(SOLUTION)

Physics

1. Soln.:

Net force F = $\sqrt{6^2+8^2}$ = 10 N. Acceleration a = F/m = 10/2 = 5 m/s^2
Angle $\theta = \tan^{-1}(8/6) \approx 53^o$
Ans. (2)

1. Soln.:

Mass m = 600/10 = 60 kg. Normal reaction N = m(g + a) = 60 (10 +2) = 720 N
Ans. (2)

3. Soln.:

$F_{max} = \mu mg = 0.2 \times 5 \times 10 = 10$ N
Ans . (2)

4. Soln.:

$$a = \frac{(m_2 - m_1)g}{m_1 + m_2} = \frac{(6-4)\times 10}{10} = 2 m/s^2$$

Ans. (2)

1. Soln.:

$\vec{p}_i = 10m\hat{i}$, $\vec{p}_f = 10m\hat{j}$. $\Delta\vec{p} = \vec{p}_f - \vec{p}_i = -10m\hat{i} + 10m\hat{j}$. $\left|\Delta\vec{p}\right| = 10m\sqrt{2}$

6. Soln.:

W = Fs = 30 × 4 = 120 J

7. Soln.:

KE = mgh = 2 × 10 × 5 = 100 J
Ans. (3)

8. Soln.:

E = Pt = 60 × 3600 = 216000 J.

9. Soln.:

W = mgh = 20 × 10 × 5 = 1000 J.
Ans. (4)

10. Soln.:

$$K = \frac{1}{2}mv^2 \Rightarrow K' = \frac{1}{2}m(2v)^2 = 4K$$

Ans. (3)

11. Soln.:

PE lost = mg(h-h/2) = mg(h/2) = $\frac{1}{2}$ mgh

Ans (2)

12. Soln.:
Plane mirror gives virtual, erect image of same size.
Ans. (3)

13. Soln.:
At 2f, concave mirror gives real , inverted, same size image

14. Soln.:
$$v = \frac{c}{n} = \frac{3\times10^8}{1.33} \approx 2.25\times10^8 \text{ m/s}$$
Ans. (2)

15. Soln.:
At normal incidence, light passes undeviated
Ans (3)

Chemistry

16. Answer:
∴ 'Be' and 'N' have comparatively more stable valence sub shell than 'B' and 'O'
Correct order of first ionisaiton enthalpy is:
Li < B < Be < C < O < N < F < Ne

17. Answer:
Atomic radius decrease on moving from left to right in a period. So order of sizes for Cl, P and Mg is Cl < P < Mg. Down the group size increases. So overall order is: Cl < P < Mg < Ca

18. Answer:
Cl atom has the highest electron affinity in the periodic table. F is a member of group 17 has highest electron gain enthalpy than S which is a group 16 element. This is turn higher than the electron affinity of O atom. Thus Cl > F > S > O

19. Answer:
For isoelectronic species, ionic radius increase when there is increase in negative charge. It happens because effective nuclear charge on the atom (Z_{eff}) decreases.
Same when ionic radius decrease with increase in positive charge as Z_{eff} increases.

20. Answer:
Bond energy generally decreases on moving from top to bottom along a group. It happens due to fact that size increase on moving down the group and thus, the two nuclei are far apart and less capable of holding the two atom together.
But in case of F_2 molecule due to more repulsion in between non bonding electron pair (2p) of two fluorine (due to small size of F atom) in comparison to non bonding electron pair (3p) in chlorine, the bond energy of F_2 is less than Cl_2
BE (F_2) = 158.2 kJ/mole and BE(Cl_2) = 242.6 kJ/ mole

21. Answer:
In this reaction, copper is losing oxygen and hydrogen is gaining oxygen. If a substance gain oxygen during a reaction it is said to be oxidized. if a reaction, it is said to be reduced. So in this reaction, hydrogen is getting oxidized while hydrogen is getting is reduced.

22. Answer:
A balance chemical equation states the physical state of reactants and products. Symbols of elements and formula of compounds and numbers of atom/molecules formed in the reaction but does not tell about the feasibility of the reaction.
Hence option D is correct.

23. Answer:
$CaO(S) + H_2O(l) \rightarrow Ca(OH)_2$ (aq)
A combination reaction is a reaction where two or more elements or compounds combine to form a single compound. Calcium oxide combines with water to form calcium hydroxide. Hence, it is combination reaction.
It is an exothermic reaction as a lot of heat liberate with a hissing sound during the reaction.
Hence option (4) is correct

24. Answer:
The term used to indicate the development of unpleasant smell and taste in fat and oil containing foods due to aerial oxidation is rancidity.
The process of oxidizing fatty and oily substances is called rancidity

25. Answer:
Reaction
$2kBr + BaI_2 \rightarrow 2\ KI + BaBr_2$
It is a double displacement reaction, also known as a double replacement reaction (is a type of chemical reaction where two compounds react, and the positive ions (cation) and the negative ions (anion) of the two reactants switch places, forming two new compounds or products.)

