## MATHEMATICS

1. If $a$ and $b$ are any two real numbers with opposite signs, which of the following is the greatest ?
(A) $(a-b)^{2}$
(B) $(|a|-|b|)^{2}$
(C) $\left|a^{2}-b^{2}\right|$
(D) $a^{2}+b^{2}$
2. The sum of the infinite series :
$\frac{1}{10}+\frac{2}{10^{2}}+\frac{3}{10^{3}}+\ldots+\frac{n}{10^{n}}+\ldots$.
(A) $\frac{1}{9}$
(B) $\frac{10}{81}$
(C) $\frac{1}{8}$
(D) $\frac{17}{22}$
3. The number $(1024)^{1024}$ is obtained by raising $(16)^{16}$ to the power $n$. What is the value of $n$ ?
(A) 64
(B) $64^{2}$
(C) $64^{6}$
(D) 160
4. The smallest value the expression $x^{2}+6 x+8$ attains on the set $\left\{x \in R \mid x^{2}-2 x-8 \leq 0\right\}$ is
(A) 0
(B) -1
(C) 8
(D) 3
5. Let $P_{1}$ be the set of all prime numbers, i.e., $P_{1}=\{2,3,5,7,11, \ldots\}$, Let $P n=\left\{n p\left|p \in P_{1}\right|\right\}$, i.e., the set of all prime multiples of $n$. Then which of the following sets is non empty?
(A) $P_{1} \cap P_{23}$
(B) $\mathrm{P}_{7} \cap \mathrm{P}_{21}$
(C) $P_{12} \cap P_{20}$
(D) $\mathrm{P}_{20} \cap \mathrm{P}_{24}$
6. The number of integers a such that $1 \leq \mathrm{a} \leq 100$ and $\mathrm{a}^{\mathrm{a}}$ is a perfect square is :
(A) 50
(B) 53
(C) 55
(D) 56
7. On a card, the following three statements are found :
(1) On this card exactly one statement is false.
(2) On this card exactly two statements arc false.
(3) On this card exactly three statements are false.

The number of false statements on the card is exactly
(A) 0
(B) 1
(C) 2
(D) 3
8. In triangle $A B C$, with $\angle A=90^{\circ}$, the bisectors of the angles $B$ and $C$ meet at $P$. The distance from $P$ to the hypotenuse is $4 \sqrt{2}$. The distance $A P$ is :
(A) 8
(B) 4
(C) $8 \sqrt{2}$
(D) $4 \sqrt{2}$
9. In a rhombus one of the diagonals is twice the other diagonal. Let A be the area of the rhombus in square units. Then each side of the rhombus is :
(A) $\sqrt{\mathrm{A}}$
(B) $\frac{1}{2} \sqrt{2 \mathrm{~A}}$
(C) $\frac{1}{2} \sqrt{5 \mathrm{~A}}$
(D) $\frac{1}{4} \sqrt{4 \mathrm{~A}}$
10. In the following figure, $A E=E B, B D=2 D C$ What is the ratio of the areas of $P E D$ and $A B C$ ?

(A) $\frac{1}{4}$
(B) $\frac{1}{6}$
(C) $\frac{1}{9}$


PHYSICS
11. A ball is thrown vertically upwards with a certain initial velocity. Assume that there is no resistance due to air. Among the graphs below, the graph that is not an appropriate representation of the motion of the ball is :
(i)

(ii) )

(iii)

(iv)

(A) A
(B) B
(C) C
(D) D
12. An electron of mass $m_{e}$ initially at rest takes time $t_{1}$ to move a distance $s$ in a uniform electric field in the same field environment, a proton of mass $m_{p}$ initially at rest takes time $t_{2}$ to move the same distance (in the opposite direction). Ignoring gravity, the ratio $t_{2} / t_{1}$ is :
(A) 1
(B) $\left(\frac{m_{e}}{m_{p}}\right)^{1 / 2}$
(C) $\frac{m_{p}}{m_{e}}$
(D) $\left(\frac{m_{p}}{m_{e}}\right)^{1 / 2}$
13. A simple camera with a converging lens of 60 mm focal length is focused on very far objects. To focus the camera on a nearby object 1.5 m away, the distance between the film and lens will have to be:
(A) decreased by 2.5 mm
(B) increased by 2.5 mm
(C) kept fixed as before. but aperture increased by a factor of 2.5
(D) kept fixed as before, hut aperture decreased by a factor of 2.5
14. A molecule of gas in a container hits one wall (1) normally and rebounds back. It suffers no collision and hits the opposite wall (2) which is at an angle of $30^{\circ}$ with wall 1.


