SAMPLE QUESTION PAPER
PHYSICS (312)

Time: 3 hrs **Maximum Marks: 80**

Note:

i. This question paper consists of 43 questions in all.
ii. All questions are compulsory.
iii. Marks are given against each question.
iv. Use log tables if required.
v. **Section A** consists of

a. **Q.No. 1 to 16** – Multiple Choice type questions (MCQs) carrying 1 mark each. Select and write the most appropriate option out of the four options given in each of these questions. An internal choice has been provided in some of these questions. You have to attempt only **one** of the given choices in such questions.
b. **Q.No. 17 to 28** – Objective type questions carrying 02 marks each (with 2 sub-parts of 1 mark each). Attempt these questions as per the instructions given for each of the questions 17 – 28.

vi. **Section B** consists of

a. **Q.No. 29 to 37** – Very Short questions carrying 02 marks each to be answered in the range of 30 to 50 words.
b. **Q.No. 38 to 41** – Short Answer type questions carrying 03 marks each to be answered in the range of 50 to 80 words.
c. **Q.No. 42 to 43** – Long Answer type questions carrying 05 marks each to be answered in the range of 80 to 120 words.

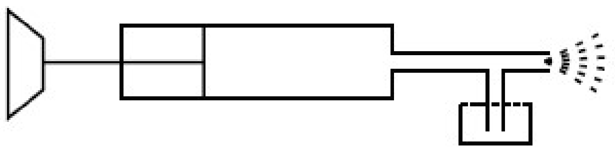
SECTION A		
S.NO.	Questions	Marks
	Q.No. 1 to 16 are the objective questions of 1 mark each: *An internal choice has been provided in some of these questions. You have to attempt only **one** of the given choices in such questions.*	
1.	(i) The net force on a kite held stationary in the sky is- A. 1N B. Increasing C. 0 N D. Decreasing OR (ii) In terms of fundamental unit 1 N can be expressed as- A. 1 N = 1 kg ms^{-2} B. 1 N = 1 kg m^{-3} C. 1 N = 1 $kg^{-1}ms^{-2}$ D. 1 N = $kgms^{2}$	1

2.	(i) The mass of a body is 2 kg, its weight is- A. 19.6 N B. 9.8 N C. 10 N D. 5 N OR (ii) A body of mass 200 g falls through air with an acceleration of 6 ms^{-2}. The air drag on the body is A. 1200 N B. 1.2 N C. 1.96 N D. 0.76 N	1
3.	(i) A passenger in a moving bus is thrown forward when the bus is suddenly stopped. This is explained A. by Newton's first law B. by Newton's second law C. by Newton's third law D. by the principle of conservation of mass OR (ii) The need of banking of road is A. To provide additional gravitational force for higher velocity B. To provide additional centrifugal force for higher velocity C. To provide additional centripetal force for higher velocity D. To provide additional electrostatic force for higher velocity	1
4	(i) The phenomenon of Capillarity is due to A. Cohesion. B. Adhesion. C. Cohesion and Adhesion both D. neither Cohesion ,nor Adhesion OR (ii) For a non viscous, incompressible fluid in steady flow where the area of cross section of pipe is halved the velocity of flow is- A. Quadrupled B. Tripled C. Doubled **D.** Unchanged	1
5	The excess of pressure inside two soap bubbles of diameters in the ratio 4 : 1 is (A) 1 : 4 (B) 2 : 1 (C) 1 : 2 (D) 4 : 1	1

6	Thermodynamics means A. study of the relationship between heat and other forms of energy B. study of the conversion of chemical energy to other forms of energy C. study of the relationship between mechanical energy to other forms of energy D. study of the conversion of mechanical energy to other forms of energy	1
7	(i) Out of the following the law of a thermodynamics law actually is- A. Zeroth law of thermodynamics B. Faraday's Law of thermodynamics C. Ideal Gas Law of thermodynamics D. Boyle's Law of thermodynamics OR (ii) Out of the following a type of thermodynamic system is- A. Open system B. Closed system C. Thermally isolated system D. All of the mentioned	1
8	Transverse progressive waves are characterised by (A) compressions and rarefactions (B) crests and troughs (C) compressions and troughs (D) crests and rarefactions	1
9	When a wave passes from one medium to another, there is change of (A) frequency and velocity (B) wavelength and velocity (C) frequency and wavelength (D) frequency, wavelength and velocity	1
10	(i) Number of beats produced by two waves of $y_1 = a \sin 1000 \pi t$, $y_2 = a \sin 1004 \pi t$ is (a) 0 (b) 1 (c) 2 (d) 8 OR (ii) A source of sound of frequency 150 Hz is moving in a direction towards an observer with a velocity 110 ms^{-1}. If the velocity of sound is 330 ms^{-1}, the frequency of sound heard by the person is (A) 225 Hz (B) 200 Hz (C) 150 Hz (D) 100 Hz	1

11	The displacement y of a particle in a medium can be expressed as $y = 10^{-6} \sin(100t + 20x + \pi/4)$ where t is in second and x in meter . The propagation constant of the wave is (A) 100 s^{-1} (B) 10^{-6} m (C) 20 m^{-1} (D) $\pi/4$ rad	1
12	Which of the following colour of white light deviates the most when passes through a prism? (A) Red (B) Violet (C) Yellow (D) Green	1
13	(i) For total internal reflection, correct statement is- (A) Light travels from rarer to denser medium. (B) Light travels from denser to rarer medium. (C) Light travels in air only. (D) Light travels in water only. OR (ii) The cause of the blue color of the ocean is A) reflection B) scattering of light by water molecules C) total internal reflection D) refraction	1
14	The refracting angle of a prism is 30′ and its refractive index is 1.6. Calculate the deviation caused by the prism. A. 28′ B. 8′ C. 30′ D. 18′	1
15	In an experiment of scattering of alpha particle showed for the first time that the atom has, (A)Electron (B)Proton (C)Neutron (D)Nucleus	1