26. Answer:
$FeSO_4 + x \rightarrow Na_2SO_4 + Fe(OH)_2$
From the above reaction x is NaOH so correct option is 3.

27. Answer:
In reaction, two simple substances combine to form a more complex substance. Thus it is a combination reaction.

28. Answer:
Statement I : Correct
The radii of isoelectronic species increases in the order $Mg^{2+} < Na^{+} < F^{-} < O^{2-}$
(number of electrons = 10)
In general, radius of cation is smaller than anion A^{+}, A^{-} cation with positive charge have higher effective nuclear charge.

29. Answer:
Explanation
To match each element with its correct electronic configuration, let's consider the electronic configurations of each element based on their positions in the periodic table:

Nitrogen (N): It is in the 2nd period and belongs to the p-block, specifically group 15. The electronic configuration of nitrogen is $1s^2\ 2s^2\ 2p^3$ Looking at the options in List II, this matches with the electronic configuration labeled III ($[He]2s^2 2p^3$) which reflects the electronic configuration of nitrogen starting after the helium core.

Sulfur (S): Sulfur is in the 3rd period, also in the p- block, specifically group 16. Its electronic configuration is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$. In the given list, this corresponds to 'II' ($[Ne]3s^2 3p^4$), which captures the configuration of sulfur starting after the neon core.

Bromine (Br): Bromine is located in the 4th period and in the p-block, belonging to group 17. Its electronic configuration is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4p^5$, which is correctly represented by 'I' ([Ar] $3d^{10}\ 4s^2\ 4p^5$), showing the configuration after the argon core.

Krypton (Kr): Krypton falls in the 4th period and is a noble gas situated in the p-block at group 18. Its electronic configuration is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6\ 4s^2\ 4p^6$, which aligns with 'IV ([Ar] $3d^{10}\ 4s^2\ 4p^6$), clearly depicting krypton's electronic configuration post-argon.

Therefore, the correct match is:

A-III (Nitrogen matches with [He] $2s^2p^3$)

B-II (Sulfur matches with [Ne] $3s^2\ 3p^4$)

C-I (Bromine matches with [Ar] $3d^{10}\ 4s^2\ 4p^5$)

D-IV (Krypton matches with [Ar] $3d^{10}\ 4s^2\ 4p^6$)

Thus, the correct answer is Option (3): A- III, B-II, C-I, D-IV.

30. Answer:
(1) is correct:
All four species have 10 electrons, making them isoelectronic.

(2) is incorrect:

While they are isoelectronic, they do not have the same nuclear charge. O^{2-} has 8 protons, F^- has 9, Na^+ has 11, and Mg^{2+} has 12.

(3) is correct:

O^{2-} has the largest ionic radius because it has the lowest effective nuclear charge for the same number of electrons.

(4) is correct:
Mg^{2+} has the smallest ionic radius due to its highest effective nuclear charge.

Biology

31. Sol:
When food materials are broken down outside the body and absorbed, its called saprophytic nutrition. Green plants are autotrophs. Cuscuta, lice and tapeworms are parasites.

32. Sol:
Lactic acid is formed in skeletal muscle. Pyruvate is formed in glycolysis during aerobic respiration.

33. Sol:
Autotrophs are capable of converting carbon dioxide and water into carbohydrates, utilizing solar energy.

34. Sol:
Most common test for detection of starch is iodine test as iodine is trapped in the helical structure of starch and gives blue black colour.

35. Sol:
Stomach inner lining is coated with mucus to protect it from acid attack.Salivary amylase, pepsin are enzymes. Bile is secreted by liver.

36. Sol: (3)

37. Sol:
Process of selecting individuals with desired characters by man is called artificial selection or breeding.

38. Sol:
Mendel-father of genetics, Lamarck-theory of use and disuse of organs, Weismann-theory of germplasm

39. Sol:
Fathers sperm is either X or Y carrying whereas egg is always X carrying. So mothers X and fathers X carrying zygote(XX) will develop into a girl.

40. Sol:
Pollen grains, produced in the anthers of flowering plants, carry the male gametes required for fertilization. They transfer genetic material to the ovules in the ovary.

41. Sol:
Spirogyra-multicellular. Bacteria cannot reproduce sexually.

42. Sol: (4)

43. Sol: (3)

44. Sol:
Pacemaker – S A Node. Blood cancer – Leukemia. Osteoporosis – Brittle bones. Joint pain –arthritis. Platelets- blood clotting

45. Sol:
Lymph nodes destroy pathogens as they store lymphocytes (WBCs).

46. Sol:
Contraceptives prevent pregnancy.

47. Sol:
In mammals, veins differs from arteries in having semilunar valves to prevent backflow of blood.

48. Sol:
Colour of skin, Colour of eyes and Texture of hair, all these characters are due to genes and hence inherited.

49. Sol:
A reflex arc is a simple, direct neural pathway that facilitates an immediate and automatic response to a stimulus, such as withdrawing a hand from a hot surface.

50. Sol: (1)