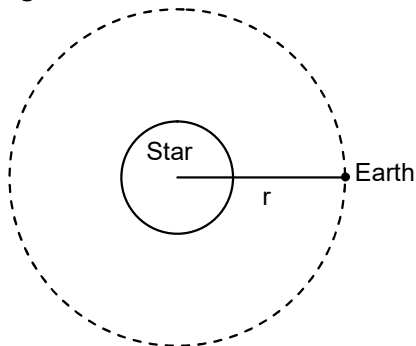


displacement of mass = $2(2\pi r)$

$$\Rightarrow 2 \times 2 \times \frac{22}{7} \times \frac{14}{11} \Rightarrow 16 \text{ cm}$$

increment in potential energy $\Rightarrow mg(16)$

6. C
6.



$$E = 5 \times 10^{-8} \times (4\pi r^2) \quad \dots(i)$$

$$E = mc^2 \quad \dots(ii)$$

From eq. (i) and (ii)
 $m = 5.62 \times 10^{13} \text{ kg}$

$$r = 300 \text{ light year}$$
$$r = [300 \times 9.46 \times 10^{15}] \text{ m}$$

7. D

7. Energy of 50 person = $50 \times 100 \frac{\text{J}}{\text{S}}$

$$E \times \left(\frac{50}{100}\right) = \frac{5000 \times 4\text{hr}}{1000}$$

$$E = 40 \text{ kwh}$$

$$E = 40 \text{ units}$$

8. C

8. Synthesis of immunoglobulins is not a function of mature RBCs.

9. C

9. Amphibians and Reptiles are group of limbless animals.

- Order Apoda of class Amphibia carry limbless Amphibians (e.g. Ichthyophis)
- Snakes are limbless reptiles belongs to Order Ophidia.

10. D

10. Housefly, fruitfly, mosquitoes have one pair of wings.

11. C

11. Single stranded RNA viruses tend to mutate more rapidly than double stranded viruses. RNA polymerase that copies the virus genes generally lacks proofreading skills which make RNA viruses prone to high mutation rates – upto million times greater than DNA.

12. B

12. Aerenchyma is present in leaves & petioles of hydrophytes

13. D

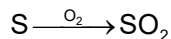
13. Bryophytes are not well differentiated into roots, stem & leaves so this statement is false.

14. C

14. Carbon fixation in succulents plants takes place through crassulacean acid metabolism.

15. B
 15. If a flower emit fruity or musky fragrance (very strong) after sunset then it will be pollinated by Bats. Bees or Butterflies pollinate plants where scent is high during the day while moths & bats pollinate plants whose fragrance is greatest at night.

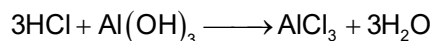
16. C
 16. Coal a fossil fuel contains 0.3 to 5% of S



$$1 \text{ mole } SO_2 = 6.022 \times 10^{23} \times 3 \text{ atoms}$$

$$= 1.8066 \times 10^{24} \text{ atoms}$$

17. A
 17. Stomach fluid has HCl, KCl, and NaCl.
 Each of 0.01 M and volume of fluid is 2L.
 Al(OH)₃ is the antacid used to neutralize stomach acid HCl.
 Moles of HCl present in 2 L of fluid = M × V
 = 0.01 × 2
 = 0.02 moles.

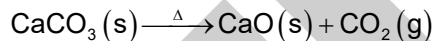


\downarrow \downarrow
 3 mole needs 1 mole
 1 mole needs $\frac{1}{3}$ mole

$$0.02 \text{ mole} \rightarrow \frac{1}{3} \times 0.02 \text{ mole} = \frac{0.02}{3} \times 78 \text{ g } Al(OH)_3$$

$$= 0.52 \text{ g}$$

18. A
 18. Mixture of CaCO₃ + CaO = 0.5 g
 $x \text{ g} + y \text{ g}$
 $\Rightarrow x + y = 0.5 \text{ g} \quad \dots(1)$



$$\frac{x}{100} \text{ mol} \longrightarrow \frac{x}{100} \text{ mol}$$

$$= \frac{x}{100} \times 56 \text{ g } CaO$$

$$= 0.56 x \text{ g } CaO$$

Given that

$$0.56 x + y = 0.434 \quad \dots(2)$$

Solving equation (1) and (2)