16	According to Bohr's postulates, an electrons revolve around the nucleus in ______________orbits. (A) Dynamic (B) Stationary (C) Lower (D) First **OR** Which spectral series of hydrogen lie in UV region? (A) Paschen (B) Lyman (C) Brackett (D) Balmer	1
	<u>Q.No. 17 to 28</u> are the objective questions of 2 marks each: *Some of these questions have 4 sub-parts. You have to do **any 2 sub-parts** out of 4 sub-parts in such questions.*	
17.	**Read the passage and answer the questions that follow it.**	1 X 2
	Friction between any two surfaces in contact is the force that opposes the relative motion between them. The force of limiting friction (F) between any two surfaces in contact is directly proportional to the normal reaction (R) between them i .e . , $F \propto R$ or $F= \mu R$, where μ is coefficient of limiting friction , then $\mu = \tan\theta$.	
	*Attempt **any two parts** from following questions* (i to iv):	
(i)	The maximum force of static friction between a pair of surfaces is independent of (a) mass of the body (b) coefficient of friction (c) area of contact (d) acceleration due to gravity	
(ii)	Unit of coefficient of limiting friction: (a) N (b) Nm (c) N/m (d) unitless	
(iii)	Arrange in ascending order ; μ_r, μ_k, and μ_{ms} (i.e. coefficient of rolling friction, coefficient of kinetic friction, coefficient of maximum static friction respectively.) (a)$\mu_k < \mu_r < \mu_{ms}$ (b)$\mu_r < \mu_k < \mu_{ms}$ (c)$\mu_{ms} < \mu_r < \mu$ (d)none of these	
(iv)	The value of static friction acting on the body at rest which is under the influence of applied external force of 5 N is (a) 0 N (b) 5 N (c) 10 N (d) 2.5 N	
18.	**Complete the sentence using following words:** (*Attempt **any two parts** from following questions* (i to iv)) **[more, force, linear momentum, inertia, isolated, less]**	1 X 2
(i)	Total linear momentum of __________ system is conserved.	
(ii)	The rate of change of momentum is higher when force is ____________.	

<table>
<tr><td>(iii)</td><td colspan="2">The fielder lowers his hands to catch a ball, just to minimize the _____________.</td><td></td></tr>
<tr><td>(iv)</td><td colspan="2">Recoil of the gun is based on law of conservation of _______________.</td><td></td></tr>
<tr><td>19.</td><td colspan="2">Read the passage and answer the questions that follow it. (i to ii)</td><td>1 X 2</td></tr>
<tr><td></td><td colspan="2">Bernoulli’s Theorem has many applications among which one is a spray gun which is shown in the figure where a piston pushes air out of a nozzle. A thin tube of uniform cross section is connected to the nozzle. The other end of the tube is in a small liquid container. As the piston pushes air through the nozzle, the liquid from the container rises into the nozzle and is sprayed out. For the spray gun shown, the radii of the piston and the nozzle are 20 mm and 1 mm respectively. The upper end of the container is open to the atmosphere.
</td><td></td></tr>
<tr><td>(i)</td><td colspan="2">According to Bernoulli’s Theorem: $P + \frac{1}{2}dv^2 + hdg = constant$
$which\ is\ expresesd\ as\ \ [A + B + C = constant]$,
Then for unit volume of an ideal fluid in a streamline flow:
A, B and C respectively are corresponds to
(a) potential energy, kinetic energy and pressure energy
(b) potential energy, pressure energy and kinetic energy
(c) pressure energy, kinetic energy and potential energy
(d) kinetic energy, pressure energy and potential energy</td><td></td></tr>
<tr><td>(ii)</td><td colspan="2">If the piston is pushed at a speed of 5 mms^{-1} , the air comes out of the nozzle with a speed of
(a) 0.1 ms^{-1} (b) 1 ms^{-1} (c) 2 ms^{-1} (d) 8 ms^{-1}</td><td></td></tr>
<tr><td>20</td><td colspan="2">Fill in the blanks: (Attempt any two parts from following questions (i to iv))</td><td>1 X 2</td></tr>
<tr><td>(i)</td><td colspan="2">When the observer moves away from the stationary source, the apparent frequency is ________________ than the actual frequency of the source.</td><td></td></tr>
<tr><td>(ii)</td><td colspan="2">The frequency of the sound appear to be ________________ than the actual frequency when the source towards the stationary observer.</td><td></td></tr>
<tr><td>(iii)</td><td colspan="2">The Waves set up in the string fixed at both the ends are____________ waves</td><td></td></tr>
<tr><td>(iv)</td><td colspan="2">___________effect is observed for light waves as well as sound waves.</td><td></td></tr>
<tr><td>21.</td><td colspan="2">Match column –I statement with the right option of column - II</td><td>1 X 2</td></tr>
<tr><td></td><td>Column –I</td><td>Column - II</td><td></td></tr>
<tr><td></td><td>(i) S.I. unit of electric flux is
(ii) S.I. unit of electric field is</td><td>P. $\frac{N}{C}$
Q. $\frac{kg\ m}{sec^2 C}$
R. $\frac{Nm^2}{C}$</td><td></td></tr>
</table>

