11th PCB PAPER Hints and solutions (22.07.2019)

Physics

: HINTS AND SOLUTIONS :

1 (b)

Time constant $= \frac{L}{R}$

$\therefore \quad \left[\frac{L}{R}\right] = [\mathrm{T}]$

$\therefore \quad \left[\frac{R}{L}\right] = [\mathrm{T}^{-1}]$

3 (a)

Energy density $= \frac{Energy}{Volume} = \frac{ML^2T^{-2}}{L^3} = [ML^{-1}T^{-2}]$

Young' s modulus $= \frac{Stress}{Strain} = \frac{ML^{-1}T^{-2}}{M^0L^0T^0} = [ML^{-1}T^{-2}]$

Both have the same dimensions

4 (d)

Coefficient of viscosity $= \frac{F \times r}{A \times v} = \frac{[\mathrm{MLT}^{-2}] \times [\mathrm{L}]}{[\mathrm{L}^2] \times [\mathrm{LT}^{-1}]}$

$= [\mathrm{ML}^{-1}\mathrm{T}^{-1}]$

5 (d)

Charge = Current × Time $= [AT]$

6 (b)

Positions $x = ka^m t^n$

$$[\mathrm{M}^0\mathrm{LT}^0] = [\mathrm{LT}^{-2}]^m[\mathrm{T}]^n$$

$$= [\mathrm{M}^0\mathrm{L}^m\mathrm{T}^{-2m+n}]$$

On comparing both sides

$$m = 1$$

$$-2m + n = 0$$

$$n = 2m$$

$$n = 2 \times 1 = 2$$

7 (d)

From the expression $= \frac{\text{Power}}{\text{Area}}$ $\left(\because \frac{\text{Energy}}{\text{time}} = \text{power}\right)$

$\frac{\mathrm{W}}{\mathrm{m}^2} = \mathrm{Wm}^{-2}$

$\frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi r}$

Or $[\mu_0] = \frac{[F]}{[I_1 I_2]} = \frac{[\mathrm{MLT}^{-2}]}{[\mathrm{A}^2]} = [\mathrm{MLT}^{-2}\mathrm{A}^{-2}]$.

8 (a)

$\frac{[\text{Energy}]}{[\text{Volume}]} = \frac{[\mathrm{ML}^2\mathrm{T}^{-2}]}{[\mathrm{L}^3]} = [\mathrm{ML}^{-1}\mathrm{T}^{-2}]$

$[\text{pressure}] = \frac{[\mathrm{MLT}^{-2}]}{[\mathrm{L}^2]} = [\mathrm{ML}^{-1}\mathrm{T}^{-2}]$

9 (b)

$RC = T$

$\because [R] = ML^2T^{-3}A^{-2}]$ and $[C] = [M^{-1}L^{-2}T^4A^2]$

10 (a)

$[\mathrm{B}] = \left[\frac{\text{force} \times \text{length}}{\text{mass}}\right] = \left[\frac{\text{energy}}{\text{mass}}\right] = [\text{latent heat}]$

12 (b)

Subtract 3.87 from 4.23 and then divide by 2.

13 (c)

$P_1 = [ML^2T^{-1}]$

$D_2 = [(2M)(2L)^2(2T)^{-1}]$

$P_2 = 4[ML^2T^{-1}] = 4P_1$

14 (a)

Electric potential $V = \frac{W}{q} = \frac{\text{joule}}{\text{coulomb}} = \frac{\text{newton} \times \text{metre}}{\text{coulomb}}$

$$= \frac{(\mathrm{kg} - \mathrm{ms}^{-2}) \times \mathrm{m}}{\text{coulomb}}$$

$$= \mathrm{kg} - \mathrm{ms}^{-2} \times \mathrm{m} \times \text{coulomb}^{-1}$$

$\therefore \quad = [\mathrm{ML}^2\mathrm{T}^{-2}\mathrm{Q}^{-1}]$

15 (c)

