Reg. No. : .....

Name : .....

**Code No. 2015**

**SECOND YEAR**
**SAY/IMPROVEMENT**
**JUNE 2018**

Time : 2 Hours
Cool-off time : 15 Minutes

Part – III

# PHYSICS

Maximum : 60 Scores

***General Instructions to Candidates :***

- There is a 'Cool-off time' of 15 minutes in addition to the writing time.
- Use the 'Cool-off time' to get familiar with questions and to plan your answers.
- Read questions carefully before answering.
- Read the instructions carefully.
- Calculations, figures and graphs should be shown in the answer sheet itself.
- Malayalam version of the questions is also provided.
- Give equations wherever necessary.
- Electronic devices except non-programmable calculators are not allowed in the Examination Hall.

***വിദ്യാർത്ഥികൾക്കുള്ള പൊതുനിർദ്ദേശങ്ങൾ :***

- നിർദ്ദിഷ്ട സമയത്തിന് പുറമെ 15 മിനിറ്റ് 'കൂൾ ഓഫ് ടൈം' ഉണ്ടായിരിക്കും.
- 'കൂൾ ഓഫ് ടൈം' ചോദ്യങ്ങൾ പരിചയപ്പെടാനും ഉത്തരങ്ങൾ ആസൂത്രണം ചെയ്യാനും ഉപയോഗിക്കുക.
- ഉത്തരങ്ങൾ എഴുതുന്നതിന് മുമ്പ് ചോദ്യങ്ങൾ ശ്രദ്ധാപൂർവ്വം വായിക്കണം.
- നിർദ്ദേശങ്ങൾ മുഴുവനും ശ്രദ്ധാപൂർവ്വം വായിക്കണം.
- കണക്ക് കൂട്ടലുകൾ, ചിത്രങ്ങൾ, ഗ്രാഫുകൾ, എന്നിവ ഉത്തരപേപ്പറിൽ തന്നെ ഉണ്ടായിരിക്കണം.
- ചോദ്യങ്ങൾ മലയാളത്തിലും നല്കിയിട്ടുണ്ട്.
- ആവശ്യമുള്ള സ്ഥലത്ത് സമവാക്യങ്ങൾ കൊടുക്കണം.
- പ്രോഗ്രാമുകൾ ചെയ്യാനാകാത്ത കാൽക്കുലേറ്ററുകൾ ഒഴികെയുള്ള ഒരു ഇലക്ട്രോണിക് ഉപകരണവും പരീക്ഷാഹാളിൽ ഉപയോഗിക്കുവാൻ പാടില്ല.

**You may use following Physical constants wherever necessary.**

Mass of proton $1.66 \times 10^{-27}$ kg

Mass of electron $9.11 \times 10^{-31}$ kg

Elementary charge, $e = 1.6 \times 10^{-19}$ C

Velocity of light in vacuum $c = 3 \times 10^{8}$ m/s

Permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m

**Question numbers 1 to 7 carry 1 score each. Answer any 6 questions.**

**(6 × 1 = 6)**

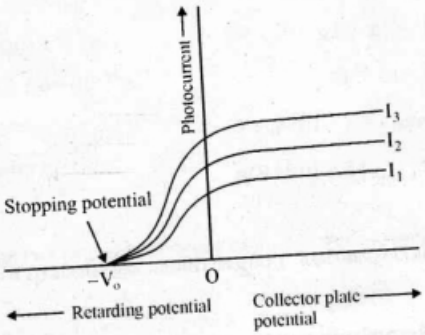
1. Write the physical quantities having the following SI unit.
   (i) cm
   (ii) Ωm

2. A uniform wire of resistance 40 Ω is cut into four equal parts and they are connected in parallel. The effective resistance of the combination is
   (i) 40 Ω
   (ii) 10 Ω
   (iii) 2.5 Ω
   (iv) 4 Ω

3. A particle of charge q is moving through a uniform magnetic field of intensity B with a velocity v. Write an expression for the force acting on the particle in vector form.

4. The minimum distance between the object and its real image for a concave mirror of focal length f is
   (i) f
   (ii) 2f
   (iii) 4f
   (iv) zero

5. Variation of photocurrent with collector plate potential for different intensities $I_1$, $I_2$ and $I_3$ of incident radiation is shown below.



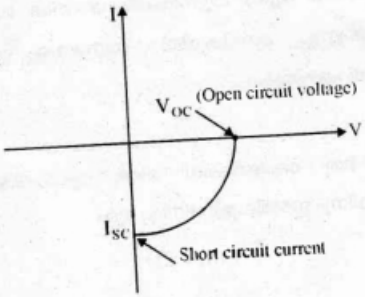

Arrange these intensities in the ascending order.

