

This Question Paper contains 20 printed pages.  
(Part - A & Part - B)

Sl.No. 1100057

**054 (E)**  
(JULY 2022)  
(SCIENCE STREAM)  
(CLASS - XII)

પ્રશ્ન પેપરનો સેટ નંબર જેની  
સામેનું વર્તુળ OMR શીટમાં  
ઘટ્ટ કરવાનું રહે છે.  
Set No. of Question Paper,  
circle against which is to be  
darken in OMR sheet.

**11**

Part - A : Time : 1 Hour / Marks : 50

Part - B : Time : 2 Hours / Marks : 50

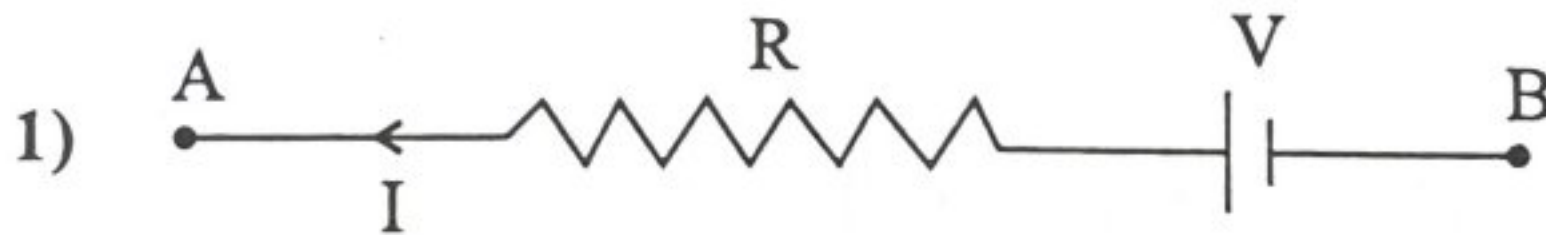
**(Part - A)**

*Time : 1 Hour]*

*[Maximum Marks : 50*

Instructions :

- 1) There are 50 objective type (M.C.Q.) questions in Part - A and all questions are compulsory.
- 2) The questions are serially numbered from 1 to 50 and each carries 1 mark.
- 3) Read each question carefully, select proper alternative and answer in the O.M.R. sheet.
- 4) The OMR sheet is given for answering the questions. The answer of each question is represented by (A) O, (B) O, (C) O, (D) O. Darken the circle ● of the correct answer with ball-pen.
- 5) Rough work is to be done in the space provided for purpose in the Test Booklet only.
- 6) Set No. of Question Paper printed on the upper-most right side of the Question Paper is to be written in the column provided in the OMR sheet.
- 7) Students may use a simple Calculator and log-table, if necessary.
- 8) Notations used in this question paper have proper meaning.



The potential difference between two points A and B  
 $V_B - V_A = \underline{\hspace{2cm}}$ .

(A)  $V - IR$

(B)  $IR - V$

(C)  $V + IR$

(D)  $IR$

Rough Work



- 2) Wheatstone bridge is wellknown for the determination of \_\_\_\_\_.
- (A) unknown resistance
- (B) unknown emf
- (C) unknown current
- (D) potential difference
- 3) Which one of the following is correct form of Lorentz force?
- (A)  $\vec{F} = q[\vec{E} + (\vec{B} \times \vec{v})]$
- (B)  $\vec{F} = q[\vec{E} - (\vec{B} \times \vec{v})]$
- (C)  $\vec{F} = q[\vec{E} - (\vec{v} \times \vec{B})]$
- (D) None of the given choices
- 4) Which one of the following is used to implant ions into solids and modify their properties?
- (A) Cyclotron
- (B) Toroid
- (C) Solenoid
- (D) Electron gun
- 5) The force acting between two straight parallel conductors of negligible cross-section, and placed one meter apart in vacuum carrying equal current of 1 mA is \_\_\_\_\_ N.
- (A)  $2 \times 10^{-7}$
- (B)  $2 \times 10^{-10}$
- (C)  $2 \times 10^{-13}$
- (D)  $2 \times 10^7$