Assuming the collisions to be elastic and the small collision time to be the same for both the walls, the magnitude of average force by wall 2 . $\left(\mathrm{F}_{2}\right)$ provided to the molecule during collision satisfy:
(A) $F_{1}>F_{2}$
(B) $F_{1}<F_{2}$
(C) $F_{1}=F_{2}$, both non-zero
(D) $F_{1}=F_{2} \geqslant 0$
15. A stone dropped from the window of a stationary train hits the ground and comes to rest. An identical stone is dropped from the window when the same train is moving with speed $v$ and it comes to rest on the ground. Assume that in each case, the entire energy lost in impact goes into heating the stone. Then
(A) The first stone is is slightly more heated than the second.
(B) The second stone is slightly more heated than the first.
(C) Both the stones will be raised to the same slightly higher) temperature.
(D) The second stone will be slightly more heated than the first only if its horizontal speed during fall is more than the final vertical speed.
16. A negatively charged particle initially at rest is placed in an electric field that varies from point to point. There are no other fields. Then :
(A) the particle moves along the electric line of force passing through it.
(B) the particle moves opposite to the electric line of force passing through it.
(C) the direction of acceleration of the particle is tangential to the electric line of force at every instant.
(D) the direction of acceleration of the particle is normal to the electric line of force at every instant.
17. There is a steady, water flow in a horizontal tube in which one part has cross sectional area $A_{1}$ and the other part has cross sectional area $\mathrm{A}_{2}$. Assume that water is incompressible.
If $A_{1} / A_{2}=16$, the ratio of the speed $u_{1}$ in part 1 and the speed $u_{2}$ in part 2 , i.e. $u_{1} / u_{2}$ is :
(A) $\frac{1}{16}$
(B) 4
(C) $\frac{1}{4}$
(D) 1
18. Positive point charges of magnitude are placed at all the twelve 'hour' positions of a clock of radius $r$. The clock is mounted on a wall in the normal way. The charge at the position ' 6 ' is removed. The resulting electric field at the centre of the clock is :
(A) 0
(B) $\frac{1}{4 \pi \varepsilon_{0}} \frac{\mathrm{q}}{\mathrm{r}^{2}}$ in the horizontal direction.
(C) $\frac{1}{4 \pi \varepsilon_{0}} \frac{\mathrm{q}}{\mathrm{r}^{2}}$ vertically upward.
(D) $\frac{1}{4 \pi \varepsilon_{0}} \frac{\mathrm{q}}{\mathrm{r}^{2}}$ vertically downward
19. The pair of quantities that do not have the same dimensions is :
(A) Latent heat, specific heat
(B) Gravitational force, Coulomb force
(C) Kinetic energy pf a freely falling body, potential energy of a compressed spring
(D) Coefficient of friction, number of molecules in a container.
20. A block of wood is floating on oil with half of its volume submerged. If the density of oil $840 \mathrm{~kg} \mathrm{~m}^{-3}$, the relative density of wood (relative to water) is :
(A) 0.84
(B) 0.42
(C) 0.21
(D) 1.00

## CHEMISTRY

21. The volume of 0.5 M aqueous NaOH solution required to neutralize 10 ml of 2 M aqueous $\overline{\mathrm{HCl}}$ splution is:
(A) 20 ml
(B) 40 ml
(C) 80 ml
(D) 120 ml
22. The compound that can be purified by sublimation is :
(A) Ammonium Sulphate
(B) Calcium Carbonate
(C) Calcium Oxide
(D) Aluminium Chloride
23. Penicillin was discovered by :
(A) Alexander G. Fleming
(B) Emil Fisher
(C) Robert B. Woodward
(D) van't Hoff
24. Among butane, 1-butene, 1 -butanol and butanal, the compound which is most polar is
(A) butane
(B) 1-butene
(C) 1-butanol
(D) butanal
25. Among ethanol, dimethyl ether, methanol, and propanal, the isomers are :
(A) ethanol, dimethyl ether, methanol and propanal
(B) ethanol and methanol
(C) ethanol, dimethyl ether, andmethanol
(D) ethanol and dimethyl ether
26. Among $\mathrm{Li}, \mathrm{Be}, \mathrm{N}$ and f the element having the largest atomic radius, is :
(A) Li
(B) Be
(C) N
(D) F
27. The proof of oxidizing action of hydrogen peroxide in acid solution is in the formation of :
(A) $\mathrm{O}_{2}$
(B) $\mathrm{H}_{2} \mathrm{O}$
(C) both $\mathrm{H}_{2} \mathrm{O}$ and $\mathrm{O}_{2}$
(D) both $\mathrm{H}_{3} \mathrm{O}^{+}$and $\mathrm{O}_{2}$
28. A gel toothpaste s a mixture of a :
(A) liquid in a solid
(B) solid in a gas
(C) liquid in a liquid
(D) gas in a solid
29. $3.01 \times 10^{23}$ molecules of elemental Sulphur will react with 0.5 mole of oxygen gas completely to produce
(A) $6.02 \times 10^{23}$ molecules of $\mathrm{SO}_{3}$
(B) $6.02 \times 10^{23}$ molecules of $\mathrm{SO}_{2}$
(C) $3.01 \times 10^{23}$ molecules of $\mathrm{SO}_{3}$
(D) $3.01 \times 10^{23}$ molecules of $\mathrm{SO}_{2}$
30. The pair of metals which will produce hydrogen gas in reaction with acid is :
(A) $\mathrm{Mg}, \mathrm{Cu}$
(B) $\mathrm{Mg}, \mathrm{Ag}$
(C) $\mathrm{Zn}, \mathrm{Pb}$
(D) $\mathrm{Cu}, \mathrm{Zn}$