6. An electron is revolving around the nucleus of a hydrogen atom in an orbit of radius nine times the radius of the first orbit. Angular momentum of the electron in this orbit is

(i) $\frac{h}{2\pi}$ (ii) $\frac{9h}{2\pi}$

(iii) $\frac{3h}{\pi}$ (iv) $\frac{3h}{2\pi}$

7. The voltage – current characteristics of an optoelectronic junction device is shown below.




Identify the device.

**Question numbers 8 to 15 carry 2 scores each. Answer any 7 questions**

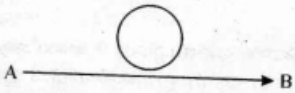
**(7 × 2 = 14)**

8. What is the radius of the circular path of an electron moving at a speed of $3 \times 10^7$ m/s in a magnetic field of $6 \times 10^{-4}$ T perpendicular to it ?

9. (a) "Parallel currents attract, and antiparallel currents repel". State whether this statement is true or false. **(1)**

   (b) Define the SI unit of current in terms of force between two current carrying conductors. **(1)**

10. A circular metallic loop and a current carrying conductor are placed as shown in figure.




If the current through the conductor is increasing from A to B, find the direction of induced current the loop.

11. (a) The electric field vector of an electromagnetic wave is represented as

$E_x = E_m \sin(kz - \omega t)$. Write the equation for the magnetic field vector. **(1)**

   (b) The ratio of intensity of magnetic field to intensity of electric field has the dimensions of **(1)**

   (i) velocity (ii) acceleration

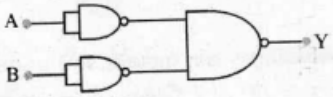
   (iii) reciprocal of velocity (iv) reciprocal of acceleration

12. Write the equations for the following nuclear reactions :

   (a) $\beta^+$ decay of ${}^{11}_{6}C$ to Boron (B). **(1)**

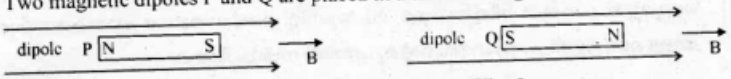
   (b) $\beta^-$ decay of ${}^{32}_{15}P$ to Sulphur (S). **(1)**

13. Write the truth table of the circuit shown below.




14. A TV transmitting antenna is 100 m tall. How much service area can it cover if the receiving antenna is at the ground level ? Radius of earth is 6400 km.

15. Two magnetic dipoles P and Q are placed in a uniform magnetic field $\vec{B}$ as shown.



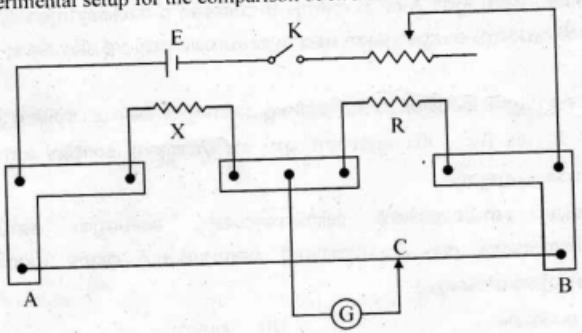

(a) Both the dipoles do not experience any torque. Why ? **(1)**

(b) Identify the dipole which is in most stable equilibrium. **(1)**

**Question numbers 16 to 22 carry 3 scores each. Answer any 6 questions.**

**(6 × 3 = 18)**

16. The experimental setup for the comparison of two resistances is shown below.




(a) The working principle of the above device is **(1)**

(i) Ohm's law

(ii) Kirchhoff's second law

(iii) Wheatstone's principle

(iv) Point Rule

(b) In figure, Let X is the effective resistance of series combination of two 3 Ω resistors and R is the effective of a parallel combination of two 3 Ω resistors. The balance point is obtained at C. If the length AB is 100 cm, find the length AC of the wire. **(2)**

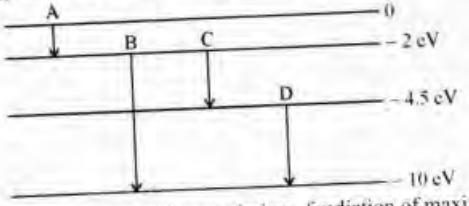
17. A magnetic needle has magnetic moment $6.7 \times 10^{-2}$ $Am^2$ and moment of inertia $7.5 \times 10^{-6}$ $kgm^2$. In a uniform magnetic field, it performs 10 complete oscillations in 6.70 s. What is the magnitude of the magnetic field ?