22.	**Fill in the blanks:** (*Attempt **any two parts** from following questions)*	1 X 2
(i)	Kirchhoff's first law for electric network is based on__________________	
(ii)	Kirchhoff's second law for electric network is based on________________	
(iii)	EMFs of two cells can be compared by using________________________	
(iv)	Meter bridge works on the principle of_______________________.	
23.	**Write TRUE for correct statement and FALSE for incorrect statements:**	1 X 2
(i)	In refrigerator the source of heat is the environment and sink of heat is the inner chamber of refrigerator. ____________________	
(ii)	If door of a working refrigerator is kept open for a long time in a closed room, the room will become cool.___________________	
24.	**Match column –I statement with the right option of column - II**	1 X 2

	Column –I	Column - II	
	(i) The internal energy of an ideal gas depends on (ii) A gas performs minimum work when it expands	P. Volume Q. Temperature R. Isothermally S. Isochorically	

25.	**Fill in the blanks:** (*Attempt **any two parts** from following questions* (i to iv)*)*	1 X 2
(i)	A ray of light undergoes_____twice on passing through a prism	
(ii)	___________ is the most scattered colour.	
(iii)	The deviation through a prism is minimum when angle of incidence is equal to angle of_______________.	
(iv)	According to Rayleigh's law of scattering, The intensity of scattered light is inversely proportional to the ______________ power of its wavelength:	
26.	**Match column –I statement with the right option of column - II**	1 X 2

	Column –I	Column - II	
	(i) Most deviated colour (ii) Least deviated colour	P. Yellow Q. Red R. Orange S. Violet	

27.	**Write TRUE for correct statement and FALSE for incorrect statements:** (*Attempt **any two parts** from following questions* (i to iv)*)*	1 X 2
(i)	β -particles have highest ionizing power. _____	
(ii)	Solar energy is mainly caused due to burning of Hydrogen in the oxygen. _______	
(iii)	Paschen series of hydrogen atom lie in UV region. ______	

(iv)	The radius R of a nucleus is proportional to cube root of its mass number. ________	
28.	**Match column –I statement with the right option of column - II**	1 X 2

	Column –I	Column - II	
	(i) SI unit of coefficient of viscosity is (ii) CGS unit of coefficient of viscosity is	P. Nsm^{-2} Q. poise R. Nm^{-2}	

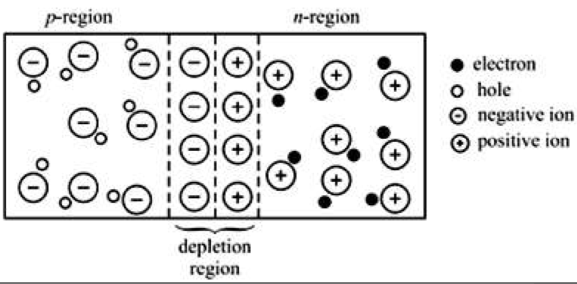
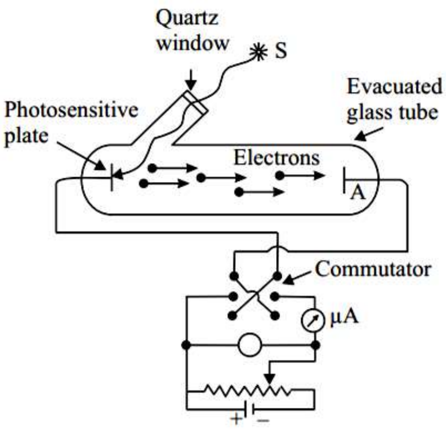
SECTION B		
Q. No.	**Question**	**Marks**
29.	Describe in brief the formation of depletion region in a p-n junction diode with a suitable diagram.	2
30.	Draw a diagram to show experimental arrangement for observing the photoelectric effect. OR Draw a plot showing the variation of photoelectric current with anode potential for two different frequencies, $v_1 > v_2$, of incident radiation having the same intensity. In which case will the stopping potential be higher?	2
31.	What is nuclear fusion? Write an equation of nuclear fusion to support your answer	2
32.	Draw a restoring force of displacement graph for a helical spring. Write an expression for the energy stored in the spring at maximum displacement.	2
33.	Show that 1 KWh energy is equal to 3.6×10^6 J.	2
34.	Show that magnetic energy required to build up the current I in a coil of self inductance L is given by – ½ LI^2. OR Find out the expression for the magnetic field due to a long solenoid carrying a current I and having n number of turns per unit length.	2
35.	Two capacitor of capacitance C_1 and C_2 are connected in series with dc voltage V. Derive an expression for the equivalent capacitance of the combination of the capacitor. OR Derive an expression for capacitance of parallel plate capacitor.	2
36.	Explain why diffraction is a very common phenomenon in case of sound, but not that common in case of light. OR Why are coherent sources necessary to produce a sustained interference pattern?	2
37.	The angle of maximum polarisation for a certain medium is 60^0. Calculate the refractive index of the medium.	2

