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Aakash National Talent Hunt Exam 2021

(*Class XI Studying Moving to Class XII*)

Answers

1. (1)
2. (3)
3. (3)
4. (4)
5. (3)
6. (1, 2, 3)
7. (3, 4)
8. (4)
9. (2)
10. (3)
11. A – P, S
    B – P, Q
    C – Q, R
    D – Q
12. (4)

13. (4)
14. (4)
15. (2)
16. (4)
17. (2, 3, 4)
18. (1, 2, 3, 4)
19. (1)
20. (2)
21. (1)
22. A – P, Q
    B – P, R
    C – P, Q, R
    D – P, R, S
23. (2)
24. (1)

25. (4)
26. (4)
27. (4)
28. (4)
29. (2, 3)
30. (1, 2, 4)
31. (1, 2, 3, 4)
32. (3)
33. (2)
34. (2)
35. A – P, R, S
    B – P, S
    C – P, R, S
    D – Q, S

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ANSWERS & SOLUTIONS

PHYSICS

1. **Answer (1)**

$a = 2 - 3v$

$$\frac{dv}{dt} = 2 - 3v \Rightarrow \int_0^v \frac{dv}{(2-3v)} = \int_0^t dt$$

$$\Rightarrow -\frac{1}{3}\ln\left(\frac{2-3v}{2}\right) = t$$

$$\frac{2-3v}{2} = e^{-3t}$$

$$\frac{2(1-e^{-3t})}{3} = v$$

As $t \to \infty$, $v \to \frac{2}{3}$

2. **Answer (3)**

$$a = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)g$$

$$= \left(\frac{10-5}{10+5}\right) \times 10 = \frac{10}{3} = 3.33 \text{ m/s}^2$$

3. **Answer (3)**

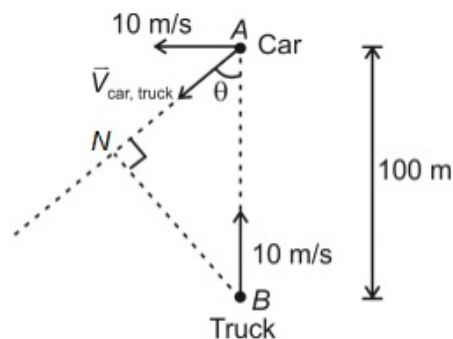$$V_{\text{car, truck}} = \sqrt{10^2 + 10^2} = 10\sqrt{2} \text{ m/s}$$

$$\tan\theta = \frac{10}{10}$$

$\theta = 45°$

$AN = 100\cos45° = 50\sqrt{2}$ m

$$t = \frac{AN}{V_{\text{car, truck}}} = \frac{50\sqrt{2}}{10\sqrt{2}}$$
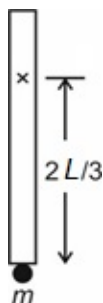
= 5 s

4.   **Answer (4)**

Immediately after the string is cut, the spring force remains unchanged and thus the block *B* remains instantaneously in equilibrium.

5.   **Answer (3)**

$$V_{min} = \sqrt{4gR}$$

$$R = \frac{2L}{3}$$

$$\Rightarrow \quad V_{min} = \sqrt{4g\left(\frac{2L}{3}\right)}$$

$$= \sqrt{8gL/3}$$

6.   **Answer (1, 2, 3)**

Work done by friction may be negative, positive or zero, depending upon frame of reference.

7.   **Answer (3, 4)**

[Torque] = [Elastic potential energy] = $[M\,L^2\,T^{-2}]$

[Angular speed] = [Frequency] = $[M^0\,L^0\,T^{-1}]$

8.   **Answer (4)**

The radial accelerations for both parts will be equal to *g*, as the velocity of both parts after explosion will be horizontal. Radial acceleration is the acceleration perpendicular to the velocity.
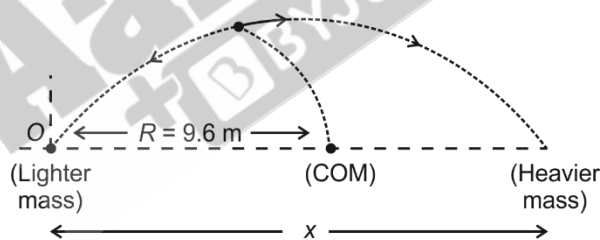
9.   **Answer (2)**

COM strikes the ground at initial range

$$R = \frac{v^2 \sin(2\theta)}{g}$$

$$= \frac{2 \times 100}{10} \times \frac{3}{5} \times \frac{4}{5}$$

$$= 9.6 \text{ m}$$

$$9.6 = \frac{6(x)}{6+2} \Rightarrow x = 12.8 \text{ m}$$

10. **Answer (3)**

A is true. Kinetic friction does not exceed limiting friction but can be more than static friction.