- 6) The place where the horizontal and vertical components of earth's magnetic field become equal, the angle of dip becomes \_\_\_\_\_.
- (A)  $0^\circ$
- (B)  $45^\circ$
- (C)  $90^\circ$
- (D)  $60^\circ$
- 7) The unit of magnetisation (M) is \_\_\_\_\_.
- (A)  $\text{Am}^{-1}$
- (B)  $\text{Am}^{-2}$
- (C)  $\text{C m}^{-1}$
- (D)  $\text{C m}^{-2}$
- 8) Superconductors are one type of \_\_\_\_\_ substances.
- (A) diamagnetic
- (B) ferromagnetic
- (C) paramagnetic
- (D) non-magnetic
- 9) When the N-pole of a bar magnet is pointing towards the coil and is moving away from the coil then the end of the coil towards the bar magnet \_\_\_\_\_.
- (A) behaves as N-pole only
- (B) behaves as S-pole only
- (C) may behaves as N-pole as well as S-pole
- (D) does not behaves as any magnetic pole



- 10) The unit of induced emf is \_\_\_\_\_.  
(A) Newton  
(B) Watt  
(C)  $\frac{\text{Weber}}{\text{Second}}$   
(D)  $\frac{\text{Volt}}{\text{Second}}$
- 11) The electromagnetic damping is due to \_\_\_\_\_.  
(A) displacement currents  
(B) conduction currents  
(C) eddy currents  
(D) none of the given choices
- 12) A pure inductor of 25 mH is connected to a source of 220 V. If the frequency of the source is 50Hz, the inductive reactance would be \_\_\_\_\_  $\Omega$ .  
(A) 5.75  
(B) 8.75  
(C) 7.85  
(D) 9.85
- 13) In an AC circuit having only capacitor, an electric current I \_\_\_\_\_ the voltage V in phase by \_\_\_\_\_.  
(A) leads,  $\pi$   
(B) leads,  $\frac{\pi}{2}$   
(C) lags behind,  $\pi$   
(D) lags behind,  $\frac{\pi}{2}$

14) Q-factor is given by \_\_\_\_\_.

(A)  $Q = \frac{1}{R} \sqrt{\frac{L}{C}}$

(B)  $Q = \frac{1}{R} \sqrt{\frac{C}{L}}$

(C)  $Q = \frac{L}{R} \sqrt{\frac{1}{C}}$

(D)  $Q = \frac{R}{L} \sqrt{\frac{1}{C}}$

15) To serve which one of the following purposes, a laminated core is used in the construction of transistor?

(A) To minimize flux leakage

(B) To decrease the resistance of the windings

(C) To minimize effect of eddy currents

(D) To decrease hysteresis

16) By which one of the following equation the magnitudes of electric and magnetic fields in an electromagnetic wave are related?

(A)  $E_0 = \frac{B_0}{C}$

(B)  $B_0 = \frac{E_0}{C}$

(C)  $E_0 = \frac{B_0^2}{2C}$

(D)  $B_0 = \frac{E_0^2}{2C}$

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- 17) Due to which one of the following reasons, Maxwell's displacement current is generated?
- (A) due to conduction of electric charge
  - (B) due to time-varying electric field
  - (C) due to decrease in the magnetic field
  - (D) due to constant electric field
- 18) Which one of the following is the frequency range for AM (Amplitude Modulated) band?
- (A) 530 kHz to 1710 kHz
  - (B) 530 Hz to 1710 Hz
  - (C) 2300 kHz to 2700 kHz
  - (D) 23 MHz to 27 MHz
- 19) An object pin is kept on an axis of a concave mirror between pole (P) and focal point (F). Its image would be
- (A) Real, Inverted and Small
  - (B) Real, Erect and Big
  - (C) Virtual, Inverted and Small
  - (D) Virtual, Erect and Big
- 20) The refractive index of medium-2 with respect to medium-1 is  $n_{21}$ . The angle of incidence for a ray is  $i$  and angle of refraction is  $r$ . If  $n_{21} < 1$ , then
- (A)  $r < i$  and the refracted ray bends towards the normal
  - (B)  $r < i$  and the refracted ray bends away from the normal
  - (C)  $r > i$  and the refracted ray bends towards the normal
  - (D)  $r > i$  and the refracted ray bends away from the normal