Maximum percentage error in $P = 4\% + 2 \times 2\%$

$= 8\%$

16. Conceptual understanding

17. Conceptual understanding

18. Conceptual understanding

19. Conceptual understanding

20. Conceptual understanding

21. Conceptual understanding

22. Conceptual understanding

23. Conceptual understanding

24. Conceptual understanding

25. Conceptual understanding

Chemistry

1 (a)

Given, velocity of particle A=0.05 ms^{-1}

Velocity of particle B=0.02 ms^{-1}

Let the mass of particle $A = x$

$\therefore$ The mass of particle $B = 5x$

de-Broglie's equation is

$$\lambda = \frac{h}{mv}$$

For particle A

$$\lambda_A = \frac{h}{x \times 0.05} \quad \text{... (i)}$$

For particle B

$$\lambda_B = \frac{h}{5x \times 0.02} \quad \text{... (ii)}$$

Eq. (i)/(ii)

$$\frac{\lambda_A}{\lambda_B} = \frac{5x \times 0.02}{x \times 0.05}$$

$$\frac{\lambda_A}{\lambda_B} = \frac{2}{1}$$

or 2: 1

2 (a)

Number of radial nodes $= (n - l - 1)$

For $3s, n = 3, l = 0$(number of radial node=2)

For $2p, n = 2, l = 1$(number of radial node=0)

3 (c)

$$\Delta x \times \Delta p \geq \frac{h}{4\pi}$$

where, Δx =uncertainty in position.

Δp=uncertainty in momentum.

$= 1.0 \times 10^{-5}$kg ms^{-1}

$$\therefore \ \Delta x \times 1.0 \times 10^{-5} \geq \frac{6.62 \times 10^{-34}}{4 \times 3.14}$$

$$\Delta x \geq \frac{6.62 \times 10^{-34}}{4 \times 3.14 \times 1.0 \times 10^{-5}}$$

$\geq 5.27 \times 10^{-30}$m

4 (a)

It is impossible to determine simultaneously the exact position and momentum of moving particle like electron, proton, neutron.

$$\Delta x \times \Delta p \geq \frac{h}{4\pi}$$

where, Δx=uncertainty in position.

Δp=uncertainty in momentum.

5 (d)

K$(Z = 19)$: $1s^2, 2s^2 2p^6, 3s^2 3p^6, 4s^1$

In the ground state the value of l can be either zero or one.

Hence, the set (d) of quantum numbers $i.e.$, $(n = 3, l = 2, m = +2)$cannot possible in the ground state.

6 (c)

For chlorine atom,

electronic configuration

$= 1s^2, 2s^2, 2p^6, 3s^2, 3p^5$

For $3p^5$,

$n = 3, l = 1, m = -1, 0, +1$

7 (b)
The maximum number of electron in any orbital is 2.

8 (d)
The values of quantum number will give idea about the last subshell of element. From that value we can find the atomic number of element,
$n = 3$ means 3rd-shell
$l = 0$
$m = 0$ } means subshell
It means it is $3s$-subshell which can have 1 or 2 electrons.
∴ Configuration of element is
$1s^2, 2s^2, 2p^6, 3s^{1-2}$
∴ Atomic $i.e.$, number is 11 or 12.

9 (c)
$n = 4$, means electron is in 4th shell and $l = 2$, means subshell is d. Therefore, the orbital is in $4d$-subshell.

10 (a)
Four quantum numbers are
$n = 4, l = 0, m = 0, s = +\frac{1}{2}$
$n = 4$ indicates that the valence electron is present in 4th shell (4th period), $l = 0$ indicates that the valence electron is present in s-subshell. $m = 0$ indicates that the valence electron is present in orbital of s-subshell. $s = +\frac{1}{2}$ indicates that the spining of electron in orbital is clockwise. So, from the above discussion it is clear that valence electron is present in $4s$ subshell as $4s^1$. s^1 indicates that the element is present in IA group. So, the element present in 4th period and IA group is potassium (K).

11 (b)
Total number of orbitals for principal quantum number n is equal to n^2 .