## BIOLOGY

31. A cancer which is not a tumor is:
(A) Lymphoma
(B) Leukemia
(C) Prostate cancer
(D) Oral cancer
32. The phase of the cell cycle in which DNA synthesis takes place is:
(A) G1 phase
(B) S phase
(C) G2 phase
(D) G0 phase
33. You have a tube containing $10^{2}$ bacteria. You have taken out $10^{2}$ bacteria. How many bacteria are left in the tube ?
(A) approximately $10^{7}$
(B) approximately $10^{6}$
(C) approximately $10^{5}$
(D) approximately $10^{9}$
34. Association in which both the organisms get benefited is :
(A) Commensalism
(B) Mutualism
(C) Ammensalism
(D) Parasitism
35. You are part of a scientific expedition that has ventured deep into the Amazon rain forest. You spot a tree with branches spread over a large area. What can you conclude about the rot structure of the tree?
(A) It is dicotyledonous
(B) It is monocotyledonous
(C) It may be either monocotyledonous or dicotyledonous
(D) There is no correlation between foliage and root structure
36. Alleles are :
(A) Different forms of the same protein
(B) Two different genes
(C) Different forms of the same gene
(D) Two different proteins
37. If a person's spinal cord is injured which of the following functions might be affected ?
(A) Talking
(B) Seeing
(C) Sneezing
(D) Hearing
38. The amount of $\mathrm{CO}_{2}$ plant is greater at night than during the day because :
(A) The rate of respiration is higher at night.
(B) More $\mathrm{CO}_{2}$ is produced because it is colder during the night.
(C) Photosynthesis during the day uses up some of the $\mathrm{CO}_{2}$ produced by respiration.
(D) More glucose is available for respiration during the night
39. Osmosis takes place between two solutions separated by a semipermeable membrane because.
(A) Water molecules move from the more dilute solution to the less dilute solution
(B) Solute molecules move from the less dilute solution to the more dilute solution
(C) Water molecules move from the less dilute solution to the more dilute solution
(D) Solute molecules move from the more dilute solution to the less dilute solution
40. Arteries do not have valves but veins do, because :
(A) Arteries have a narrower lumen than veins
(B) Arteries have thicker walls than veins
(C) Arteries carry oxygenated blood whereas veins carry deoxygenated blood
(D) Valves prevent backflow of blood in veins

## MATHEMATICS

1. $\quad a b$ and cd are two 2 - digit natural numbers and $4 b+a=13 k_{1}$ and $5 d-c=17 k_{2}$, where $k_{1}$ and $\mathrm{k}_{2}$ are natural numbers. Then find the largest number that will always divide product of ab and cd.
2. An operation defind as the product of non zero digits of $x$. e.g. An operation defined as the product of non zero digits of $x$. e.g.
 a two digit number formed by the digits $1,2,3,4,5,6,7,8$, and 9 .
3. A ray of light originating at the vertex $A$ of a square $A B C D$ passes through the vertex $B$ after getting reflected by $\mathrm{BC}, \mathrm{CD}$ and DA in that order. If $\theta$ is the angle of the initial position of the ray with $A B$ then find the value of $\sin \theta$.

## PHYSICS

4. A fish looking up through the water sees the outside world contained in a circular horizon. If the refractive index of water is $4 / 3$ and the fish is 12 cm below the surface, then find the radius of the circle.
5. Figure shows the position-time graph of particle of mass 4 kg . What is the

(a) force on the particle for $\mathrm{t}<0$, t $<4 \mathrm{~s}, 0<\mathrm{t}<4 \mathrm{~s}$ ?
(b) Impulse at $\mathrm{t}=0$ and $\mathrm{t}=4 \mathrm{~s}$ ? (Consider one dimensional motion only)
6. Any two ends of a circular conducting wire are connected by a cell. Find the magnetic field at the centre $O$.


