SECTION A [40 MARKS]

ANSWER **ALL** QUESTIONS

Question 1 **[15]**

a) For each question, there are four alternatives A, B, C and D. Choose the correct alternative and circle it. Do not circle more than ONE alternative. If there are more than one choice circled, NO score will be awarded.

i. Flowers remain fresh when its stem is dipped in water due to

A polarity.

B pressure.

C viscosity.

D capillarity.

ii. Which **ONE** of the following quantities associated with a body executing SHM is directly proportional to its displacement?

A velocity

B total energy

C time period

D acceleration

iii. An amplitude of a particle executing SHM is A. What would happen to its kinetic energy if the displacement of the particle is at $\frac{A}{\sqrt{2}}$?

A kinetic energy > potential energy

B kinetic energy < potential energy

C kinetic energy = potential energy

D kinetic energy = total energy

iv. The Coulomb's force between two charged spherical bodies at a distance is 'F'. What will happen to the force if the separation between the two charged bodies is doubled?

A F

B 2F

C F/2

D F/4

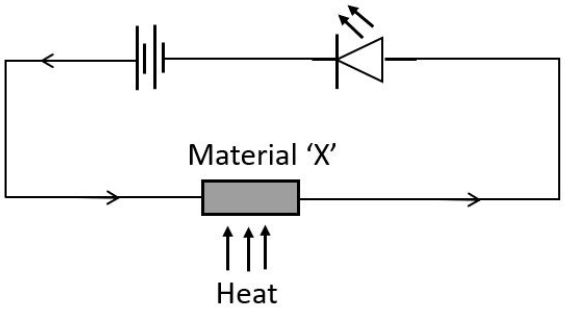
v. A transformer has 400 primary turns and 100 secondary turns. To obtain 30 V from secondary winding, the voltage applied to the primary winding must be

A 20 V.
B 120 V.
C 220 V.
D 320 V.

vi. According to the particle nature of light, light exists as particles called photons. Therefore, photons are

A neutral.
B negatively charged.
C positively charged.
D deflected by electromagnetic field.

vii. The material 'X' in the circuit does not conduct electricity at room temperature. However, when it is heated to a certain temperature, the current flows through the circuit making the LED glow. What could be the material 'X'?

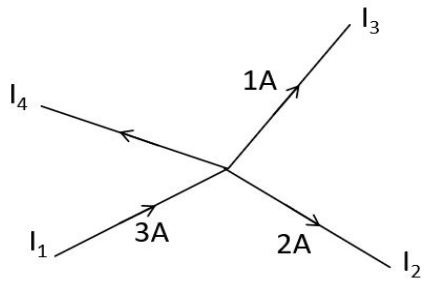


A iron
B glass
C copper
D silicon

viii. What is the function of moderator in a nuclear fission reactor?

A As a safety precaution for coolant.
B To maintain the temperature of the reactor.
C To prevent radioactive material from escaping.
D To slow down the neutrons released during fission.

ix. What is the value of the unknown current (I_4)?



A 0 A

B 1 A

C 2 A

D 3 A

x. What elementary particles are the building blocks for protons and neutrons?

A quarks

B leptons

C photons

D positrons

xi. The phenomenon of photoelectric effect is enhanced by electromagnetic radiation of

A shorter wavelength.

B longer wavelength.

C low frequency.

D low intensity.

xii. In Young's double slit experiment, the distance between slits is doubled and the distance between the slit and the screen is halved. What would be the effect on the fringe width?

A same

B doubled

C one-fourth

D quadrupled

xiii. A particle of mass 0.2 kg executes SHM from the mean position. How far will it travel in 0.5 s if the period and the amplitude are 6 s and 8 cm respectively?

A 4 m
B 4 cm
C 6.9 m
D 6.9 cm

xiv. The step-up transformer has transformer ratio

A less than one.
B equal to one.
C equal to zero.
D greater than one.

xv. Which type of mirror make objects appear smaller but the area of view larger?

A converging mirror
B diverging mirror
C parabolic
D plane

b) Fill in the blanks with appropriate word. **[5]**

i.	The angle of contact is _____ of the inclination of solid to liquid surface and is _____ for a given pair of solid and liquid and surrounding medium.	
ii.	For an oscillator, if the frequency of driving force is very close to its _____ frequency, there is increase in amplitude of the oscillation which is known as _____.	
iii.	According to _____ law, the magnitude of induced emf produced in a coil is directly proportional to the rate of change of _____.	
iv.	In a _____ lens, a virtual object cannot form a virtual image and in a _____ lens, a real object cannot form a real image.	
v.	A heat dependent resistor known as _____ thermistor decreases its resistance as the temperature _____.	

c) Correct the following statements. **[5]**

i. The AC generator is a self-sustaining dynamo.

ii. The graph showing variation of potential difference across plates of capacitor against charged stored represents capacitance of the capacitor.

iii. The amount of energy released during a nuclear reaction is given by the mass-energy relation $E = \frac{1}{2}mv^2$.

iv. Light from a distant source produces a spherical wave front.

