GOOD SAMARITAN PUBLIC SCHOOL, SIRKALI
PRE-BOARD EXAM (2019-20)

PHYSICS

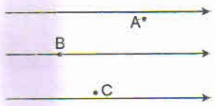
Time Allowed: 3 hours **Max. Marks: 70**

General Instructions: *Same as Model Question Paper–1.*

SECTION–A

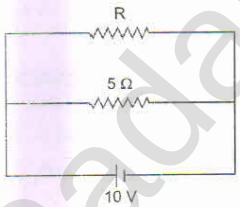
Choose and write the correct option in the following questions.

1. A, B and C are three points in a uniform electric field. The electric potential is



(a) maximum at A (b) maximum at B
(c) maximum at C (d) same at all the three points A, B and C

2. The power dissipated in the circuit shown in the figure is 30 watts. The value of R is



$P = VI$
$I = \frac{30}{10} = 3A$
$V = IR$
$10 = 3 \times R$
$R = \frac{10}{3}\Omega$

$\frac{1}{R} + \frac{1}{5} = \frac{3}{10}$
$\frac{5+R}{5R} = \frac{3}{10}$
$10 + 2R = 3R$
$R = 10\Omega$

(a) 20 Ω (b) 15 Ω (c) 10 Ω (d) 30 Ω

3. In a metre bridge experiment null point is obtained at 20 cm from one end of the wire, when resistance X is balanced against another resistance Y. If $X < Y$, then where will be the new position of null point from the same end if one decides to balance a resistance of 4 X against Y?

(a) 50 cm (b) 80 cm (c) 40 cm (d) 70 cm

$\frac{X}{Y} = \frac{20}{80} = \frac{1}{4}$
$4X = Y$
$\frac{4x}{Y} = \frac{l}{100-l}$
$100 - l = l$
$l = 50cm$

4. The plane at which the earth's magnetic field is horizontal is

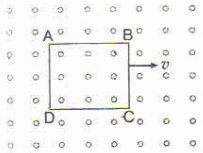
(a) plane through magnetic meridian
(b) plane through magnetic equator
(c) plane through magnetic poles
(d) it is not horizontal anywhere

OR

The best material for the core of a transformer is

(a) stainless steel (b) mild steel (c) hard steel (d) soft iron

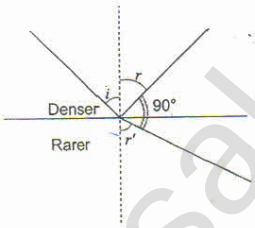
5. A metallic square loop *ABCD* is moving in its own plane with a velocity v in a uniform magnetic field perpendicular to plane as shown in fig. An electric field is induced



(a) in *AD* but not in *BC* (b) in *BC* but not in *AD*

(c) neither in *AD* nor in *BC* (d) in both *AD* and *BC*

6. A ray of light from denser medium strikes a rarer medium at an angle of incidence i (fig. shown). The reflected and refracted rays make angle 90° with each other. The angles of reflection and refraction are r and r' respectively. The critical angle is



(a) $\sin^{-1}(\cot r)$ (b) $\sin^{-1}(\tan i)$ (c) $\sin^{-1}(\tan r')$ (d) $\tan^{-1}(\sin i)$

7. The angle of incidence at which reflected light is totally polarised for reflection from air to glass (refractive index n) is

(a) $\sin^{-1}$ (b) $\sin^{-1}\left(\frac{1}{n}\right)$ (c) $\tan^{-1}\left(\frac{1}{n}\right)$ (d) $\tan^{-1}(n)$

8. If a source of power 4 kW produces 10^{20} photons per second, the radiation belongs to the part of spectrum called

(a) γ-rays (b) X-rays (c) ultraviolet ray (d) microwaves

9. If radius of the $^{27}_{13}$Al nucleus is taken to be R_{Al}, then the radius of $^{125}_{53}$Te nucleus is nearly

(a) $\frac{3}{5}R_{Al}$ (b) $\left(\frac{13}{53}\right)^{1/3}R_{Al}$ (c) $\left(\frac{53}{13}\right)^{1/3}R_{Al}$ (d) $\frac{5}{3}R_{Al}$

OR

A radioactive isotope has a half-life of 2 years. How long will it take the activity to reduce to 3% of its original value?