## CHEMISTRY

7. The electronic configuration of some elments are given below :
(i) $1 \mathrm{~s}^{2}, 2 \mathrm{~s}^{2}, 2 \mathrm{p}^{6}, 3 \mathrm{~s}^{1}$
(ii) $1 s^{2}, 2 s^{2}, 2 p^{6}, 3 s^{2}, 3 p^{6}, 3 d^{1}, 4 s^{2}$
(iii) $1 \mathrm{~s}^{2}, 2 \mathrm{~s}^{2}, 2 \mathrm{p}^{4}$
(iv) $1 s^{2}, 2 s^{2}, 2 p^{6}, 3 s^{2}, 3 p^{6}, 4 s^{2}$
(v) $1 s^{2}, 2 s^{2}, 2 p^{6}, 3 s^{2}, 3 p^{5}$
(vi) $1 s^{2}, 2 s^{2}, 2 p^{6}, 3 s^{2}, 3 p^{6}$
(vii) $1 s^{2}, 2 s^{2}, 2 p^{6}, 3 s^{2}, 3 p^{3}$
out of these
(a) which is an alkaline earth metal ?
(b) which has the lowest chemical reactivity ?
(c) which belogs to group 15 of the periodic table ?
(d) which is a transition element?
(e) which is a halogen ?
(f) which belongs to second period?
(g) which forms unipositive ion in its compounds ?
8. What is meant by the term bond order ? Calculate the bond ofder of : $\mathrm{N}_{2}, \mathrm{O}_{2}, \mathrm{O}_{2}^{+}$and $\mathrm{O}_{2}^{-}$.
9. The enthalpy of combustion of graphite is 393.3. kJ . Calculate
(a) the amount of graphite needed to produce 196.7 kJ of heat
(b) the number of moles of $\mathrm{CO}_{2}$ formed when 196.7 kJ of heat is produced.
(c) the volume of oxygen required as S.T.P. to burn 24.0 g of graphite in this process.

## BIOLOGY

10. (A) Give the reasons for the following
(i) The wall of trachea is supporfed by cartilagenous rings.
(ii) The lung alveoli are covered with blood capillaries.
(iii) The glottis is guarded by epiglottis.
(B) Write the technical term for the following :
(i) An organism whose cells don't have well organised muscles.
(ii) Sum total of chemical processes taking place in cell
11. Answer the following question :
(i) If one ripenedfruit is kept in a basket of raw fruits which causes ripening of raw fruits also. Name the hormone responsible for it.
(ii) Which nitrogenous waste product is most toxic \& which one is least toxic in animals ?
(iii) Which type of cell is found in bacteria and blue green algae?
(iv) Which chemical molecule carries hereditary inform
(v) Which substance is used to remove chlorophyll from a green leaf during photosynthesis experiments?
12. Answer the following questions -
(i) Name the hormone responsible for inducing rooting in callus or stem cuttings $\qquad$ .
(ii) Name the hormone which induces cell division in plants $\qquad$ _.
(iii) Name the plant hormone which promotes closing of stomata during water scarcity $\qquad$ .
(iv) Name the animal hormone that stimulates maturation of lymphocytes $\qquad$ .
(v) Name the hormone that stimulates reabsorption of water from collecting tubules of nephron $\qquad$ .

## HINTS \& SOLUTIONS (PRACTICE PAPER-1)

| Ques. | $\mathbf{1}$ | $\mathbf{2}$ | $\mathbf{3}$ | $\mathbf{4}$ | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Ans. | A | B | D | A | C | C | C | A | C | D | D | D | A | A | B |
| Ques. | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| Ans. | C | A | D | A | B | B | A | A | C | D | A | C | A | D | C |
| Ques. | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |  |  |  |  |  |
| Ans. | B | B | B | B | A | C | C | C | A | D |  |  |  |  |  |

## MATHEMATICS

1. Obvious $(A)$ is greatest
2. $S=\frac{1}{10}+\frac{2}{10^{2}}+\frac{3}{10^{3}}+\ldots+\frac{n}{10^{n}}+\ldots \infty$
$\frac{S}{10}=\frac{1}{10^{2}}+\frac{2}{10^{3}}+$ $\qquad$ $\infty$

Subtracting,
$\frac{9 \mathrm{~S}}{10}=\frac{1}{10}+\frac{1}{10^{2}}+\frac{1}{10^{3}}+$ $\qquad$ .$\infty$
$\frac{9 S}{10}=\frac{\frac{1}{10}}{1-\frac{1}{10}}$
$\frac{9 S}{10}=\frac{1}{9}$
$S=\frac{10}{81}$
3.
$(1024)^{1024}=(16)^{16}$
$\left(2^{10}\right)^{1024}=\left(2^{4}\right)$
$10 \times 1024=4 \times 16 n$
$\mathrm{n}=\frac{10 \times 1024}{4 \times 16}$

$$
n=160
$$

4. 

$$
\begin{aligned}
& x^{2}+6 x+8 \\
& x \in R \\
& x^{2}-2 x-8 \leq 0 \\
& x^{2}-2 x-8= \\
&
\end{aligned}
$$


$x \in[-2,4]$
clearly min value of expression is 0
at $x=-2$
5. Check by option
$P_{12}=\{24,36,60,84, \ldots$.
$P_{20}=\{40,60,100, \ldots .$.
$P_{12} \cap P_{20}$ has common element
6. All even values of a i.e. 50 and 1, 9, 25, 49, 81, total 55
7. If any statement is true then remaining 2 are false.
8.