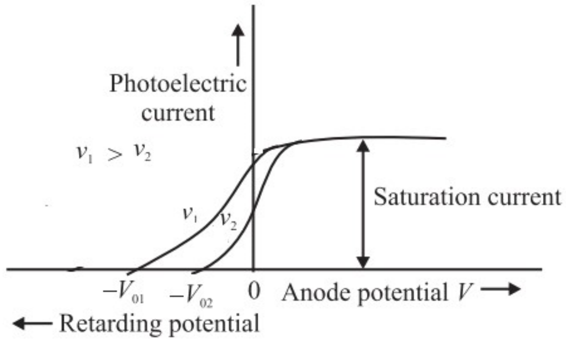
38.	Draw the circuit diagram of a full-wave rectifier using p-n junction diode. Explain its working and show the output input waveforms.	3
39.	A raindrop of mass 1 g falling from a height of 1 km hits the ground with a speed of 50 ms^{-1} calculate I. The loss of P.E. of the drop II. The gain in K.E. of the drop OR A body of mass 0.5 kg travels in a straight line with velocity $v = ax^{3/2}$ where $a = 5m^{-1/2}s^{-1}$. What is the work done during its displacement from x = 0 to x = 2 m.	3
40.	Derive the expression for the electric potential at any point along the axial line of an electric dipole. OR Derive the expression for the potential energy of an electric dipole of dipole moment $\vec{p}$ placed in a uniform electric field $\vec{E}$.	3
41.	State and explain Brewster's law with the help of a diagram. The value of Brewster angle for a transparent medium is different for light of different colours. Give reason	3
42.	(a) Draw the circuit arrangement for studying the V-I characteristics of a p-n junction diode in (i) forward and (ii) reverse bias. Briefly explain how the typical V- I characteristics of a diode are obtained and draw these characteristics. (b) Explain the I V characteristics of Light emitting diode. OR What are energy bands in solids? How are they formed? How do we classify solids as conductor semiconductors and insulators on the basis of energy bands?	5
43.	(a) State Lenz's law. "The Lenz's law is a consequence of the principle of conservation of energy." Justify this statement. (b) Deduce an expression for the mutual inductance of two long coaxial solenoids but having different radii and different number of turns. OR Using phasor diagram for a series LCR circuit connected to an ac source of voltage $E = E_m \cos \omega t$,derive the relation for the current flowing in the circuit and the expression for resonance frequency. Draw a plot showing the variation of the peak current (i_m) with frequency of the a.c. source used.	5

Physics Marking Scheme SECTION – A			
(Q.No. 1 to 16) MCQs of 1 marks each			
S.no	Correct option	Explanation	Marks
1.	(i) C OR (ii) A	(i) Since the kite is at rest.net force acting on it zero OR (ii) N is the unit of force = m a =kg m s^{-2}	1
2.	(i) A OR (ii) D	(i) W = mg =2×9.8 = 19.6 N OR (ii) $Mg - F_a = ma$ $Mg - F_a = 0.20 \times 6 = 1.2$ $F_a = Mg - 1.2$ =1.96 -1.2 = 0.76 N	1
3.	(i) A OR (ii) C		1
4	(i) C OR (ii) **C**	(i) Cohesion and adhesion body decide the angle of contact and also the magnitude and direction of the rising force OR (ii) Equation of continuity Av = constant	1
5	**A**	Excess Pressure $\propto \frac{1}{Radius}$	1
6	A	The branch of physical science is concerned with the relationship between heat, and other forms of energy like mechanical, electrical, chemical energy, etc.	1
7	(i) A OR (ii) D	(i) Thermodynamics is primarily based on a set of four rules that are universally applicable when applied to systems that fall within their respective limitations. They are as follows: Zeroth law of thermodynamics First law of thermodynamics Second law of thermodynamics Third law of thermodynamics OR (ii) Open system, Closed system, Thermally isolated system all are types of thermodynamic system.	1
8	B		1
9	B	Frequency of the wave depends upon source; hence do not change with change in medium.	1

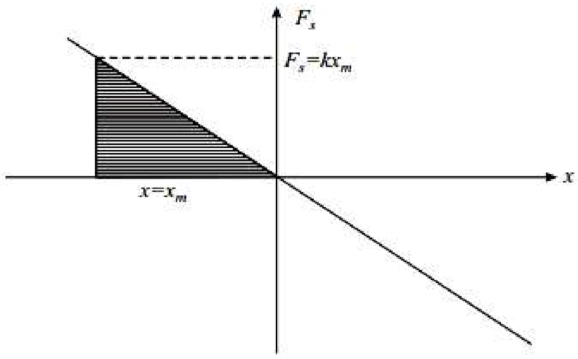
10	(i) C OR (ii) A	$\omega_1 = 1000\pi \Rightarrow 2\pi\upsilon_1 = 1000\pi \Rightarrow \upsilon_1 = 500$ $\omega_2 = 1004\pi \Rightarrow 2\pi\upsilon_2 = 1004\pi \Rightarrow \upsilon_2 = 502$ Beat frequency = $\lvert\upsilon_1 - \upsilon_2\rvert = \lvert 500 - 502 \rvert = 2$ OR $\upsilon = \left(\frac{v}{v-v_s}\right)\upsilon = \left(\frac{330}{330-110}\right)(150) = 225$ Hz	1
11	C		1
12	B		1
13	(i) B OR (ii) B		1
14	D	$\delta = (\mu - 1)A = (1.6 - 1)\frac{1^o}{2} = 0.3^o = 18'$	1
15	D		1
16	(i) B OR (ii) B		1
(Q.No. 17 to 28) Objective questions of (1X2=2 marks) each			
17	*Attempt **any two parts*** *(i)* (c) *(ii)* (d) *(iii)* (b) *(iv)* (b)		1 X 2
18	*Attempt **any two parts*** *(i)* isolated *(ii)* more *(iii)* force *(iv)* linear momentum		1X2
19	(i) (c) (ii) (c) (ii. ***Explanation:*** According to equation of continuity: $A_1v_1 = A_2v_2$ $\pi r_1^2 v_1 = \pi r_2^2 v_2$ $(20)^2 \times 5 = (1)^2 \times v_2$ 2000 mm/s = v_2 $v_2 = 2\ m/s$)		1 X 2
20	*Attempt **any two parts*** *(i)* Less than *(ii)* increase *(iii)* transversal/stationary *(iv)* Doppler		1 X 2
21	(i) – R, (ii) – P		1 X 2
22	*Attempt **any two parts*** *(i)* Law of conservation of charge *(ii)* Law of conservation of energy *(iii)* potentiometer *(iv)* Wheatstone bridge		1 X 2