12 (a)
The number of orbitals in an orbit (or shell) $= n^2$
where, n =no. of orbit or shell
Given, $n = 4$
∴ No. of orbitals in the 4th shell $=(4)^2$
$= 16$

13 (c)
1. $n = 4, l = 0, m = 0, s = +\frac{1}{2}$
→ $4s$ energy level.

2. $n = 3, l = 1, m = -1, s = +\frac{1}{2}$
→ $3p$ energy level.

3. $n = 3, l = 2, m = -2, s = +\frac{1}{2}$
→ $3d$ energy level.

4. $n = 3, l = 0, m = 0, s = +\frac{1}{2}$
→ $3s$ energy level.

According to aufbau principle, the energy of orbitals (other than H-atom) depend upon $n + 1$ value.
$n + l$ for $3d = 3 + 2 = 5$
So, it is highest energy level (in the given options).

14 (b)
Given, azimuthal quantum number (l)=2
Number of orbital's =$(2l+1)$
$= (2 \times 2 + 1) = 4 + 1 = 5$

15 (c)
$n = 4$(4th shell)
$l = 2$(d-subshell)
$m_1 = -2$(d_{xy} orbital)
$s = +\frac{1}{2}(\uparrow)$
Hence, electron belongs to 4d-orbital.

16 (b)
5. $n = 2, l = 1, m = 0$ it is possible

6. $n = 2, l = 0, m = -1$ it is not possible because if $l - 0, m$ must be 0. The value of m totally depends upon the value of $l(m = -l$ to $+ l)$.

7. $n = 3, l = 0, m = -0$ it is possible.

8. $n = 3, l = 1, m = -1$ it is possible.

17 (d)
The number of electrons $=2n^2$
where, n =principal quantum number.
For $n = 2$
Number of electrons $= 2(2)^2 = 8$

18 (a)
Orbital angular momentum
$(\mathrm{L}) = \sqrt{l(l+1)}\frac{h}{2\pi}$
For d-orbital, $l = 2$
$(\mathrm{L}) = \sqrt{2(2+1)}\frac{h}{2\pi}$
$= \frac{\sqrt{6}h}{2\pi}$

19 (c)
Electronic configuration of Mn(25) is
$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$
∴ Electronic configuration of Mn^{2+} is
$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5$

$\because \text{Mn}^{2+} = [\text{Ar}]3d^5, 4s^0$

$3d^5$ $4s^0$

= [Ar] ↑ ↑ ↑ ↑ ↑ | □

20 (c)

Aufbau principle states that in the ground state of an atom, the orbital with lower energy is filled up first before the filling of the orbitals with a higher energy commences.

Increasing order of energy of various orbitals is $1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, \ldots$ etc.

Therefore,

1		1↓	1	1

Is not obeyed by aufbau principle. Without fully filling of s-subshell electrons cannot enter in p-subshell in ground state of atom.

21 (b)

Cr (24): $[\text{Ar}]3d^5 4s^1$

Cr^{3+}: $[\text{Ar}]3d^3 4s^0$

22 (a)

Electronic configuration of

${}_{28}\text{Ni} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^8, 4s^2$

$\text{Ni}^{2+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^8, 4s^0$

${}_{29}\text{Cu} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^1$

$\text{Cu}^{+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^0$

So, the given configuration is of Cu^{+}.

23 (d)

Subshell having lower value of $(n + l)$ will be of lower energy, where n is the principle and l is the azimuthal quantum number. Thus,

Correct energy value order is

$ns, (n-1)d, np, (n-1)f$.

24 (c)

The atomic number of neon is 10.

G. S. Ne[10]: $1s^2, 2s^2, 2p^6$

E. S. Ne [10]: $1s^2, 2s^2, 2p^5, 3s^1$

Hence, $1s^2, 2s^2, 2p^5, 3s^1$ electronic configuration indicates the excited state of neon.