- 21) When the angle of incidence becomes equal to critical angle, which one of the following choice would be correct for the angle of refraction ( $r$ )?
- (A)  $r > 90^\circ$   
(B)  $r < 90^\circ$   
(C)  $r = 90^\circ$   
(D)  $r = 45^\circ$
- 22) The primary rainbow is a result of which of the following three-step process?
- (A) reflection, refraction and reflection  
(B) reflection, reflection and refraction  
(C) refraction, reflection and refraction  
(D) refraction, refraction and reflection
- 23) The focal length of objective is 100 cm and the focal length of an eyepiece is 1 cm, then the tube length of the telescope is \_\_\_\_\_ cm.
- (A) 100  
(B) 101  
(C) 99  
(D) 1000
- 24) The phase difference between any two points on the same wavefront would be \_\_\_\_\_.
- (A)  $\frac{\pi}{2}$  rad  
(B)  $\pi$  rad  
(C)  $-\frac{\pi}{2}$  rad  
(D) 0 rad

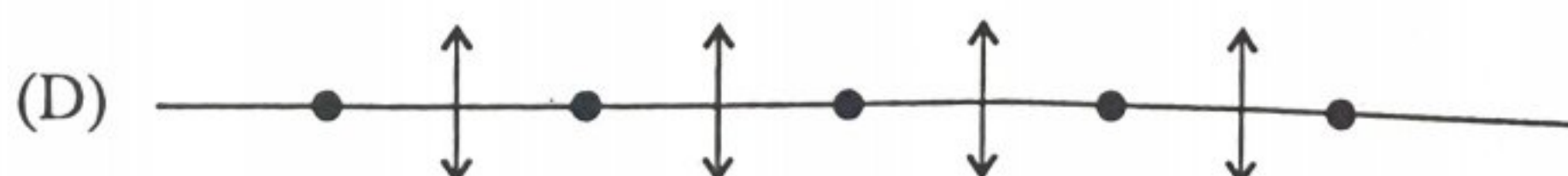
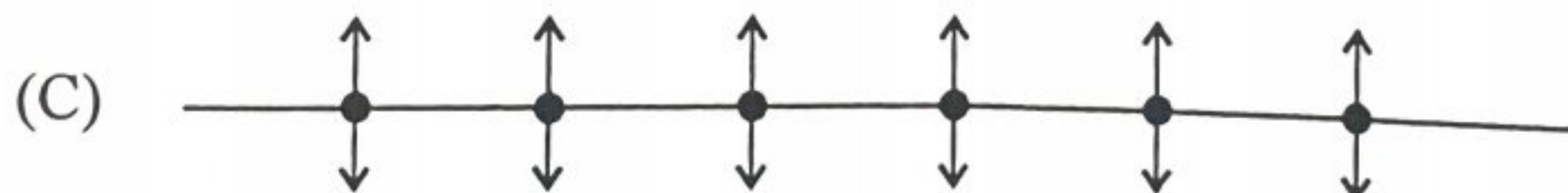
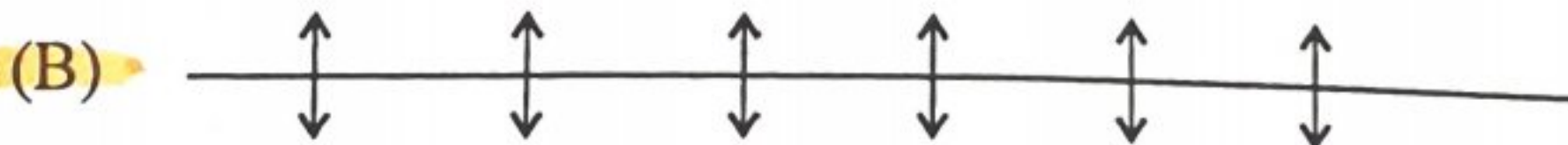
25) If the phase difference between the two waves producing interference is  $13\pi$  rad then \_\_\_\_\_ order \_\_\_\_\_ interference occurs.