Angle bisector $\quad \therefore \quad$ Incircle is formed whose radius $=4 \sqrt{2}$

$$
\begin{aligned}
& P E=r=4 \sqrt{2} \\
& P F=r=4 \sqrt{2} \text { also } P E=A E \\
\therefore \quad & \Delta A P E,(A P)^{2}=(A E)^{2}+(P E)^{2} \\
& =(4 \sqrt{2})^{2}+(4 \sqrt{2})^{2}=64 \\
\therefore \quad & A P=8
\end{aligned}
$$

9. 

Area of rhombus $=\frac{1}{2} d_{1} d_{2}$
Let one diagonal $=x$

$$
=\frac{1}{2} \times(x)(2 x)=x^{2}
$$



Let side of rhombus $=y$ \& height $=h$
$\triangle B F C$ side $B F=\sqrt{y^{2}-h^{2}}$
$\ln \triangle A F C,\left(y+\sqrt{y^{2}-h^{2}}\right)^{2}+h^{2}=(A C)^{2}=4 x^{2}$
$\triangle$ DEB $\left(y-\sqrt{y^{2}-h^{2}}\right)^{2}+h^{2}=(B D)^{2}=x^{2}$
Adding

$$
\begin{aligned}
& 4 y^{2}=5 x^{2} \\
& y=\sqrt{\frac{5 x^{2}}{4}}=\frac{\sqrt{5 A}}{2}
\end{aligned}
$$

10. 



Let $B$ is origin and the position vector of $A$ and $C$ are $2 \vec{a}$ and $3 \vec{b}$
Then P.V. of $E=\vec{a}$ and P.V. of $D=2 \vec{b}$
Now, let $P$ divides $A D$ in $\lambda: 1$ ratio
and $\quad P$ divides EC in $\mu: 1$
$\therefore \quad \frac{2 \overrightarrow{\mathrm{~b}} \lambda+2 \overrightarrow{\mathrm{a}}}{\lambda+1}=\frac{3 \overrightarrow{\mathrm{~b}} \mu+\overrightarrow{\mathrm{a}}}{\mu+1}$
$2 \overrightarrow{\mathrm{~b}} \lambda \mu+2 \overrightarrow{\mathrm{~b}} \lambda+2 \overrightarrow{\mathrm{a}} \mu+2 \overrightarrow{\mathrm{a}}=3 \overrightarrow{\mathrm{~b}} \lambda \mu+\overrightarrow{\mathrm{a}} \lambda+3 \overrightarrow{\mathrm{~b}} \mu+\overrightarrow{\mathrm{a}}$
$\vec{a}(2 \mu+2-\lambda-1)=\vec{b}(3 \lambda \mu+3 \mu-2 \lambda \mu-2 \lambda)$
But $\vec{a}$ and $\vec{b}$ are not collinear.
$2 \mu-\lambda+1=0$ and $\lambda \mu+3 \mu-2 \lambda=0$
We get $\mu=1$
Now, P.V. of $P$ is $=\frac{\vec{a}+3 \vec{b}}{2}$
Now, $\frac{\operatorname{ar} \triangle P E D}{\operatorname{ar} \triangle A B C}=\frac{\frac{1}{2}\left(\left.\left(\vec{a}-\frac{\vec{a}+3 \vec{b}}{2}\right) \times\left(2 \vec{b}-\frac{\vec{a}+3 \vec{b}}{2}\right) \right\rvert\,\right.}{\frac{1}{2}|2 \vec{a} \times 3 \vec{b}|}$
$=\frac{\frac{1}{4}|(\vec{a}-3 \vec{b}) \times(\vec{b}-\vec{a})|}{6|\vec{a} \times \vec{b}|}=\frac{1}{12}<$

11. speed will not decrease, so answer is (D)
12.