R is false. In non-uniform circular motion the change in velocity in a time period is not zero.

11. **Answer A(P, S); B(P, Q); C(Q, R); D(Q)**

$$R = \frac{u^2 \sin^2 \theta}{g} \text{ and } H = \frac{u^2 \sin^2 \theta}{2g}$$

A. $R = \dfrac{4^2 \sin(2 \times 30°)}{g} = \dfrac{4\sqrt{3}}{5} \text{ m and } H = \dfrac{4^2 \sin^2 30°}{2g} = \dfrac{1}{5} \text{ m}$

B. $R = \dfrac{4^2 \sin(2 \times 60°)}{g} = \dfrac{4\sqrt{3}}{5} \text{ m and } H = \dfrac{4^2 \sin^2 60°}{2g} = \dfrac{3}{5} \text{ m}$
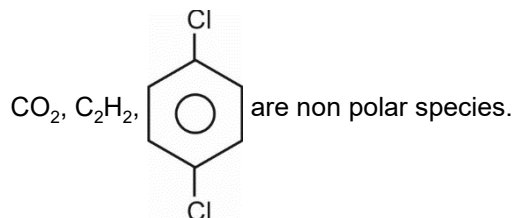
C. $R = \dfrac{\left(4\sqrt{3}\right)^2 \sin(2 \times 30°)}{g} = \dfrac{12\sqrt{3}}{5}$ m and $H = \dfrac{\left(4\sqrt{3}\right)^2 \sin(2 \times 30°)}{2g} = \dfrac{3}{5}$ m

D. $R = \dfrac{\left(2\sqrt{6}\right)^2 \sin(2 \times 45°)}{g} = \dfrac{12}{5}$ m and $H = \dfrac{\left(2\sqrt{6}\right)^2 \sin^2 45°}{2g} = \dfrac{3}{5}$ m

Hence body accelerates forward and friction acts backwards.

CHEMISTRY

12. Answer (4)

CO_2, C_2H_2,

 are non polar species.

13. Answer (4)

Energy required to convert 27 g of Al to Al^{3+} = 5.99 + 18.8 + 28.44 = 53.23 eV

Energy required to convert 27 mg of Al to Al^{3+} = $\dfrac{53.23}{1000} = 0.0532$ eV

14. Answer (4)

Mass of NaCl in 50 g salt = $50 \times \dfrac{95}{100} = 47.5$ g

Number of NaCl formula units = $\dfrac{47.5}{58.5} \times 6.022 \times 10^{23} = 4.9 \times 10^{23}$

15. Answer (2)

$E_n = -13.6 \dfrac{Z^2}{n^2}$ eV

16. Answer (4)

∵ Unit of P = unit of $\dfrac{an^2}{v^2}$

∴ unit of a = atm L^2 mol^{-2}

Also, unit of v = unit of nb

∴ unit of b = L mol^{-1}

17. Answer (2, 3, 4)

NH_4^+ is acidic.

18. Answer (1, 2, 3, 4)

Boyle's law states that for a fixed amount of gas at constant temperature, the volume of gas is inversely proportional to the pressure of the gas.