(a) 4.8 years (b) 7 years (c) 10 years (d) 9.6 years

10. Hydrogen atom emits light when it changes from $n = 2$ energy level. Which colour of light would the atom emit?

(a) red (b) yellow (c) green (d) violet

In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(*a*) *Assertion and reason both are correct statements and reason is correct explanation for assertion.*

(*b*) *Assertion and reason both are correct statements but reason is not correct explanation for assertion.*

(*c*) *Assertion is correct statement but reason is wrong statement.*

(*d*) *Assertion is wrong statement but reason is correct statement.*

11. **Assertion** : For a charged particle moving from point P to point Q the net work done by an electrostatic field on the particle is independent of the path connecting point P to point Q.

    Reason : The net work done by a conservative force on the object moving along a closed loop is zero.

12. **Assertion** : The sensitivity of a moving coil galvanometer is increased by placing a suitable magnetic material as a core inside the coil.

    Reason : Soft iron has a high magnetic permeability and cannot be easily magnetized or demagnitized.

13. **Assertion** : We use a thick wire in the secondary of a step-down transformer to reduce the production of heat.

    Reason : When the plane of the armature is parallel to the lines of force of magnetic field, the magnitude of induced e.m.f. is maximum.

Fill in the Blanks:

14. The value of the intensity of magnetization of the magnetic material, when the magnetizing field is reduced to zero, is called its _____ .

15. The redistribution of light energy on account of superposition of light waves from two coherent sources of light is known as _____ .

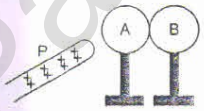
Answer the following questions in one word or one sentence:

16. Define intensity of radiation based on photon picture of light.

17. How does the angle of minimum deviation of a glass prism vary if the incident violet light is replaced by red light?

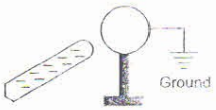
18. Draw a plot of resistivity of copper as a function of temperature.

19. Two metallic spheres A and B kept on insulating stands are in contact with each other. A positively charged rod P is brought near the sphere A as shown in the figure. The two spheres are separated from each other, and the rod P is removed. What will be the nature of charges on spheres A and B ?



OR

A metal sphere is kept on an insulating stand. A negatively charged rod is brought near it, then the sphere is earthed as shown. On removing the earthing, and taking the negatively charged rod away, what will be the nature of charge on the sphere ? Give reason for your answer.



20. The small ozone layer on top of the stratosphere is crucial for human survival. Why ?

OR

Illustrate by giving suitable examples, how you can show that electromagnetic waves carry both energy and momentum.

SECTION–B

21. Plot a graph showing the variation of undecayed nuclei N versus time t. From the graph, find out how one can determine the half-life and average life of the radioactive nuclei.

22. (*i*) Which property of nuclear force explains the constancy of binding energy per nucleon $\left(\frac{BE}{A}\right)$ for nuclei in the range $20 < A < 170$?

(*ii*) Complete the following nuclear reactions:

(*a*) $^{32}_{15}P \longrightarrow {}^{A}_{Z}X + e^{-} + \bar{\nu}$

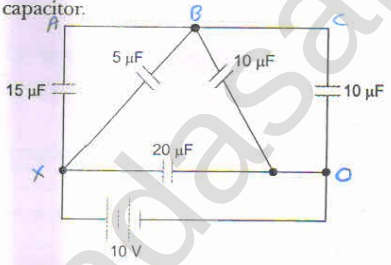
(*b*) $^{12}_{6}C + {}^{12}_{6}C \longrightarrow {}^{A}_{Z}Y + {}^{4}_{2}He$

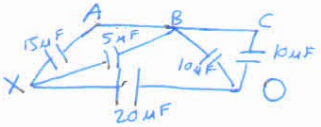
OR

An electromagnetic wave of wavelength λ is incident on a photosensitive surface of negligible work function. If the photoelectrons emitted from the surface have the same de Broglie wavelength λ_B, prove that $\lambda = \left(\frac{2mc}{h}\right)\lambda_B^2$.