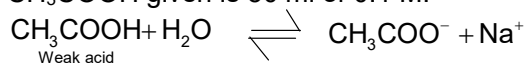
$$x = \frac{0.066}{0.44} = 0.15 \text{ g}$$

$$y = 0.5 - 0.15 = 0.35 \text{ g}$$

$$\Rightarrow \% \text{ of } y (CaO) = \frac{0.35}{0.5} \times 100 = 70\%$$

19. C
 19. Order of metallic character is
 O < C < Be < Li < Na

20. C
 20. CH₃COOH given is 50 ml of 0.1 M.

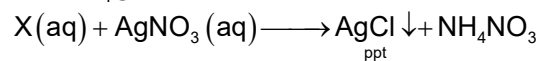


According to Ostwald's dilution law, degree of dissociation increases with increase in dilution. So, on dilution the number of ions will increase and the conduction.

21. B

21. Compound X + NaOH → Pungent gas which turns red litmus blue.

X is NH_4Cl



⇒ X is NH_4Cl

$\text{NH}_4\text{Cl}(\text{aq})$ is slightly acidic due to hydrolysis.

22. D

22. Equal volume of all gases contains equal number of molecules or moles under similar conditions of temperature and pressure.

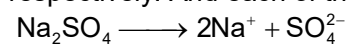
Given masses are equal

⇒ Moles will be equal if their molecular masses are also equal.

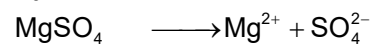
$$\Rightarrow \text{N}_2 = \frac{x\text{g}}{28\text{g mol}^{-1}}, \quad \text{CO} = \frac{x\text{g}}{28\text{g mol}^{-1}}$$

23. B

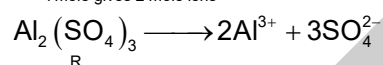
23. 10 millimoles of each Na_2SO_4 , MgSO_4 and $\text{Al}_2(\text{SO}_4)_3$ in three different containers P, Q and R respectively. And each of them are made as one litre solution.



(P)
1 mole gives 3 mole ions



(Q)
1 mole gives 2 mole ions

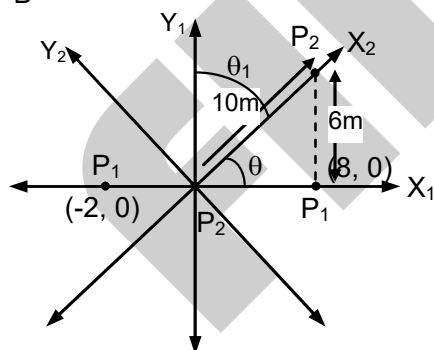


(R)
1 mole gives 5 mole ions.

The order of osmotic pressure is $R > P > Q$ or $Q < P < R$.

24. B

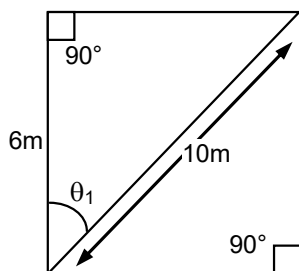
24.