25 (a)

The ground state configuration of chromium is

${}_{24}\text{Cr} = [\text{Ar}]3d^5 4s^1$

$\therefore \quad {}_{24}\text{cr}^{2+} = [\text{Ar}]3d^4 4s^0$

1 (c)
A species is a group of organisms, which are closely related and sharing a common gene pool. **John Ray** (1627-1705) introduced the term 'species' for any shole kind of living thing.

2 (b)
"SystemaNaturae" was written by **Carolus Linnaeus.**

3 (d)
The term 'Systematic Botany' refers to the methodical study of plants, dealing with identification, naming and classification.

4 (d)
The categories in taxonomic hierarchy are Kingdom → Division/Phylum → Class → Order → Family → Genus → Species.

Hierarchy of categories is also called as Linnaean hierarchy.

5 (b)
Taxon is used to represent any rank in taxonomic hierarchy.

6 (a)
The system by which various taxonomic categories are arranged in a proper descending order is called taxonomic or systematic hierarchy. The correct sequence of categories in systematic hierarchy is-

Kingdom, sub-kingdom, division or phylum, class, sub-class, series, order, family, genus, species.

7 (b)
Botanical garden allows *exsitu* conservation of gerplasm.

8 (a)
The basic unit of classification is species. It is the lowest category of classification. It is a group of closely related individuals with similar morphological, anatomical, biochemical and cytological characters. It is a group of naturally interbreeding populations with ability to produce fertile off springs. Individuals of a species share a common gene pool. Species is reproductively isolated, thus genetically closed system. Species has the real existence in nature. The term 'species' was given by **John Ray**, an English naturalist.

9 (c)
Taxonic or systematic hierarchy may be defined as a series of different ranks placed descending order. In other words, it is a system by which various taxonomic categories are arranged in a proper descending order. Kingdom is the highest rank and species is the lowest or basic rank, i.e., Kingdom>phylum/division>class>order>family >genus>species.

10 (d)
According to Mayr, species are group of interbreeding natural populations that are reproductively isolated from other such groups. Species is the lowest taxonomic rank. It contains most similar organisms.

11 (b)
Species is the smallest rank of taxonomic classification modern concept of species is biological species concept (E Mayr; 1942). Mayr defined he species as the group of interbreeding natural populations that are reproductively isolated from other such groups.

12 (a)
Linnaeus introduced five categories in the taxonomic hierarchy, i.e., class, order, species and variety. Later on, three more categories, i.e., kingdom, division or phylum and family were added and variety was discarded to make a hierarchy of seven obligate categories.

13 (a)
The term new systematic was given by **Julian Huxley** (1940). New systematic or Biosystematics is the concept of systematic which bring out taxonomic affinity on the basis of evolutionary, genetic and morphological traits. The term systematic was given by **Linnaeus** (Father of Taxonomy), who also gave binomial nomenclature concept.

Darwin has given theory of natural selection and theory of pangenesis.

14 (b)
Mayr (1942) defined species as an array of actually or potentially interbreeding natural populations that are reproductively isolated from other such groups under natural conditions.

15 (d)
The discipline of biology which deals with the kind and diversity of all organisms and the existing relationship amongest them is called systematics. The word 'systematics' is derived from Latin word *systema* which means

systematic arrangement of organisms. It was first used by **Carolus Linnaeus.** He used **SystemaNaturae** as the title of his publication. The scope of systematics was later enlarged to include identification, nomenclature and classification. Systematic takes into account evolutionary relationships between organisms.

16 (d)
When the specific name repeats the unaltered generic name this is called tautonym, e.g., *Malusmalus*.