19. Answer (1)

For MO_2

$\dfrac{M + 32}{32} = \dfrac{100}{36.78}$

$\Rightarrow$　M = 55 g

$$O\ 50.45 \left|\ \frac{50.45}{16} = 3.153\ \right|\ \frac{3.15}{0.9} = 3.5\ \right|\ 7$$

$$M\ 49.55 \left|\ \frac{49.55}{55} = 0.9\ \right|\ \frac{0.9}{0.9} = 1\ \right|\ 2$$

formula of oxide M_2O_7

20. Answer (2)

	Molecular formula	Empirical formula
Glucose	($C_6H_{12}O_6$)	CH_2O
Sucrose	($C_{12}H_{12}O_{11}$)	$C_{12}H_{22}O_{11}$
Fructose	($C_6H_{12}O_6$)	CH_2O
Formaldehyde	(HCHO)	CH_2O
Acetic acid	(CH_3COOH)	CH_2O

21. Answer (1)

For 2p orbital,

n = 2

l = 1

$\therefore$　number of spherical nodes = 2 – 1 – 1 = 0

22. Answer A(P, Q); B(P, R); C(P, Q, R); D(P, R, S)

- For enthalpy of formation, compound is formed from its elements in their most stable states of aggregation.
- If the number of gaseous reactants not equal to gaseous products, then $\Delta S \neq 0$.
- Combustion of N_2 is an endothermic process.

BIOLOGY

23. Answer (2)

Organelles which are not included in endomembrane system are mitochondria, chloroplast and peroxisomes. ATP are produced in mitochondria. Trapping of light energy and CO_2 assimilation occur in chloroplast. Steroidal hormones are synthesised　by SER. Glycolipids are formed in Golgi complex. Lysosomes are involved in digestion of nucleic acid.

24. Answer (1)

During mitosis, nuclear membrane disappears at the end of prophase. After prophase there are three stages of karyokinesis of mitosis, that are metaphase, anaphase and telophase.

25. Answer (4)

All organisms from the prokaryotes to eukaryotes can sense various changes upto variable degrees in their surroundings.

26. Answer (4)

Microvilli are cytoplasmic extensions of the epithelial cells that increase absorptive surface area. Pseudostratified epithelium is made of columnar cells and could be simple pseudostratified columnar or ciliated pseudostratified columnar.

27. Answer (4)

The ducts of glands and tubular parts of nephron are lined by cuboidal epithelium.

28. Answer (4)

Nearly, all of the essential nutrients, and 70-80% of electrolytes and water are reabsorbed by this segment. PCT also helps to maintain the pH and ionic balance of the body fluids by selective secretion of hydrogen ions, ammonia and potassium ions into the filtrate and by absorption of HCO_3^- from it.

29. Answer (2, 3)

Mycelia in phycomycetes are coenocytic and members of deuteromycetes lack sexual reproduction. So, they do not show dikaryophase in their life cycle.

30. Answer (1, 2, 4)

Following are the conditions responsible for dissociation of oxygen from Hb (This dissociation occurs in tissues):

- Low pO_2
- High pCO_2
- High H^+ ion concentration
- Decrease in pH
- High temperature

Unloading of oxygen is favoured by increase in body temperature.

31. Answer (1, 2, 3, 4)

Width of double helix is 2 nm (20 Å).

The base ratio A+T/G+C is constant for all individuals of a given species.

10 bases stacked on each other along a single strand of DNA cover a distance of 34 Å.

Regions rich with Guanine-Cytosine require higher temperature for melting than regions rich in Adenine-Thymine since each G–C pair forms three hydrogen bonds between anti parallel strands whereas each A–T pair forms just two.

32. Answer (3)

The plants given in the paragraph belong to three different families Brassicaceae, Solanaceae and Liliaceae. Plants belong to these families have superior ovary.

33. Answer (2)

The plants of tomato, chilli, brinjal and potato belong to the family Solanaceae. The gynoecium of the members of this family has swollen placenta. Tricarpellary syncarpous gynoecium is found in *Asparagus* amongst the given plants.

Asparagus belongs to the family Liliaceae and has floral formula $\oplus \, \phi \, \overbrace{P_{(3+3)}} A_{3+3} \, \underline{G}_{(3)}$. Valvate aestivation of calyx is found in tomato, chilli, brinjal and potato.

34. Answer (2)

There are two hydrogen bonds between adenine and thymine (A=T) and three hydrogen bonds between cytosine and guanine $(C \equiv G)$.

35. Answer A(P, R, S); B(P, S); C(P, R, S); D(Q, S)

TMV causes mosaic disease in tobacco plants. RNA is the genetic material in this virus. Viruses lack cell wall. *Mycoplasma* are pathogenic in animals and plants. They lack cell wall. Viroids are infectious RNA particles. *Euglena* performs photosynthesis and lack cell wall.

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