displacement if $P_1 \Rightarrow 10\text{ m}$

displacement if $P_2 \Rightarrow 10\text{ m}$

8m



$$\tan \theta_1 = \frac{8}{6}$$

$$\tan \theta_1 = \frac{4}{3}$$

$$\theta_1 = 53.2^\circ$$

25. ABCD

$$\text{frequency } \nu = \frac{c}{\lambda} = \frac{3 \times 10^8}{650 \times 10^{-9}}$$

$$\Rightarrow 4.6 \times 10^{14} \text{ Hz}$$

$$\text{Energy of each photon } \Rightarrow E = h\nu$$

$$= 6.625 \times 10^{-34} \times 4.6 \times 10^{14}$$

$$= 3.4 \times 10^{-19} \text{ J}$$

If n is number of photon in each pulse then

Total energy of pulse $\Rightarrow nE$

$$\text{Power } \Rightarrow P = \frac{nE}{t}$$

$$0.6 = \frac{n \times 3.1 \times 10^{-19}}{30 \times 10^{-3}}$$

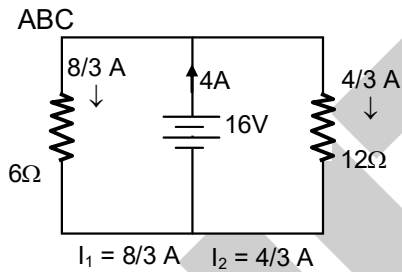
$$n = 5.9 \times 10^{16}$$

$$\text{Total energy of one pulse} = nE$$

$$\Rightarrow 5.9 \times 10^{16} \times 3.1 \times 10^{-19}$$

$$\Rightarrow 1.1 \times 10^{17} \text{ eV}$$

26.
26.



$$1. \text{ Power in } R_1 = \left(\frac{8}{3}\right)^2 \times 6 \Rightarrow 42.6 \text{ W}$$

$$2. \frac{I_1}{I_2} = 2$$

3. Total current $\Rightarrow 4 \text{ A}$

4. 6Ω & 12Ω both are in parallel combination

27. ABD

$$1. \text{ lateral shift } = \frac{t(\sin(i-r))}{\cos r}$$

$$\therefore \sin(A-B) = \sin A \cos B - \cos A \sin B$$

$$x = \frac{t(\sin i \cos r - \cos i \sin r)}{\cos r}$$

$$x = t \left(\sin i - \frac{\cos i \sin r}{\cos r} \right)$$

2. For maximum value of x , $i = 90^\circ$

$$x = \frac{t(\sin(90 - r))}{\cos r}$$

$$x = t \frac{\cos r}{\cos r}$$

$$x = t$$

3. The angle of refraction and angle of incidence are related with refractive index in accordance with Snell's law, Hence lateral shift also depends on the refractive index

4. Refractive index increases with decrease in wavelength, so lateral displacement also depends on the wavelength.

28. ACD

28. Option B is correct.

29. ABC

29. If front part of brain is affected then it will impair speaking ability, smell, and walking on narrow path.

30. AB

30. The molecules which are primarily responsible for structure support and mortality are actin and tubulin alpha.

31. AD

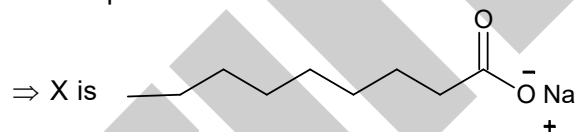
31. Types of bonding in dry ice which is solid CO_2 are covalent and vander waals forces.

32. BD

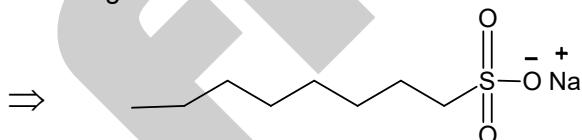
32. Temperature of water increases on dissolving the compound. That means it is exothermic process. So they are KOH and HCl.

33. B

33. X is soap solution of 1% w/v



Y is detergent solution of 1% w/v



X splits into two equal parts X_1 and X_2

Y splits into two equal parts Y_1 and Y_2

$X_1 + \text{NaCl (g)} \rightarrow$ No effect

$Y_1 + \text{NaCl (g)} \rightarrow$ No effect.

$X_2 + \text{CaCl}_2 \text{ (g)} \rightarrow$ Precipitation or formation of scum .

(Soap) (Hareness causing salt)

Y_2 is detergent so does not form ppt with CaCl_2