> For electron, $\mathrm{t}_{1}=\sqrt{\frac{2 \mathrm{~s}}{\mathrm{a}_{\mathrm{e}}}}$
> For protion, $\mathrm{t}_{2}=\sqrt{\frac{2 \mathrm{~s}}{\mathrm{a}_{\mathrm{p}}}}$
or $\frac{t_{2}}{t_{1}}=\sqrt{\frac{a_{e}}{a_{p}}}=\sqrt{\frac{e E}{m_{e}} \times \frac{m_{p}}{e E}}$
$=\sqrt{\frac{m_{p}}{m_{e}}}$
13. Focal length, $f=6 \mathrm{~cm}$
$u=1.5 \mathrm{~m}=150 \mathrm{~cm}$
$\mathrm{v}=$ ?
$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$
$\frac{1}{6}=\frac{1}{v}+\frac{1}{150}$
$\frac{1}{v}=\frac{1}{6}-\frac{1}{150}=\frac{25-1}{150}$
$v=\frac{150}{24}=\frac{75}{12}=\frac{25}{4}=6.25$
change in distance $=6.25-6=0.25 \mathrm{~cm}$
$=0.25 \mathrm{~cm}=2.5 \mathrm{~mm}$ decreased
14. Initial momentum, $P_{1}=m v \cos 30$
and final momentum, $\mathrm{P}_{2}=\mathrm{mvcos} 30$
change in momentum
$\Delta P=-2 m v \cos 30$
$\Delta \mathrm{P}=-\sqrt{3} \mathrm{mv}$
Force on wall-1
$F_{1}=\frac{2 m v}{\Delta t}$
Force on wall-2
$F_{2}=\frac{\sqrt{3} m v}{\Delta t}$, so $F_{1}>F_{2}$
17. $A_{1} u_{1}=A_{2} u_{2}$
$\frac{u_{1}}{u_{2}}=\frac{A_{2}}{A_{1}}=\frac{1}{16}$
18. resultant force at centre is zero. On removing the charge from the position 6, the resultant force at centre will be $\frac{\mathrm{kq}}{\mathrm{r}^{2}}$ downward.
20. $\frac{v}{V}=\frac{d_{w}}{d_{L}}$

$\frac{1}{2}=\frac{d_{w}{ }^{*}}{840}$
R.D. $=\frac{420}{10^{3}}=0.42$

## CHEMISTRY

21. 

| NaOH | HCl |
| :--- | :--- |
| $\mathrm{N}_{1} \mathrm{~V}_{1}=$ | $\mathrm{N}_{2} \mathrm{~V}_{2}$ |
| $0.5 \times \mathrm{V}=$ | $2 \times 10$ |
| $\mathrm{~V}=40 \mathrm{~mL}$ |  |

25. Ethanol $\left(\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{OH}\right)$ and dimethyl ether $\left(\mathrm{CH}_{3}-\mathrm{O}-\mathrm{CH}_{3}\right)$ have same molecular formula but different functional groups, so they are isomers.
26. For the elements belonging to one period, increase in atomic number results in decrease in atomic radius. So Li has the largest atomic radius.
27. $2 \mathrm{H}_{2} \mathrm{O}_{2} \longrightarrow 2 \mathrm{H}_{2} \mathrm{O}+\mathrm{O}_{2}$
28. $\mathrm{S}+\mathrm{O}_{2} \longrightarrow \mathrm{SO}_{2}$ 1 mole 1 mole 1 mole
$\frac{1}{2}$ mole $\quad \frac{1}{2}$ mole $\quad \frac{1}{2}$ mole
$3.01 \times 10^{23} \quad 0.5$ mole ?
$\therefore 3.01 \times 10^{23}$ molecules of $\mathrm{SO}_{2}$ will be formed.
29. Zn and Pb are placed above hydrogen in the metal activity series, so they will produce hydrogen gas with dilute acids.

## MATHEMATICS

1. $a b \times c d=(10 a+b)(10 c+d)$

$$
\begin{aligned}
& =[40 b+10 a-39 b][51 d-(50 d-10 c)] \\
& =[10(4 b+a)-39 b][51 d-10(5 d-c)] \\
& =\left[10 \times 13 k_{1}-39 b\right]\left[51 d-10 \times 17 k_{2}\right] \\
& =13 \times 17\left(10 k_{1}-3 b\right)\left(3 d-10 k_{2}\right) \\
& =221\left(10 k_{1}-3 b\right)\left(3 d-10 k_{2}\right)
\end{aligned}
$$

Hence, the largest number that will divide the product ab and cd is 221.
2. Sum of numbers when tens digit is 1 .
$S_{1}=1+2+3+4+5+6+7+8+9=45$
Sum of number when ten's digit is 2

$$
\begin{aligned}
\mathrm{S}_{2} & =2+4+6+\ldots \ldots \ldots+18 \\
& =2(1+2+3+\ldots \ldots \ldots .+9)=2 \times 45
\end{aligned}
$$