23. Obtain Bohr's quantisation condition for angular momentum of electron orbiting in n^{th} orbit in hydrogen atom on the basis of the wave picture of an electron using de Broglie hypothesis.

24. The figure shows a network of five capacitors connected to a 10 V battery. Calculate the charge acquired by the 5 μF capacitor.





25. A 0.5 m long solenoid of 10 turns/cm has area of cross-section 1 cm^2. Calculate the voltage induced across its ends if the current in the solenoid is changed from 1 A to 2 A in 0.1 s.

OR

A small flat search coil of area 5 cm^2 with 140 closely wound turns is placed between the poles of a powerful magnet producing magnetic field 0.09 T and then quickly removed out of the field region. Calculate

(*i*) change of magnetic flux through the coil, and

(*ii*) emf induced in the coil.

26. In the case of a concave mirror of focal length f, when an object is kept between f and $2f$, show that its image is formed beyond $2f$.

27. Five point charges, each of charge + q are placed on five vertices of a regular hexagon of side 'l'. Find the magnitude of the resultant force on a charge – q placed at the centre of the hexagon.

OR

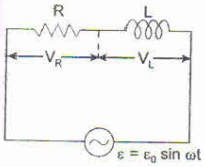
A simple pendulum consists of a small sphere of mass m suspended by a thread of length l. The sphere carries a positive charge q. The pendulum is placed in a uniform electric field of strength E directed vertically downwards. Find the period of oscillation of the pendulum due to the electrostatic force acting on the sphere, neglecting the effect of the gravitational force.

SECTION–C

28. (*i*) An ac circuit as shown in the figure has an inductor of inductance L and a resistor of resistance R connected in series. Using the phasor diagram, explain why the voltage in the circuit will lead the current in phase.

(*ii*) The potential difference across the resistor is 160 V and that across the inductor is 120 V. Find the effective value of the applied voltage. If the effective current in the circuit be 1.0 A, calculate the total impedance of the circuit.

(*iii*) What will be the potential difference in the circuit when direct current is passed through the circuit?



OR

An ac circuit consists of a series combination of circuit elements X and Y. The current is ahead of the voltage in phase by $\frac{\pi}{4}$. If element X is a pure resistor of 100 Ω,

(*i*) name the circuit element Y.

(*ii*) calculate the rms value of current, if rms value of voltage is 141 V.

(*iii*) what will happen if the ac source is replaced by a dc source?

29. (*i*) Plot a graph to show the variation of stopping potential with frequency of incident radiation in relation to photoelectric effect.

(*ii*) Use Einstein's photoelectric equation to show how from this graph,

(*a*) Threshold frequency, and (*b*) Planck's constant can be determined.

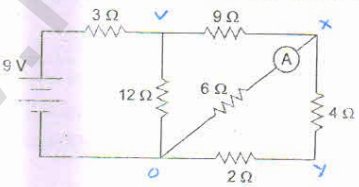
OR

(*i*) How does one explain the emission of electrons from a photosensitive surface with the help of Einstein's photoelectric equation ?

(*ii*) Work function of aluminium is 4.2 eV. If two photons each of energy 2.5 eV are incident on its surface, will the emission of electrons take place? Justify your answer.

(*iii*) The stopping potential in an experiment on photoelectric effect is 1.5 V. What is the maximum kinetic energy of the photoelectrons emitted ? Calculate in Joules.

30. In the circuit shown in the figure, find the value of the current shown in the ammeter A.



31. (*i*) Explain briefly, using a proper diagram, the difference in behaviour of a conductor and a dielectric in the presence of external electric field.

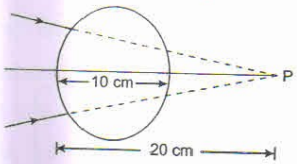
(*ii*) Define the term polarization of a dielectric and write the expression for a linear isotropic dielectric in terms of electric field.

