महाराष्ट्र वनसेवा मुख्य परीक्षा - २०१२

OOO

2012

PHYSICS (Optional)

भौतिकशास्त्र (वैकल्पिक)

100351

Time : 3 hours **Maximum Marks : 200**

Note :

(i) *Answers must be written in English.*

(ii) *Question **No. 1** is **compulsory**. Of the remaining questions, attempt **any Four** selecting one question from **each section**.*

(iii) *Figure to the **RIGHT** indicates marks of the respective question.*

(iv) *Make suitable assumptions, wherever necessary and state the same.*

(v) *Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.*

(vi) *Credit will be given for orderly, concise and effective writing.*

(vii) *Candidates should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise they will be penalised.*

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1. Answer ***any four*** of the following :

(a) Derive an expression of Moment of Inertia of a solid cylinder about an axis passing through its centre and perpendicular to its own axis. **10**

(b) Define the term interference. In Young's double slit experiment show that bright and dark bands are equally spaced. **10**

(c) What is Doppler effect in sound and obtain an expression for the apparent frequency of the note when the source and the listener are moving away from each other ? **10**

(d) What are Miller indices ? Derive an expression for the interplanar spacing for planes of the (h k l) type in the case of a cubic structure. **10**

(e) What are beats ? Discuss analytically the formation of beats. Calculate the velocity of sound in a gas in which two waves of lengths 1 metre and 1.01 metres produce 10 beats in 3 seconds. **10**

P.T.O.

SECTION - A

2. (a) State Bernoullis theorem and derive Bernoullis equation. A flat plate of area 10 sq cm is separated from a large plate by a layer of glycerine 1 mm thick. If the viscous coefficient of glycerine is 20 gm per cm per sec, what force is required to keep the plate moving with a velocity of 1 cm per second ? **20**

   (b) Describe the diesel cycle in detail, using the figure of different strokes in the diesel engine. Draw the P - V diagram and explain the working of diesel engine. Derive the efficiency η for the same. Compare the diesel engine and otto engine for the value of efficiency and state the advantages of diesel engine. **20**

3. (a) With neat ray diagram write the detailed theory of Michaelson and Morley's experiment. Discuss its Null result. **20**

   (b) What is triple point ? Derive Clausius Clapeyron latent heat equation, using the P - V diagram. Calculate the boiling point of water at a pressure of 2.026×10^5Pa, if boiling point at 1.013×10^5Pa is 373 K specific volume of steam $= 1.671 \times 10^{-3}$ m^3 Latent heat of vaporization L = 540 cal/gm i.e. 2.268×10^6 J/kg. **20**

SECTION - B

4. (a) Discuss refraction at a convex surface when the image is virtual. Show that for air medium **10**

$$\frac{\mu}{v} - \frac{1}{u} = \frac{\mu - 1}{R}$$

   (b) Describe the charging of capacitor through series L − C − R circuit, when the battery of e.m.f. 'E' is applied across it. Derive the expression for charge across the capacitor, 'q' at time 't'. Discuss three different cases of over-damping, under damping and critical damping, show it graphically. Calculate the maximum charge on the capacitor of 10 μF if it is connected in series with a resistance of 10 kΩ and a dc source of 5 V. **20**

   (c) State the principle of transformer. Draw the neat diagram of the transformer and explain the working of it. What is turns ratio ? Define efficiency of transformer. **10**

5. (a) With neat ray diagram explain the theory of Newton's Ring and show that radius of dark ring is directly proportional to square root of natural number. **10**

   (b) Write in detail, the Weiss - Molecular field theory and derive the Curie - Weiss Law. **20**

   (c) State and derive Biot and Savarts Law. **10**

SECTION - C

6. (a) What are X-rays ? How the production of X-rays can be described using the cooledge X-ray tube ? What are the properties of X-rays ? Explain the characteristic line X-ray spectrum and the continuous X-ray spectrum. **20**

   (b) Write detailed note on vector atom model with the explanation of spin-orbit interaction for two electron atoms, explain L−S coupling with the help of vector diagram. **20**

7. (a) What is De-Broglie hypothesis ? Define De-Broglie wavelength. With neat diagram, describe the Davisson and Germer experiment of reflection of electrons from the Nickel target, which experimentally verified the existence of matter waves. **20**

   (b) What is Nuclear Fission ? Explain the concept of chain reaction. Define Nuclear reactor and write its features. What is breedor reactor ? **20**

SECTION - D

8. (a) Explain summerfield free electron model and obtain an expression of density of state. **20**

   (b) What is operational amplifier ? Explain its application as an integrator. **20**

9. (a) What is thermionic emission ? Derive an expression of Richardson T^2 formula. **20**

   (b) State Barkhausen criteria of oscillation. Describe phase shift oscillator circuit and its action. State its advantages and disadvantages. **20**

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