## Similarly

$$
\mathrm{S}_{3}=3+6+9+\ldots \ldots \ldots+27
$$

$$
\begin{equation*}
=3(1+2+3+ \tag{+9}
\end{equation*}
$$

$$
=3 \times 45
$$

$$
S_{4}=4 \times 45
$$

$$
S_{9}=9 \times 45
$$

$$
\therefore \quad \text { Total sum }=S_{1}+S_{2}+S_{3}+\ldots \ldots .+S_{9}
$$

$$
=45+2 \times 45+\ldots \ldots+9 \times 45
$$

$$
=45(1+2+3+\ldots \ldots+9)
$$

$$
=45 \times 45
$$

$$
=2025 .
$$

3. Let $A B=$ a then $B E=a \tan \theta$
$\frac{\mathrm{CE}}{\mathrm{CF}}=\tan \theta$
$C F=a \cot \theta-a$
Now, In $\Delta$ GHF
$\tan \theta=\frac{\mathrm{HF}}{\mathrm{GH}}=\frac{1-\tan \theta}{2-\cot \theta}$
Solving we get
$\tan \theta=\frac{2}{3}$
$\sin \theta=\frac{2}{\sqrt{13}}$

## PHYSICS

4. Real depth of fish, $\mathrm{FO}=12 \mathrm{~cm}$
from figure $\angle \mathrm{FO} A=\mathrm{i}_{\mathrm{c}}$
$\tan \mathrm{i}_{\mathrm{c}}=\frac{\mathrm{OA}}{12}$

$\because \sin i_{c}=\frac{1}{\mu}=\frac{3}{4}$
$\mathrm{QR}=\sqrt{4^{2}-3^{2}}=\sqrt{7}$
from equation (i)
from $\triangle P Q R$
$O A=12 \tan i_{c}=12 \times \frac{3}{\sqrt{7}}$
5. (a) For $\mathrm{t}<0$ and $\mathrm{t}>4 \mathrm{~s}$, the particle is at rest as the position does not change with respect to time Evidently no force acts on the particle during these intervals.


Further, for $0<t<4 \mathrm{~s}$, the position of the particle continuously changes with respect to time. As the position-time graph is a straight line, it represents uniform motion and there is no acceleration. Hence, it is also clear that no force acts on the paticle during this interval.
(b) Becuase the velocity is uniform O to A hence velocity at O
$=$ velocity at $A=$ Slope of the graph $O A=(3 / 4) \mathrm{m} / \mathrm{s}$
Impulse (at $\mathrm{t}=4 \mathrm{~s}$ ) = change in momentum $=$ final momentum - initial momentum
$=0-\mathrm{mv}=-4 \times(3 / 4)=-3 \mathrm{~kg} \mathrm{~m} / \mathrm{s}$
6.


Let the length $\ell_{1}$ and $\ell_{2}$
Then the resistance will be in the ratio of the $\ell_{1}$ and $\ell_{2}$
$\frac{\mathrm{R}_{1}}{\mathrm{R}_{2}}=\frac{\ell_{1}}{\ell_{2}}$ but $l \propto \frac{1}{\mathrm{R}}$ so $\frac{\mathrm{l}_{1}}{\mathrm{I}_{2}}=\frac{\ell_{2}}{\ell_{1}}$
$\Rightarrow I_{1} \ell_{1}=I_{2} \ell_{2}$
Magnetic field at centre due to current $I_{1}$
$B_{2}=\frac{\mu_{0} I_{1}}{2 r} \times \frac{\ell_{1}}{2 \pi r} \odot\left(\right.$ here $\left.N=\frac{\ell_{1}}{2 \pi r}\right)$
Magnetic field due to current $\mathrm{I}_{2}$
$B_{2}=\frac{\mu_{0} I_{2}}{2 r} \times \frac{\ell_{2}}{2 \pi r} \otimes$
Net magnetic field at centre
$B=B_{1}-B_{2}=\frac{\mu_{0} l_{1} \ell_{1}}{2 r \times 2 \pi r}-\frac{\mu_{0} l_{2}}{2 r} \times \frac{\ell_{2}}{2 \pi r}$
$B=\frac{\mu_{0}}{4 \pi r^{2}}\left(I_{1} \ell_{1}-I_{2} \ell_{2}\right)=0$