v. The impossibility to measure both the position and momentum of a microscopic particle at the same time is based on Einstein's photoelectric equation.

d) Match each item of Column A with the most appropriate item of Column B. Rewrite the correct pairs by writing the alphabet against the number in the spaces provided. **[5]**

Column A		Column B	
i.	Produces a desired electric field	a)	$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$
ii.	Maximum velocity	b)	$L = L_1 + L_2 + L_2$
iii.	Series combination of capacitors	c)	Mean positions
iv.	Electric flux	d)	$V = I\left(\frac{R_1 \times R_2}{R_1 + R_2}\right)$
v.	Potential divider	e)	Capacitors
vi.	Series combination of induction	f)	$V_o = V_i\left(\frac{R_2}{R_1 + R_2}\right)$
vii.	Ohm's law	g)	Extreme positions
viii.	Electric field strength	h)	$\frac{1}{L} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}$
ix.	Maximum acceleration	i)	Inductors
x.	Produces a desired magnetic field	j)	$\emptyset = EA\ \cos\theta$
		k)	$E = \frac{F}{q_0}$
		l)	$C = C_1 + C_2 + C_3$

Column A	Column B
i.	
ii.	
iii.	
iv.	
v.	
vi.	
vii.	
viii.	
ix.	
x.	

e) Answer the following questions.

i. Define magnification of a spherical mirror. **[1]**

ii. The time period of a simple pendulum is found to be 2 sec in Phuentsholing. However, when the same pendulum set is taken to Gasa, its time period increases. Give **ONE** reason. **[1]**

iii. The distilled water is not an ideal fluid. Justify with **TWO** reasons. **[2]**

iv. Write any **TWO** future implications of nanotechnology. **[2]**

v. State any **TWO** ways to increase the induced emf of an AC generator. **[1]**

vi. The battery of a smartphone does not last for a long duration therefore, to improve its life, phones are designed to use low voltage under bright light and higher voltage in low light automatically. Name the sensor that connects the part of a potential divider in a mobile circuit board. **[1]**

vii. Will light from two sources form an interference pattern on a screen? Justify. **[1]**

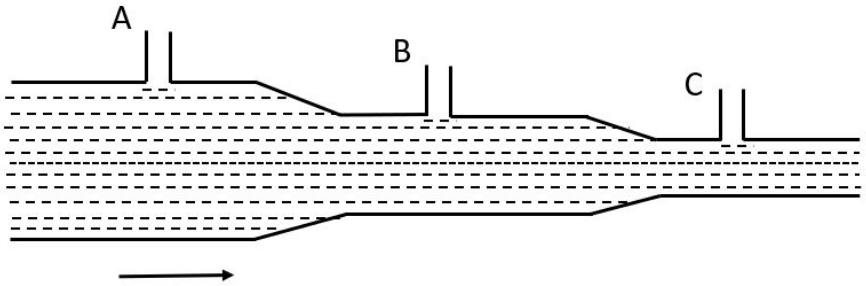
viii. What is the relation between the sunspots and the climatic condition on earth? **[1]**

SECTION B [60 MARKS]
ATTEMPT **ANY SIX** QUESTIONS

Question 2

a) Write any **TWO** factors that influence solar insolation. **[1]**

b) In the given diagram, liquid is flowing through a horizontal pipe. Three equal size pores are drilled to check the liquid pressure. From which hole do you expect the liquid to gush out with greatest pressure? Give an appropriate reason to support your answer. **[2]**



c) An object of height 5 cm is placed at a distance of 15 cm from a convex lens of focal length 10 cm. Find the position of the image formed. **[2]**

d) A metallic bob suspended from a rigid support with the help of an inextensible string is set to oscillate. Derive the relation between the time period of oscillation and the length of the string used. **[3]**

e) Deduce the Lenz's law based on the opposition to flux change with a diagram. **[2]**

Question 3

a) Define power of lens. How much is one dioptre (1 D)? **[2]**

b) How is interference different from diffraction based on intensity pattern? **[2]**

c) A capillarity tube of diameter 2×10^{-3} m is dipped in a liquid of surface tension 0.072 N/m, and density of 993.73 kg/m^3. Calculate the height to which the liquid will rise in the capillary tube. (Given: $g = 10\ m/s^2$, angle of contact $= 45^0$) **[2]**

d) Which of the given circuits of LDR is more applicable for automatic control of street lights? Explain briefly. **[2]**

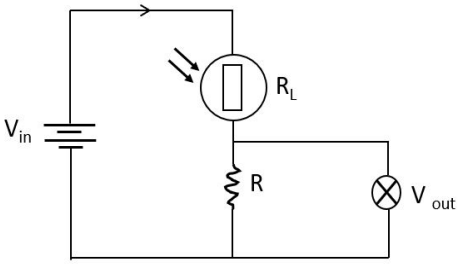


Figure A

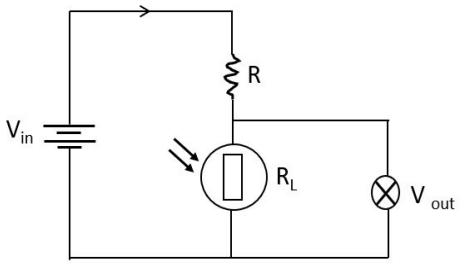


Figure B

e) Bhutan should look for alternative sources of energy such as nuclear energy to generate electricity. Which would you recommend: nuclear fission or nuclear fusion? Support your answer with **TWO** points. **[2]**