23	(i) FALSE (ii) FALSE	1 X 2
24	(i) - Q, (ii) – S	1 X 2
25	*Attempt* ***any two parts*** *(i)* refraction *(ii)* violet *(iii)* emergence *(iv)* $fourth$	1 X 2
26	(i) - S, (ii) – Q	1 X 2
27	*Attempt* ***any two parts*** *(i)* FALSE *(ii)* FALSE *(iii)* FALSE *(iv)* TRUE	1 X 2
28	(i) – P, (ii) – Q.	1 X 2

SECTION – B			
S. NO.	Explanation	Marks	
29	There is greater concentration of electrons in the n-region of the semiconductor crystal and of holes in the p-region. Because of this, electrons tend to diffuse to the p-region and holes to the n-region and recombine. Each recombination eliminates a hole and a free electron. This results in creation of positively and negatively charged ions near the junction in n and p regions, respectively which a narrow region near the junction is depleted in mobile charge carriers. It is about 0.5 μm thick and is called the depletion region. 	1 1	2
30		2	2

<table>
<tr><td></td><td>OR


As the frequency of the incident light increases, the maximum kinetic energy of the photoelectrons also increases, therefore stopping potential will be more when radiation of greater frequency (ν_1) is incident on the metal surface.</td><td></td><td></td></tr>
<tr><td>31</td><td>The process in which two nuclei of lighter elements (such as hydrogen) fuse to form a heavier nucleus (such as helium), and a neutron is emitted, is called nuclear fusion. A large amount of energy is released in this process.
$${}_1^2H + {}_1^2H \rightarrow {}_2^3He + {}_0^1n + energy$$</td><td>1

1</td><td>2</td></tr>
<tr><td>32</td><td>

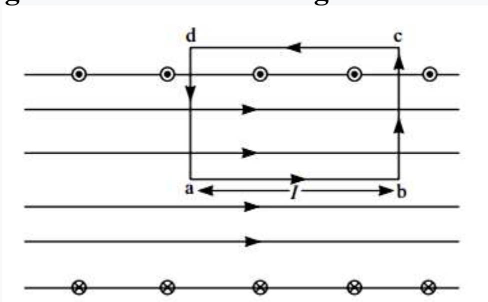
Energy stored = Work done = Area of shaded part = $\frac{1}{2} \times base \times$height
$= \frac{1}{2} \times x_m \times kx_m$
$= \frac{1}{2} \times k{x_m}^2$</td><td>1

1</td><td>2</td></tr>
<tr><td>33</td><td>1kWh = 1kW ×1h
= 1000 W × 3600 s
= 3.6 × 10^6 Ws
= 3.6 × 10^6 J</td><td>½
½
½
½</td><td>2</td></tr>
<tr><td>34</td><td>Energy stored in an inductor:
Consider a source of emf connected to an inductor L. As the current starts growing, the opposing induced emf is given by
$e = -L\frac{di}{dt}$
work done = $dW = |e|idt = L\frac{di}{dt}dt = Lidi$
$W = \int Lidi = \frac{1}{2}Li^2$
Energy stored in magnetic energy = $\frac{1}{2}Li^2$</td><td>½
½
½

½</td><td>2</td></tr>
</table>

OR

Expression for the magnetic field due to a long solenoid:



Let us take a rectangular loop abcd as shown in Fig and let i be the current flowing through solenoid.

Along the path ab, the magnetic field is uniform. Hence, for this path $\vec{B}.\vec{dl}$ = Bℓ. Along the paths cd, as the magnetic field is weak it may be taken as zero. Hence, for this path $\vec{B}.\vec{dl}$ = 0. The two short sides bc and da also do not contribute anything to $\vec{B}.\vec{dl}$ as B is either zero (outside the solenoid), or perpendicular to $\vec{dl}$ (inside the solenoid).

If n be the number of turns per unit length along the length of the solenoid, then the number of turns enclosed by the rectangular loop of length ℓ is nℓ. If each turn of the solenoid carries a current i, then the total current threading the loop is nℓi.

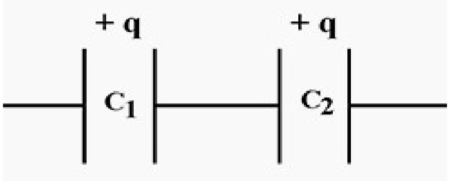
Hence, from Ampere's circuital law,

$$\sum\vec{B}.\vec{dl} = \mu_o(n\,\ell\, i)$$

or $$B\ell = \mu_o(n\,\ell\, i)$$

$$B = \mu_o ni$$

35



1

$V_1 = \frac{q}{c_1}$

$V_2 = \frac{q}{c2}$

$V = v_1 + v_2$

$= \frac{q}{c_1} + \frac{q}{c_2}$ ....(1) ½ 2

If the equivalent capacitance is C,

$V = \frac{q}{C}$ ……………..(2)