32. (*i*) How are eddy currents generated in a conductor which is subjected to a magnetic field?

(*ii*) Write two examples of their useful applications.

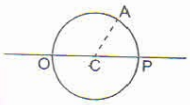
(*iii*) How can the disadvantages of eddy currents be minimized?

33. A converging beam of light travelling in air converges at a point P as shown in the figure. When a glass sphere of refractive index 1.5 is introduced in between the path of the beam, calculate the new position of the image. Also draw the ray diagram for the image formed.



OR

A point '*O*' marked on the surface of a glass sphere of diameter 20 cm is viewed through glass from the position directly opposite to the point *O*. If the refractive index of the glass is 1.5, find the position of the image formed. Also, draw the ray diagram for the formation of the image.



34. Define the dipole moment of a magnetic dipole. Write its S.I. unit.

Obtain the expression for the torque acting on a magnetic dipole placed in an external uniform magnetic field.

SECTION–D

35. (*i*) Distinguish between an intrinsic semiconductor and a *p*-type semiconductor. Give reason why a *p*-type semiconductor crystal is electrically neutral, although $n_h >> n_e$.

(*ii*) Name the important process that occurs during the formation of a *p-n* junction. Explain briefly, with the help of a suitable diagram, how a *p-n* junction is formed. Define the term 'barrier potential'.

OR

(*i*) Write the important considerations which are to be taken into account while fabricating a p-n junction diode to be used as a Light Emitting Diode (LED). What should be the order of band gap of an LED, if it is required to emit light in the visible range ? Draw a circuit diagram and explain its action.

(*ii*) Draw the V-I characteristics of an LED. State two advantages of LED lamps over conventional incandescent lamps.

36. (*i*) State and explain the law used to determine magnetic field at a point due to a current element. Derive the expression for the magnetic field due to a circular current carrying loop of radius *r* at its centre.

(ii) A long wire with a small current element of length 1 cm is placed at the origin and carries a current of 10 A along the X-axis. Find out the magnitude and direction of the magnetic field due to the element on the Y-axis at a distance 0.5 m from it.

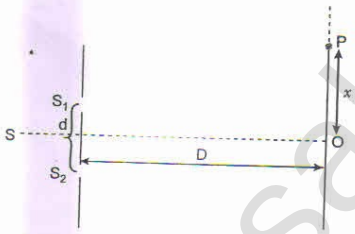
OR

(i) Derive the expression for the magnetic field due to a current carrying coil of radius r at a distance x from the centre along the X-axis.

(ii) A straight wire carrying a current of 5 A is bent into a semicircular arc of radius 2 cm as shown in the figure. Find the magnitude and direction of the magnetic field at the centre of the arc.

37. (i) Can the interference pattern be produced by two independent monochromatic sources of light? Explain.

(ii) The intensity at the central maximum (O) in a Young's double slit experimental set-up shown in the figure is I_O. If the distance OP equals one-third of the fringe width of the pattern, show that the intensity at point P, would equal $\frac{I_O}{4}$.



(iii) In Young's double slit experiment, the slits are separated by 0.5 mm and screen is placed 1.0 m away from the slit. It is found that the 5th bright fringe is at a distance of 4.13 mm from the 2nd dark fringe. Find the wavelength of light used.

OR

(i) Derive the relation $a \sin\theta = \lambda$ for the first minimum of the diffraction pattern produced due to a single slit of width 'a' using light of wavelength λ.

(ii) State with reason, how the linear width of central maximum will be affected if (a) monochromatic yellow light is replaced with red light, and (b) distance between the slit and the screen is increased.

(iii) Using the monochromatic light of same wavelength in the experimental set-up of the diffraction pattern as well as in the interference pattern where the slit separation is 1 mm, 10 interference fringes are found to be within the central maximum of the diffraction pattern. Determine the width of the single slit, if the screen is kept at the same distance from the slit in the two cases.