



First Year Entrance Examination English curriculum

Subject : Physics
Duration : 2 Hours

Instruction : Answer All the questions

1. The equation below is called the Planck time;

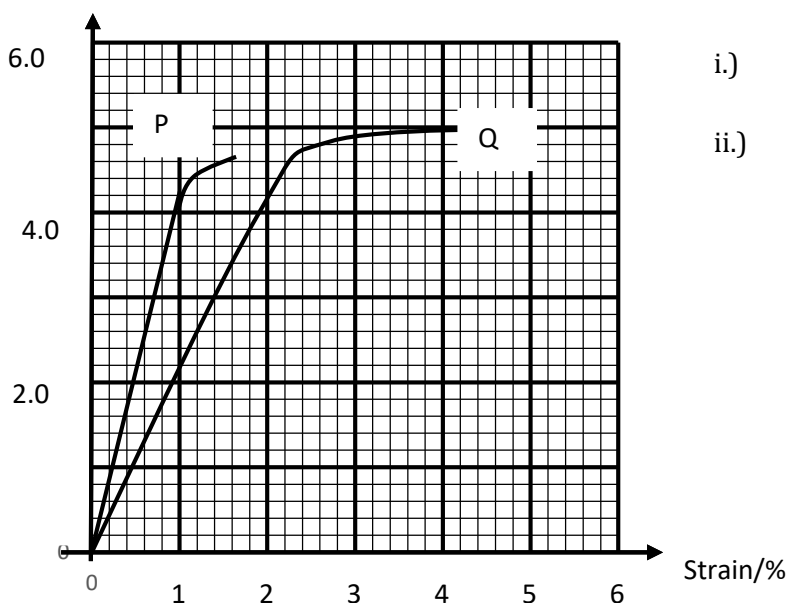
$$t_p = \sqrt{\frac{Gh}{c^5}}$$

Where G is the universal gravitational constant, h is the Planck constant and c is the speed of light.

- a.) Show that the combination of these three fundamental constants of nature forms a quantity with the dimension of time
- b.) State two shortcomings of using homogeneity to show that an equation is correct (5 marks)

2. a.) i.) Define young's modulus of elasticity of a material (2 marks)
- ii.) A metallic wire of diameter 2.0 mm is hung vertically from a fixed support. When the wire is loaded with a 20 kg mass it snaps and breaks. The wire experiences a temperature rise of 5.0×10^{-3} K. Giving that the Specific heat capacity of the wire's material is $390 \text{ J kg}^{-1} \text{ K}^{-1}$ and its density is 8900 kg m^{-3} , calculate the Young's modulus of elasticity of the wire (4 marks)
- b.) The graph in figure 1 below shows the stress against strain curves of two materials P and Q

Stress/ Gpa



- i.) Calculate the young's modulus of each material (2 marks)
- ii.) State which of the material is stronger (1 mark)

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3. In an RCL series circuit , the values of resistance $R=25.0\Omega$, $L= 30.0 \text{ mH}$ and $C= 12.0 \mu\text{F}$ are all connected in series to a 90.0 V ac (rms) , 500 Hz source. Calculate
- The r.m.s current in the circuit
 - The r.m.s voltage across L and C
 - The phase angle at which the r.m.s voltage leads the r.m.s current in the circuit
 - The power factor of the circuit (8marks)
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4. a.) i.) State conditions necessary for a mechanical system to be in equilibrium (2 marks)
ii.)A uniform ladder which is 5m long and having a mass of 20 kg leans with its upper end against a smooth vertical wall and its lower end on rough ground. The bottom of the ladder is 3m from the wall .Calculate the friction force between the ladder and the ground (3 marks)
- b.) A helicopter hovers in still air well away from the ground. The mass of the helicopter is 5 tonnes and the diameter of its blades is 8 m . Calculate the speed of the air projected down wards by the blades given that the density of air is 1.3 kgm^{-3} . (3 marks)
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5. a.) What do you understand by the activity of a radio active sample (2 marks)
- b.) A point source of gamma having a half life of 45 minutes is placed 3.00 m from a GM-tube and the counter records an initial count rate of $720 \text{ counts per second}$. The counter is immediately moved to a new position and left there. After 3 hours the count rate recorded is exactly $5.00 \text{ counts per second}$. How far is the counter from the source (4 marks)
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6. a.) With the use of a circuit diagram, explain how a transistor can be used to operate a street lamp. (4 marks)
- b.) In a car , a red warning light comes on when the ignition is switched on if the door is not closed properly or the seat belt is not fastened or both door and seat belt are not properly secured .Construct a truth table , showing the door and seat belt inputs to a logic gate system as high (1) if properly secured and low (0) otherwise, the ignition input as high (1) if ON and low (0) other wise and for the red warning light , the output as high(1) if ON and low (0) other wise. (4 marks)
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7. a.) Distinguish between photoelectric emission and thermionic emission (2 marks)
- b.) A metal has a work function of $2.25 \times 10^{-19} \text{ J}$.
- Explain what is meant by the work function of metal. (2 marks)
 - An electromagnetic radiation of wavelength 560 nm falls on this metal surface. Determine by calculation , whether or not electrons will be emitted from this metal surface. (2 marks)
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THE END