- (A)  $13^{\text{th}}$ , destructive
- (B)  $13^{\text{th}}$ , constructive
- (C)  $7^{\text{th}}$ , destructive
- (D)  $7^{\text{th}}$ , constructive

26) For which one of the following colour the width of the diffraction fringe would be maximum?

- (A) Red
- (B) Green
- (C) Yellow
- (D) Violet

27) Which one of the following figure represents polarisation in the plane of the paper?





28) What is the Brewster angle for air to glass transmission?

[Refractive index of glass = 1.5]

(A)  $36^\circ$

(B)  $48^\circ$

(C)  $57^\circ$

(D)  $84^\circ$

29) The quantum of energy  $4000\text{ h}\nu$  contains \_\_\_\_\_ photons.

(A) 8000

(B) 2000

(C) 2400

(D) 4000

30) The case in which a definite momentum of an electron extends all over space, is

(A)  $\Delta P = 0; \Delta x \rightarrow \infty$

(B)  $\Delta P \rightarrow \infty; \Delta x = 0$

(C)  $\Delta P = 0; \Delta x = 0$

(D)  $\Delta P \rightarrow \infty; \Delta x \rightarrow \infty$

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31) The maximum frequency of X-rays produced by 30 kV electrons would be \_\_\_\_\_ Hz.

(A)  $2.74 \times 10^{18}$

(B)  $7.24 \times 10^{18}$

(C)  $4.72 \times 10^{18}$

(D)  $27.4 \times 10^{18}$

32) The wavelength of  $H_{\alpha}$  line for Balmer series is \_\_\_\_\_ nm.

(A) 364.6

(B) 410.2

(C) 656.3

(D) 448.1

33) Which one of the following represents Bohr's radius?

(A)  $\frac{h^2 \epsilon_0^2}{4\pi m e^2}$

(B)  $\frac{h \epsilon_0}{2\pi m e^2}$

(C)  $\frac{h \epsilon_0^2}{\pi m e^2}$

(D)  $\frac{h^2 \epsilon_0}{\pi m e^2}$

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34) If four de Broglie wavelengths fit into the circumference of the orbit of radius  $r$ , then  $\lambda =$  \_\_\_\_\_.

(A)  $4\pi r$

(B)  $\frac{\pi}{4}r$

(C)  $2\pi r$

(D)  $\frac{\pi}{2}r$

35)  $1 \mu C_i =$  \_\_\_\_\_ Bq.

(A)  $3.7 \times 10^4$

(B)  $3.7 \times 10^7$

(C)  $3.7 \times 10^{13}$

(D)  $3.7 \times 10^{16}$

36) What is the energy formed by the Photon carrying frequency of  $6.0 \times 10^{14}$  Hz.

(A)  $3.98 \times 10^{-19}$  J

(B)  $1.99 \times 10^{-19}$  J

(C)  $3.98 \times 10^{-17}$  J

(D)  $1.99 \times 10^{-17}$  J

37)  ${}_{92}^{235}\text{U} + {}_0^1\text{n} \rightarrow$  \_\_\_\_\_  $+ {}_{41}^{99}\text{Nb} + 4 {}_0^1\text{n}.$

(A)  ${}_{51}^{133}\text{Sb}$

(B)  ${}_{54}^{140}\text{Xe}$

(C)  ${}_{51}^{140}\text{Sb}$

(D)  ${}_{54}^{133}\text{Xe}$

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- 38) \_\_\_\_\_ eV energy is required for electron to jump the forbidden gap at room temperature in the pure Si.
- (A) 0.11  
(B) 1.1  
(C) 2.1  
(D) 0.21
- 39) \_\_\_\_\_ is used as a voltage regulator.
- (A) Photocell  
(B) Light Emitting Diode  
(C) Zener diode  
(D) Solar cell
- 40) An electric dipole with dipole moment  $4 \times 10^{-9}$  cm is aligned at  $30^\circ$  with the direction of a uniform electric field of magnitude  $5 \times 10^4$  NC<sup>-1</sup>. The magnitude of the torque on the dipole is \_\_\_\_\_ J.
- (A)  $10^2$   
(B)  $10^{-2}$   
(C)  $10^4$   
(D)  $10^{-4}$
- 41) The dimensions of electric flux is \_\_\_\_\_.
- (A)  $M^1 L^1 T^{-3} A^{-1}$   
(B)  $M^1 L^{-3} T^3 A^{-1}$   
(C)  $M^1 L^3 T^3 A^{-1}$   
(D)  $M^1 L^3 T^{-3} A^{-1}$