18. With the help of a ray diagram, show the formation of image of a point object by refraction of light at a spherical surface separating two media of refractive indices $n_1$ and $n_2$. Using the diagram derive the relation $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$.

19. (a) Draw a graph showing the variation of stopping potential with frequency of incident radiation. Mark the threshold frequency in the figure. **(2)**

(b) Using Einstein's photoelectric equation, show that photoelectric emission is not possible if the frequency of incident radiation is less than the threshold frequency. **(1)**

20. (a) The energy levels of an atom are as shown in the figure. **(1)**




Which transition corresponds to emission of radiation of maximum wavelength ?

(b) Sketch the energy level diagram for hydrogen atom and mark the transitions corresponding to Balmer series. **(2)**

21. The decay rate of a radioactives ample is called its activity.

(a) What is the SI unit of activity ? **(1)**

(b) The half life of $^{238}_{92}U$ against alpha decay is $1.5 \times 10^{17}$ s. Calculate the activity of a sample of $^{238}_{92}U$ having $25 \times 10^{20}$ atoms. **(2)**

22. (a) Draw the circuit diagram where a zener diode is used as a direct voltage regulator. **(1)**

(b) In a zener regulated power supply a zener diode with zener voltage 4 V is used for regulation. The load current is to be 4 mA and zener current is 20 mA. If the unregulated input is 10 V, what should be the value of resistor that is to be connected in series with the diode ? **(2)**

**Question numbers 23 to 26 carry 4 scores each. Answer any 3 questions.** **(3 × 4 = 12)**

23. Coulomb's law is a quantitative statement about the force between two point charges.

    (a) Write the mathematical expression of the above law. **(1)**

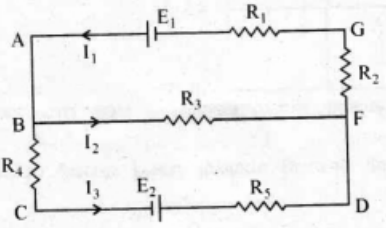
    (b) Two ions carrying equal charges repel with a force of $1.48 \times 10^{-8}$ N when they are separated by a distance of $5 \times 10^{-10}$ m. How many electrons have been removed from each iron ? **(3)**

24. Potential energy of a system of charges is directly proportional to the product of charges and inversely to the distance between them.

    (a) Prove the above statement. **(2)**

    (b) Two point charges $3 \times 10^{-8}$ C and $-2 \times 10^{-8}$ C are separated by a distance of 15 cm. At what point on the line joining the charges the potential is zero ? **(2)**

25. The circuit shown can be analyzed using Kirchhoff's rules.




    (a) Apply Kirchhoff's first law to the point B. **(1)**

    (b) State Kirchhoff's second law. **(2)**

    (c) Apply Kirchhoff's second law to the mesh ABFGA. **(1)**

26. Biot-Savart's law relates current with the magnetic field produced by it.

    (a) Write the mathematical expression of the above law in vector form. **(1)**

    (b) Using the law derive an expression for intensity of magnetic field at a point at distance $x$ from the centre and on the axis of a circular current loop. **(3)**

**Question numbers 27 to 29 carry 5 scores each. Answer any 2 questions.**

**(2 × 5 = 10)**

27. A series LCR circuit shows the phenomenon called resonance.
    (a) Write the condition for resonance and obtain an equation for resonant frequency. **(2)**
    (b) Obtain the Q value of a series LCR circuit with L = 2.0 H, C = 32 μF and R = 10 Ω. **(2)**
    (c) Complete the following table using the suitable words from the bracket for two series LCR circuits. **(1)**
    (current and applied voltage are in the same phase, current leads the applied voltage, current lags the applied voltage)

| Inductive reactance (Ω) | Capacitive reactance (Ω) | Resistance (Ω) | Phase relationship between current and applied voltage |
|---|---|---|---|
| 94 | 57 | 20 | – |
| 48 | 48 | 26 | – |

28. Telescope is used to provide angular magnification of distant objects.
    (a) If $f_o$ is the focal length of the objective and $f_e$ that of the eye piece, the length of the telescope tube is _____. **(1)**
    (b) Draw the ray diagram of a refracting type telescope when it is in normal adjustment. **(2)**
    (c) Write any two advantages of reflecting type telescopes over refracting type telescopes. **(2)**

29. *A wavefront is defined as a surface of constant phase.*
    (a) The energy of the wave travels in a direction _____ to the wavefront. **(1)**
    (b) Explain Huygen's principle. **(2)**
    (c) Using Huygen's principle, prove that angle of incidence is equal to angle of reflection. **(2)**