## CHEMISTRY

7. (a) (iv) is alkaline earth metal as it contains two electrons in the outermost $s$-orbital
(b) : (vi) has the lowest chemical reactivity âs it is a noble gas element.
(c) (vii) contains three electrons in the $p$-subshell and group number for $p$-subshell is 15 ( $10+$ no. of valence electrons).
(d) (ii) is a transition element as the last electron enters into $d$-subshell.
(f) (iii) belongs to second period as the maximum principal quantum number $(\mathrm{n})$ is 2 .
(g) (i) contains only one electron in the outermost s-orbital so it forms unipositive ions in its compound.
8. Bond order is defined as half of the difference between the number of electrons present in bonding $\left(N_{b}\right)$ and anti bonding $\left(\mathrm{N}_{\mathrm{a}}\right)$ orbitals.
Bond order $=\frac{N_{b}-N_{a}}{2}$
Bönd orders of $(\mathrm{i})$ nitrogen $\left(\mathrm{N}_{2}\right)$ molecule
The electronic configuration of $\mathrm{N}_{2}$ is
$\left[\mathrm{KK} \sigma(2 \mathrm{~s})^{2} \sigma^{\star}(2 \mathrm{~s})^{2} \pi\left(2 \mathrm{p}_{x}\right)^{2}=\pi\left(2 \mathrm{p}_{\mathrm{y}}\right)^{2} \sigma\left(2 \mathrm{p}_{z}\right)^{2}\right]$
As $\mathrm{N}_{\mathrm{b}}=8, \mathrm{~N}_{\mathrm{a}}=2$, therefore.
bond order $=1 / 2\left(N_{b}-N_{a}\right)=1 / 2(8-2)=3$
(ii) Oxygen $\left(\mathrm{O}_{2}\right)$ molecule. The electronic configuration of $\mathrm{O}_{2}$ molecule is
$\mathrm{KK} \mathrm{\sigma}(2 \mathrm{~s})^{2} \sigma^{*}(2 \mathrm{~s})^{2} \sigma\left(2 p_{z}\right)^{2} \pi\left(2 p_{x}\right)^{2}=\pi\left(2 p_{y}\right)^{2} \pi^{*}\left(2 p_{y}\right)^{1}=\pi^{*}\left(2 p_{x}\right)^{1}$
As $\mathrm{N}_{\mathrm{b}}=8$ and $\mathrm{N}_{\mathrm{a}}=4$, therefore
bond order $1 / 2\left(N_{b}-N_{a}\right)=1 / 2(8-4)=2$
(iii) Oxygen molecular positive ion $\left(\mathrm{O}_{2}{ }^{+}\right)$. The electronic configuration of $\mathrm{O}_{2}{ }^{+}$is
$\operatorname{KK\sigma } \sigma(2 \mathrm{~s})^{2} \sigma^{*}(2 \mathrm{~s})^{2} \sigma\left(2 p_{z}\right)^{2} \pi\left(2 p_{x}\right)^{2}=\pi\left(2 p_{y}\right)^{2} \pi^{*}\left(2 p_{y}\right)^{1}=\pi^{*}\left(2 p_{x}\right)$
As $\mathrm{N}_{\mathrm{b}}=8$ and $\mathrm{N}_{\mathrm{a}}=3$, therefore
bond order $=\frac{1}{2}\left(N_{b}-N_{a}\right)=\frac{1}{2}(8-3)=2.5$
(iv) oxygen molecular negative ion $\left(\mathrm{O}_{2}^{-}\right)$. The electronic configuration of $\mathrm{O}_{2}^{-}$is
$\mathrm{KK} \sigma(2 \mathrm{~s})^{2} \sigma^{\star}(2 \mathrm{~s})^{2} \sigma\left(2 p_{z}\right)^{2} \pi\left(2 p_{x}\right)^{2}=\pi\left(2 p_{y}\right)^{2} \pi^{\star}\left(2 p_{y}\right)^{2}=\pi^{*}\left(2 p_{x}\right)^{1}$
As $N_{b}=8$, and $N_{a}=5$, therefore
Bond order $=1 / 2\left(N_{b}-N_{a}\right)=1 / 2(8-5)=1.5$
9. We are given
(i) C (graphite) $+\mathrm{O}_{2}(\mathrm{~g}) \longrightarrow \mathrm{CO}_{2}(\mathrm{~g}) ; \Delta \mathrm{H}=-393.4 \mathrm{~kJ}$
(a) From the above equation, we known that
393.4 kJ of heat is produced by 12 g of graphite.
$\therefore 196.7 \mathrm{~kJ}$ of heat is produced by
$\frac{12}{393.4} \times 196.7=6$ grams of graphite.
(b) From equation (i), we can say that production of 393.4 kJ of heat is accompanied by the formation of 1 mole of $\mathrm{CO}_{2}$.
$\therefore$ Production of 196.7 kJ of heat will be accompanied by the formation of 0.5 mole of $\mathrm{CO}_{2}$.
(c) volume of oxygen required at S.T.P. to burn 12 g of graphite $=22.4$ litres.
$\therefore$ Volume of oxygen required at S.T.P. to burn 24 g of graphite $=22.4 \times 2=44.8$ litres.

## BIOLOGY

10. (A) (i) Cartilagenous rings prevent it from collapse when air pressure is low in respiratory tract.
(ii) Alveoli sac are covered with blood capillaries for the exchange of gases.
(iii) To prevent entry of food into trachea.
(B) (i) Prokaryotic
(ii) Metabolism
11. (i) Ethylene hormone
(ii) Ammonia and uric acid respectively
(iii) Prokaryotic
(iv) DNA
(v) Alchohol with boiling water is used to remove chlorophyll from a green leaf during photosynthesis experiments.
12. (i) Auxins (ii) Cytokinins (iii) Abscisic acid (iv) Thymosin (v) Anti diuretic hormone