- 42) Electric field due to a uniformly charged infinite plane sheet at a distance  $r$  \_\_\_\_\_.
- (A) is proportional to  $r$
  - (B) is proportional to  $\frac{1}{r^2}$
  - (C) is proportional to  $r^2$
  - (D) does not depend on  $r$
- 43) Which one of the following property is not true for electric field lines?
- (A) Electric field lines can be taken to be continuous curves without any breaks
  - (B) Two field lines can never cross each other
  - (C) Electric field lines form closed loops
  - (D) The tangent drawn at any point of the field lines represents direction of  $\vec{E}$
- 44) For point dipole;
- (A)  $2a \rightarrow 0, q \rightarrow 0$
  - (B)  $2a \rightarrow 0, q \rightarrow \infty$
  - (C)  $2a \rightarrow \infty, q \rightarrow 0$
  - (D)  $2a \rightarrow \infty, q \rightarrow \infty$

- 45) The work done to move unit test charge on an equipotential surface is \_\_\_\_\_.  
(A) positive  
(B) negative  
(C) zero  
(D) infinite
- 46) If  $\sigma$  is the surface charge density and  $\epsilon_0$  is the permittivity of free space, then the magnitude of the electric field at the surface of a charged conductor is \_\_\_\_\_.  
(A)  $\frac{\sigma}{\epsilon_0}$   
(B)  $\frac{2\sigma}{\epsilon_0}$   
(C)  $\frac{\sigma}{2\epsilon_0}$   
(D)  $\frac{5\sigma}{3\epsilon_0}$
- 47) If  $\vec{P}$  is polarisation for a linear isotropic dielectric and  $\vec{E}$  is the electric field, then electric susceptibility of the dielectric medium = \_\_\_\_\_.  
(A)  $\frac{\vec{P}}{\vec{E}}$   
(B)  $\vec{P} \cdot \vec{E}$   
(C)  $\vec{P} \times \vec{E}$   
(D)  $\frac{\vec{E}}{\vec{P}}$



48) When  $n$  capacitors, each of equal value  $C$ , are connected in series, the equivalent capacitance of the combination = \_\_\_\_\_.

(A)  $n^2 C$

(B)  $\frac{C}{n^2}$

(C)  $\frac{C}{n}$

(D)  $nC$

49) The mobility of an electron moving in the electric field  $\vec{E}$  with the drift velocity  $\vec{v}_d$ ,  $\mu =$  \_\_\_\_\_.

(A)  $\frac{E}{|\vec{v}_d|}$

(B)  $\frac{|\vec{v}_d|}{E}$

(C)  $|\vec{v}_d| E$

(D)  $\frac{1}{2} |\vec{v}_d| E^2$

50) Which one of the following is proper colour code of a carbon resistor having value  $0.7 \Omega \pm 5\%$ ?

(A) Black, Violet, Gold, Gold

(B) Violet, Black, White, Gold

(C) Black, Green, Silver, Gold

(D) Green, Black, Silver, Gold



**054 (E)**(JULY 2022)  
(SCIENCE STREAM)  
(CLASS - XII)**(Part - B)****Time : 2 Hours]****[Maximum Marks : 50****Instructions :**

- 1) Write in a clear legible handwriting.
- 2) There are three sections in Part - B of the question paper and total 1 to 27 questions are there.
- 3) Separate instruction is given in each section. Read it carefully and answer accordingly.
- 4) The numbers at right side represent the marks of the question.
- 5) Start new section on new page.
- 6) Maintain sequence.
- 7) Students may use a simple Calculator and log-table, if necessary.