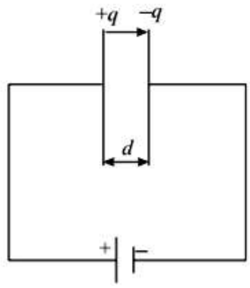
From equation (1) and (2):

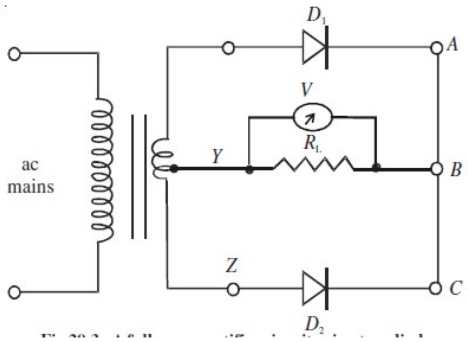
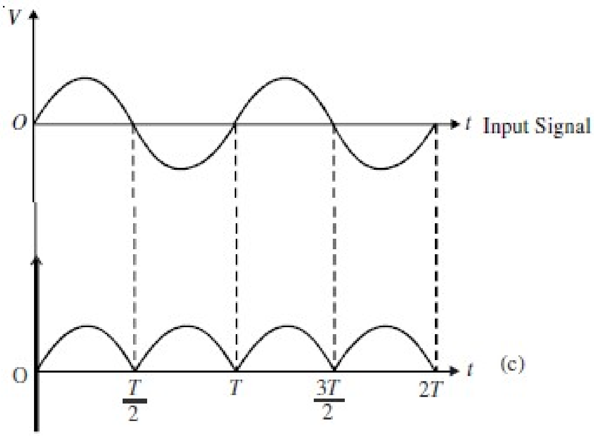
$$\frac{1}{C} = \frac{1}{c_1} + \frac{1}{c_2}$$ ½

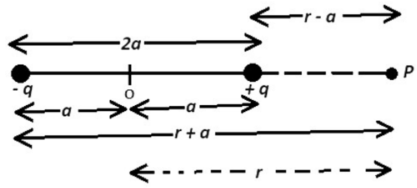
OR OR

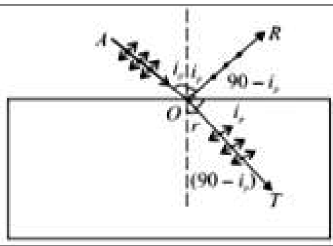
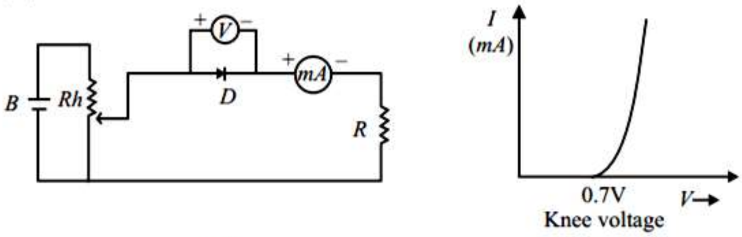
Expression for capacitance of parallel plate capacitor.

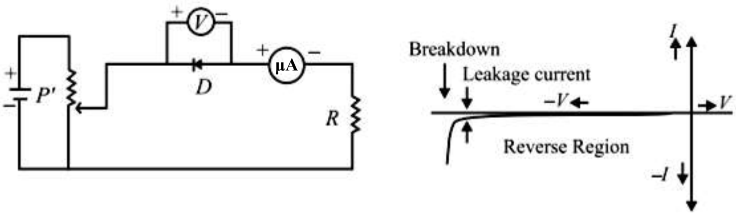
Let 'A' be the plate area and'd' be the separation between the plates of a parallel plate capacitors. Suppose that these plates acquire +q and –q charge when the ½

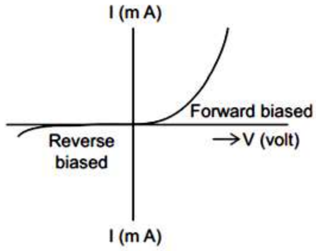
	capacitor is fully charged. These charges set up a uniform electric field $\vec{E}$ between the plates.  If σ is surface charge density on either plate, the magnitude of electric field between the plates is given by $$E = \frac{\sigma}{\varepsilon_o} = \frac{qA}{\varepsilon_o}$$ and the potential difference between the plates is given by $$V = Ed = \left(\frac{qA}{\varepsilon_o}\right) d$$ Hence, capacitance of a parallel plate capacitor $$C = \frac{q}{V} = \frac{\varepsilon_o A}{d}$$	½ ½ ½	
36	Wavelength of sound waves varies from 15m to 15mm respectively. The size of obstacles (almost) becomes comparable to wavelength of sound, so diffraction of sound wave takes place easily. But the wavelength of visible light varies from 0.4 to 0.7 micron which is very small. So, the size of most of the slits or obstacles are not comparable with wavelength of visible light, due to this diffraction of light cannot take place. So, the diffraction is a very common phenomenon in case of sound, but not that common in case of light. OR For observing interference of light, the sources of light must be coherent. When the light waves are coming from two incoherent sources, the points on the screen where two crests or two trough superpose at one instant to produce brightness may receive, at the other instant, the crest of the wave from one source and trough from the other and produce darkness. Thus, the whole screen will appear uniformly illuminated if the sources are not coherent.	1 1 OR 1 1	2
37	$I_p = 60^0$ $n = \tan i_p$ $= \tan 60$ $= \sqrt{3}$	½ ½ ½ ½	2
38	**Full Wave Rectifier** **Working:** For full wave rectifier we use two junction diodes. Suppose during **first half cycle** of input ac signal the terminal S_1 is positive relative to S and S_2 is negative relative to S, then **diode D_1 is forward biased** and diode **D_2 is reverse biased**. Therefore **current flows in diode D_1** and **not in diode D_2**. The direction of current due to diode D_1 in load resistance R_L is directed from A to B. In **next half cycle**, the terminal S_1 is negative relative to S and S_2 is positive relative to S. Then **diode D_1 is reverse biased** and **diode D_2 is forward biased**. Therefore **current flows in diode D_2** and there is **no current in diode D_1**. The direction of current due to diode D_2 in load resistance is again from A to B. Thus for input a.c. signal the output current is a continuous series of unidirectional pulses.	1 1	