Question 4

a) Give the relation between angular frequency and the time period. **[1]**

b) How does solar flare affect the telecommunication system on the Earth? **[2]**

c) Proton and neutron are not elementary particles. Explain based on β^+ and β^- decay. **[2]**

d) What is nuclear energy? **[1]**

e) Explain constructive and destructive interference based on principle of superposition of light waves with the help of diagrams. **[2]**

f) Concave lens forms a real image. Do you agree? Justify with a reason. **[2]**

Question 5

a) State Huygen's principle. **[1]**

b) Explain what will happen to the reading of a voltmeter connected to the plates of a charged capacitor if the plates are separated further? **[2]**

c) A choke of inductance 29 mH is used for carrying a current of 10 A. Determine the rate at which the current should be changed to produce an emf of 120 V? **[2]**

d) Distinguish between real and virtual images. **[1]**

Real image	Virtual Image

e) On adding an impurity ‘X’ to germanium, it was found that the electrons were majority of charge carriers, whereas on adding impurity ‘Y’ to the germanium, holes were found to be the majority of charge carriers. Identify ‘X’ and ‘Y’, and also define the process. **[2]**

f) Are the properties of electric field and gravitational field similar? Support your answer with **THREE** points. **[2]**

Question 6

a) Using an expression, state how magnetic field strength depends upon absolute permeability of a medium? **[1]**

b) Can a periodic motion be considered as simple harmonic motion? Give an example to support your answer. **[2]**

c) The force of attraction of 10 N is acting between two charges of $+7\mu C$ and $-7\mu C$ placed apart at a distance. If the charges are mutually touched and then placed again at the same distance, what will be the new force acting between them? Why? **[2]**

d) A radio with an analog tuner uses a LCR circuit to tune to desired frequency. The tuning knob is attached to $15\mu F$ capacitor connected in series with 50 Ω resistor and supplied 150 Hz frequency. Calculate: **[3]**

i) impedence.

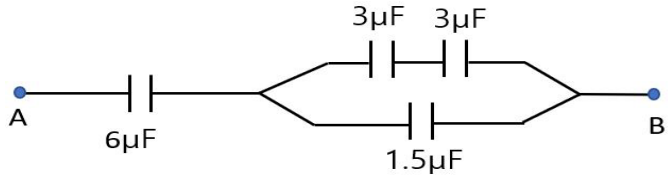
ii) phase difference.

e) Viscosity is fluid friction. Support the statement. **[2]**

Question 7

a) Define stopping potential. **[1]**

b) Calculate the equivalent capacitance of the given circuit. **[2]**



c) Prove that one dimensional projection of uniform circular motion is a SHM. **[3]**

d) Explain the statement: 'A metallic sphere is charged electrically.' **[2]**

e) Does the current lag the voltage in a LCR circut? Justify your answer with a reason. **[2]**

Question 8

a) State Kirchhoof's Loop rule. **[1]**

b) Why is gravitational force not a part of Standard Model? **[2]**

c) The work function of a photosensitive material is 3.3×10^{-19}J. What is its threshold frequency? **[2]**

d) The equation of SHM is given by $y = 3 \sin 6\, t$. Calculate: **[3]**

i) maximum acceleration and

ii) maximum velocity.

e) Differentiate between controlled chain reaction and uncontrolled chain reaction with an example. **[2]**

Controlled chain reaction	Uncontrolled chain reaction

[PHYSICAL CONSTANTS]

Acceleration due to gravity	$g = 9.8\ m/s^2$
Avogadro's number	$N_A = 6.022 \times 10^{23}$
Boltzmann constant	$k = 1.38 \times 10^{-23}\ J/K$
Density of water at 4°C	$\rho = 1000\ kg/m^3$
Electron charge	$e = 1.6 \times 10^{-19}\ C$
Energy equivalent of	1u = 931.5 MeV
Mass of an electron	$m_e = 9.1 \times 10^{-31}\ kg$
Mass of a neutron	$m_n = 1.008665\ u$
Mass of a proton	$m_p = 1.007276\ u$
Permeability of free space	$\mu_0 = 4\pi \times 10^{-7}\ TmA^{-1}$
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2N^{-1}m^{-2}$
Planck's constant	$h = 6.63 \times 10^{-34}\ J.s$
Speed of electromagnetic wave	$c = 3 \times 10^8\ ms^{-1}$
Standard atmospheric pressure	1 atm = 101325 Pa
Universal gas constant	R = 8.31 J/mol.K
1 electron volt	$1eV = 1.6 \times 10^{-19}\ J$
	$\pi = 3.14$

Rough Work