**SECTION - A**

- Answer any eight questions from the following question No. 1 to 12.  
(2 marks each)

**[16]**

- 1) Express Coulomb's law in the vector form. **[2]**
- 2) Derive formula of capacitance for Parallel Plate Capacitor. **[2]**
- 3) Derive an equivalent resistance for the series connection of resistors. **[2]**
- 4) Derive  $B = \mu_0 nI$  for the toroid. **[2]**
- 0.5 5) Define magnetisation (M). Write its formula, unit and dimension. **[2]**
- 6) Derive  $W = \frac{1}{2} LI^2$  as the energy required to build up the current I in the coil having self-inductance L. **[2]**
- 0.5 7) Explain LCR series resonance. **[2]**
- 0.5 8) Write any four points for Infrared waves. **[2]**
- 9) Derive Brewster's law in the case of polarisation by reflection. **[2]**

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- 0.3 (10) What called Thermionic emission, field emission and photoelectric emission? Also define threshold frequency. [2]
- (11) Explain the binding energy of the nucleus. [2]
- 2 (12) Draw the logic symbol and write the truth table for NAND gate. [2]

### SECTION - B

- Answer any six questions from the following question No. 13 to 21. [18]  
(3 marks each)

- 2.5 (13) Two charges  $5 \times 10^{-8} \text{ C}$  and  $-3 \times 10^{-8} \text{ C}$  are located 16 cm apart. At what points on the line joining the two charges is the electric potential zero? Take the potential at infinity to be zero. [3]
- 14) A battery of V volt and negligible internal resistance is connected across the diagonally opposite corners of a cubical network consisting of 12 equal resistors each of resistance  $R \Omega$ . Determine the equivalent resistance of the network. [3]
- 15) A square coil of side 10 cm consists of 20 turns and carries a current of 12A. The coil is suspended vertically and the normal to the plane of the coil makes an angle of  $30^\circ$  with the direction of a uniform horizontal magnetic field of magnitude 0.80 T. What is the magnitude of torque experienced by the coil? [3]
- (16) Explain motional emf and derive  $\varepsilon = Blv$ . [3]
- 17) Derive mirror formula for concave mirror? [3]
- (18) The distance between the two slits in Young's experiment is 0.1 mm. The perpendicular distance between the slits and screen is 100 cm. Wavelength of the incident light is  $6000 \text{ \AA}$ . Calculate the distance between third bright and fifth dark fringes. [3]
- 19) The energy flux of sunlight reaching the surface of the earth is  $1.388 \times 10^3 \text{ W m}^{-2}$ . How many photons (nearly) per square metre are incident on the Earth per second? The wavelength of the photon is 550 nm.  
[ $h = 6.625 \times 10^{-34} \text{ Js}$ ] [3]



(20) The half life of a radioactive element is 0.231 year. Calculate the time during which its activity becomes 10% of its initial activity. [3]

21) Draw circuit diagram for studying  $V \rightarrow I$  characteristics of a p-n junction diode in [3]

a) forward bias and

b) reverse bias

Also draw a typical  $V \rightarrow I$  characteristics of a silicon diode.

### SECTION - C

■ Answer any four questions from the following question No. 22 to 27. [16]  
(4 marks each)

22) Derive expressions for equivalent capacitance of [4]

a) series and

b) parallel connections of capacitors.

2 (23) Obtain the principle of the Wheatstone's bridge. Explain the use of meter bridge which is prepared using this principle. [4]

2 (24) Derive the differential equation for LC oscillations and explain the meaning of LC oscillations. [4]

25) Derive Lens Maker's formula for the thin lens. [4]

3.5 (26) Calculate the de Broglie wavelength associated with an electron moving with the speed of  $5.4 \times 10^6 \text{ ms}^{-1}$  and a ball of mass 150 g travelling at  $30 \text{ ms}^{-1}$ . [4]  
[ $m_e = 9.1 \times 10^{-31} \text{ kg}$ ,  $h = 6.625 \times 10^{-34} \text{ Js}$ ]

27) A 12.09 eV electron beam is used to bombard gaseous hydrogen at room temperature. What series of wavelengths will be emitted? [4]  
[use  $hc = 1242 \text{ eV}$ ]



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