	 **(Circuit of Full Wave rectifier)** 	1	3
39	Given $m=1g=10^{-3}kg$ $m=1g=10^{-3}kg$ $h=1km=1000m$ $g=10ms^{-2}$ $v=50ms^{-1}$ (1) Loss in Potential Energy of drop $=mgh=(10^{-3}kg)(10ms^{-2})(1000m)$ $=10J$ (2) Gain in Kinetic Energy of drop $=1/2mv^2=1/2\times(10^{-3}kg)(50ms^{-1})^2$ $=1.25J$ OR given : $v = ax^{3/2}$, acceleration = $dv/dt = 3/2ax^{1/2}dx/dt$ Acceleration = $3/2ax^{1/2}v = 3/2ax^{1/2}(ax^{3/2}) = 3/2\ a^2x^2$ Force = mass x acceleration $W = \int F.dx = \int 0.5\ 3/2\ a^2x^2dx = 1.5/2\ a^2x^3/3$ $=0.25 \times 5 \times 5 \times 2 \times 2 \times 2 = 50J$	1 1 1 OR 1 1 1	3

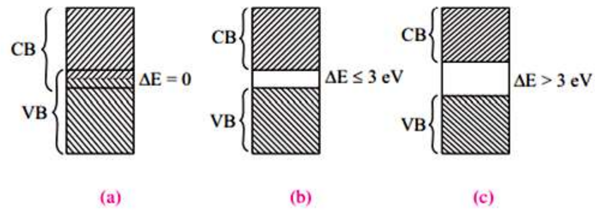
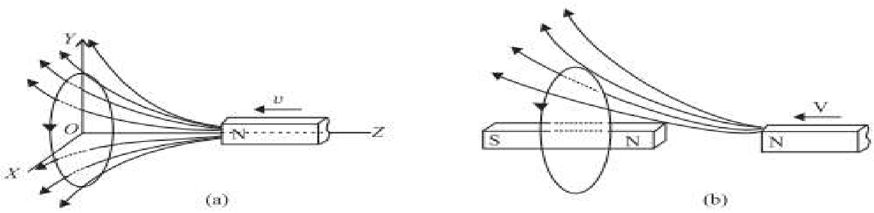
40	 Let P is an axial point at a distance of r from the centre of dipole. The electric potential at point P is given as below. $V=V_1+V_2$ V_1 and V_2 are respectively the potential due to +q and - q charges $V=\frac{1}{4\pi\varepsilon 0}\left(\frac{q}{r-a}+\frac{-q}{r+a}\right)$ $=\frac{1}{4\pi\varepsilon 0}\left(\frac{2aq}{r^2-a^2}\right)$ $=\frac{1}{4\pi\varepsilon 0}\left(\frac{p}{r^2-a^2}\right)$ Therefore the electric potential is $=\frac{1}{4\pi\varepsilon_0}\left(\frac{p}{r^2-a^2}\right)$ OR Two equal and opposite forces - qE and +qE forms a couple which tries to rotate the dipole. Torque due to this couple τ =either force X⊥ distance= qE x $2a\sin\theta$ $\tau= pE\sin\theta$ Work done in rotating the dipole through an angle $d\theta$ $dW = \tau d\theta = \mathrm{p}E\sin\theta\, d\theta$ ⇨$W = \int_{\theta_1}^{\theta_2} \mathrm{p}E\sin\theta\, d\theta = \mathrm{p}E\int_{\theta_1}^{\theta_2}\sin\theta\, d\theta = \mathrm{p}E[-\cos\theta]_{\theta_1}^{\theta_2}$ ⇨$W = \mathrm{p}E(\cos\theta_1 - \cos\theta_2)$-------(1) When $\theta_1= 90^0$and $\theta_2=\theta$, then $W = U$ ⇨ $U= \mathrm{p}E(\cos 90^0 - \cos\theta) = \mathrm{p}E(0-\cos\theta)= \boldsymbol{-\mathrm{p}E\cos\theta}$ ⇨ $\boldsymbol{u(\theta) = -\vec{p}.\vec{E}}$	1 1 1 OR 1 1 1	3
41	**<u>Brewster's Law:</u>** It states that the reflected ray is completely polarized when the refracted and reflected rays are mutually perpendicular to each other and this occurs at a special angle of incidence called as polarizing angle. Mathematically it is stated as: tan i_p = n. i_p = polarizing angle n = refractive index. Since refractive index depends upon the wavelength of light. As different colours have different wavelength therefore they have different polarizing angle.	1 1	3

<table>
<tr><td></td><td>
</td><td>1</td><td></td></tr>
<tr><td>42</td><td>(a) The circuit arrangement and their corresponding *V–I* characteristics of a diode are shown in Fig. (*1*) and (*2*). For different values of voltages the value of current is noted. A graph obtained between *V* and *I* is the characteristics of the diode.