17 (a)
Regeneration was first observed in *Hydra. Planaria* exhibits true regeneration. All these organisms show regeneration as a key feature

18 (c)
Growth is exhibited by living as well as non-living organism. When increase is body mass is considered as a criterian for growth this may be as the result of accumulation of material on non-living surface or weight increase in livings, e.g., mountains and sand dunes increase due to accumulation of material on their surface

19 (c)
Metabolism is the sum of all the metabolic activities in body, i.e., anabolism and catabolism. Anabolism is constructive process, while catabolism is a destructive process

20 (a)
Experimental taxonomy is based on determination of genetic relationship, while cytotaxonomy is based on cytological study of chromosomes, *i.e*., behavior, number and morphology of chromosomes

21 (c)

22 (b)
In trinomial nomenclature a third name is written or printed after two words name, which indicate sub-species or variety or race of the organism, *e.g.,* Indian babul (*Acacia nilotica indica*). Where *indica* means Indian species of babul

23 (b)
Binomial system of nomenclature was proposed by Carolus Linnaeus. The system of nomenclature was first issued in *Species Plantarum*. Binomial system approve two name for an organism, *i.e*., generic and specific name

24 (a)
Number and type of organisms it includes

25 (a)
Binomial system of nomenclature was proposed by Linnaeus. According to the system an organism is provided a distinct and proper name consisting of two words first generic name and second specific name which present genus and species, respectively

26 (c)
Hierarchial classification is
Kingdom
↓
Division/Phylum
↓
Class
↓
Order
↓
Family
↓
Genus
↓
Species
Class occupy a position between division/phylum and order

27 (d)
In a scientific name, the first name denote/indicates the generic name of the organism, while second name indicates or stands for specific epithet or specific names

28 (c)
Taxa is plural of taxon. A taxon represents a grouping in a systematic classification of organism (whatever its rank)

29 (c)
Panthera leo is scientific name of lion. *Cannis* is genus (cat), *Pisum* is also generic name of sweet pea, Carnivora is order

30 (b)
According to Earnt Mayr species are group of interbreeding natural populations that are reproductively isolated from other such groups. It contains most similar organisms

31 (b)
The genus *Felis* is used to represent cats

32 (c)
A natural taxon means a group of similar, genetically, related organisms having certain distinct characters from other groups. A genus with single species is called monotypic genus

33 (a)
The suffix phyta indicates division

34 (d)

The arrangement of taxonomic categories is known as taxonomical hierarchy order either it is descending or ascending

35 (a)
The ascending hierarchy in similar characteristic is Class < Family < Genus < Species, *i.e*., specificity is increasing

36 (b)
Flora is a book or taxonomic aid which have adequate information about habitat, distributions of climate and index of plants present in a particular region

37 (c)
The prime source of taxonomic studies is collection and identification of actual specimen. Nomenclature the present scientific method of naming the organism can be completed only when actual specimen is collected and identified

38 (a)
Herbarium/Herbaria (Plu) are place/collection of dried pressed and preserved (FAA solution) specimen of plants

39 (c)
Taxonomic aid monograph is treatise having complete information about a particular rank level of a taxonomic category. Key or taxonomic key contain list of traits or characters and their alternate which are helpful in taxonomic studies. Catalogue registers the species present in a particular place with brief description

40 (b)
A **herbarium** (A) is a collection/place of pressed dried and preserved plants specimen **mounted on a paper sheets** (B) labelled and arranged systematically for further reference

41 (b)

42 (b)

43 (c)
In hierarchical system of classification phylum and division occupy the same position which are used in classification of animal and plant, respectively

44 (c)

45 (a)
The correct labelling place on a herbarium sheet is lower corner of page of RHS and generally its size is 7×12 cm

46 (c)
Out of four given categories, class is the largest category. Therefore, can categorises rest three categories; order, family and genus
Kingdom → Division/Phylum → Class → Order → Family → Genus → Species

47 (a)
0.1% mercuric chloride solution are used to prevent fungal attack on herbarium nepthalene and carbon disulphide are common pesticides

48 (c)
ICVCN is the abbreviation of international Code of Viral Classification and Nomenclature. ICNCP stands for International Code of Nomenclature for Cultivated Plants

49 (c)
Nature of protoplasmic composition is shared by all living organism at all taxonomic categories. Mode of nutrition is peculiar feature of five kingdom classification

50 (a)
Hierarchical system is used in classification by majority of the biologist because each higher taxonomic category contain its below group, *i.e*., it reduce the volume of description in a catalogue of animal and plants and character at larger category need not to be repeated for smaller categories