(a) (b)
Fig. 1


(a) (b)
Fig.2
From the V-I characteristic of a junction diode it is clear that it allows current to pass only when it is forward biased.
(b) In a light emitting diode, when the forward current is low, the intensity of the emitted light is also low. As the forward current increases, the intensity of emitted light also increases and attains a maximum value, again as a result of increase in forward current, the intensity of light decreases. The LED is oriented in such a way that the efficiency of the light emitted is maximum. The IV characteristics of LEDs are similar to those of SI junction diodes. But the threshold voltage is very high and its value is different for each color of LED.


Or
In solids, very large number of atoms (typically 10^{23} atoms per cm3) come together to form crystals. If N atoms interact corresponding to each of the energy states, 2N</td><td>1
1
1
1
1
OR
2</td><td>5</td></tr>
</table>

	energy states are created. All these energy states are so close to each other (typically $\Delta E \sim 10^{-23}$ eV) that we cannot practically discriminate between them. This quasi continuous distribution of energy states, which are though separate but practically indiscriminable, is called energy band. The process of interaction of energy states (and thereby energy band formation) starts from outer unfilled energy states and then proceeds to valence level. The band formed of unfilled energy levels is called conduction band and the one formed of filled valence levels is called valence band. The relative position of these bands, at equilibrium separation, determines the conduction characteristics of a solid. • If in a solid at equilibrium separation, the conduction band (CB) and valence bands (VB) overlap as it happens in case of metals the material is conductor • If at equilibrium separation the conduction band is completely empty, valence band is completely full and there is a small band gap ($\Delta E \leq 3$ eV) between the highest level of valence band and lowest level of conduction band, called a forbidden energy gap, the solid is a semiconductor. • If at equilibrium separation, the CB is completely empty, VB is completely filled and there is a large band gap ($\Delta E > 3$ eV) the solid is an insulator. 	3	
43	**Lenz's law:** According to this law "the direction of induced current in a closed circuit is always such as to oppose the cause that produces it." For example: When the north pole of a coil is brought near a closed coil, the direction of current induced in the coil is such as to oppose the approach of north pole. For this the nearer face of coil behaves as north pole. This necessitates an anticlockwise current in the coil, when seen from the magnet side  Similarly when north pole of the magnet is moved away from the coil, the direction of current in the coil will be such as to attract the magnet. For this the nearer face of coil behaves as south pole. This necessitates a clockwise current in the coil, when seen from the magnet side. Thus, in each case whenever there is a relative motion between a coil and the magnet, a force begins to act which opposes the relative motion. Therefore to maintain the relative motion, a mechanical work must be done. This work appears in the form of electric energy of coil. Thus Lenz's law is based on conservation of energy.	1 1	

(b) Suppose two co-axial solenoids S_1 and S_2 of radii r_1 and r_2 , number of turns N_1 and N_2 each of length 'l'

Suppose I 1 is the current in outer solenoid; magnetic field at the axis, $B_1 = \mu_0 n_1 I_1$ where n_1 = number of turns/meter of outer solenoid.

Magnetic flux linked with inner solenoid (S_2) — 5

$$\phi_2 = (N_2)B_1A_1 = N_2(\mu_0 n_1 I_1)\pi {r_1}^2$$

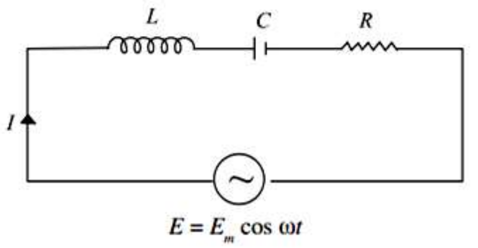
Mutual inductance of two solenoid system

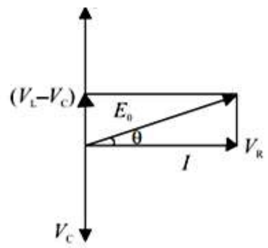
$$M = \frac{\phi_2}{I_1} = \mu_0 n_1 N_2 \pi {r_1}^2$$ — 1

$$\frac{N_1}{l} = n_1$$ — 1

$$\frac{\mu_0 n_1 N_2 \pi {r_1}^2}{l} = M$$ — 1

OR — OR





— 1

From phasor diagram

$$\boldsymbol{V} = \sqrt{V_R^2 + (V_C - V_L)^2}$$

$$V = \sqrt{(IR)^2 + (IX_C - IX_L)^2}$$

$$V = I\sqrt{R^2 + (X_C - X_L)^2}$$

$$\Rightarrow \boldsymbol{I} = \frac{V}{\sqrt{R^2 + (X_C - X_L)^2}}$$ — 1

Obviously, effective resistance of the circuit, known as impedance is given by

$$Z = \sqrt{(R)^2 + (X_C - X_L)^2}$$

At Resonance:

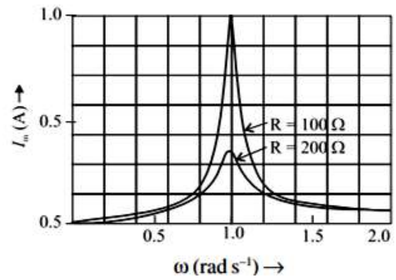
$$X_L = X_C$$

$$\omega L = \frac{1}{\omega C}$$ — 1

$$\omega^2 = \frac{1}{LC}$$

$$\omega = \frac{1}{\sqrt{LC}}$$

— 1



— 1