STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2019 – 2020 and thereafter)
SUBJECT CODE: 19PH/MC/TS23

B.Sc. DEGREE EXAMINATION APRIL 2023
BRANCH III - PHYSICS
SECOND SEMESTER

COURSE : MAJOR – CORE
PAPER : THERMAL PHYSICS AND STATISTICAL MECHANICS
TIME` : 3 HOURS. MAX. MARKS: 100

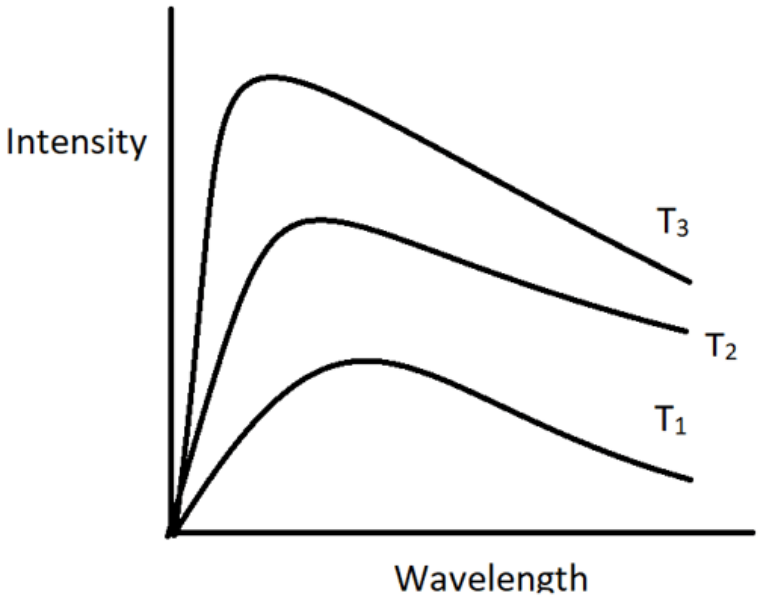
SECTION – A

ANSWER ALL QUESTIONS:

I CHOOSE THE CORRECT ANSWER: (10 x 1 = 10)

1. An iron rod is heated. The colors at different temperatures are noted. Which of the following colors shows that the iron rod is at the lowest temperature?
   a) Red b) Orange
   c) White d) Blue

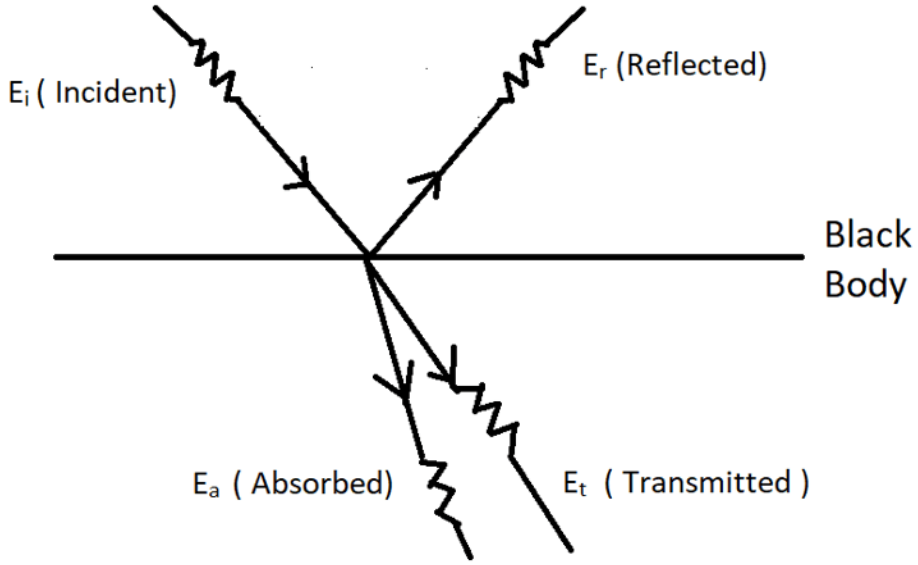
2. From the figure, what's the relation between T_1, T_2, and T_3?



a) $T_1 > T_2 > T_3$ b) $T_3 > T_2 > T_2$
c) $T_3 > T_1 > T_2$ d) $T_2 > T_1 > T_3$

…2

3. What is the relation between the Energies as shown in the figure?



a) $E_r = 0$ b) $E_a = 0$
c) $E_t = E_i$ d) $E_i = E_r$

4. The absolute zero pressure will be _____
a). When molecular momentum of the system becomes zero b). At sea level
c). At temperature -273 k d). At the centre of the earth

5. According to kelvin planck statement of 2nd law of thermodynamics.

a). It is impossible to construct an engine working on a cyclic process whose main purpose is to convert heat energy into the work
b). It is possible to construct an engine working on a cyclic process whose sole purpose is to convert heat into work
c) Both of the above d). None of the above

6. The entropy of an isolated system can never ____
a) increase b) decrease
c) be zero d) none of the mentioned

7. Maxwell's thermodynamic relations are valid for
a) Closed system only b) Only reversible process
c). All processes of thermodynamics d) A thermodynamic system in equilibrium

8. Liquid helium below ----------temperature is called helium II
   a). 2.19K b). 2.99K c). 3.19K d). 1.43K

9. The efficiency of a reversible engine
   a) depends upon the temperature of source only
   b) depends upon the temperature of sink only
   c) depends upon neither temperature of the source nor temperature of the sink
   d) depends upon both the temperature of source and sink only

10. Phase space is ----------
   a). six dimensional b). three dimensional
   c). one dimensional d). two dimensional

FILL IN THE BLANKS: (5x1=5)

11. Heat flow into a system is taken to be ____, and heat flow out of the system is taken as ____
12. Second law of thermodynamics is sometimes called as---------.
13. The entropy of an isolated system always ____ and becomes a ____ at the state of equilibrium.
14. All the cells of the phase space are not of _____ size.
15. The melting point of ice is lowered when there is increase in _____

ANSWER BRIEFLY: (5x2=10)

16. What is Joule-Thomson effect?
17. State Zeroth law of thermodynamics
18. Write down Clausius - Clapeyron latent heat equation.
19. Write down the relation between entropy and probability
20. State Wiens' displacement law.

SECTION B

ANSWER ANY FIVE QUESTIONS (5x6=30)

21. Heat is transferred to a heat engine from a furnace at a rate of 80 MW. If the rate of waste heat rejection to a nearby river is 50 MW, determine the thermal efficiency for this heat engine.

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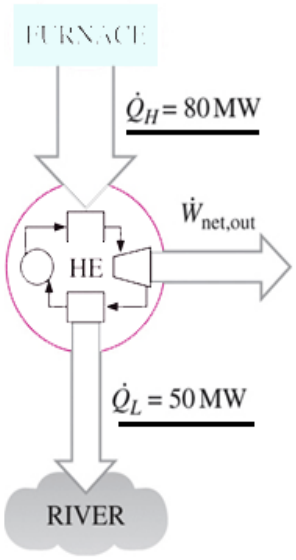

22. A refrigerator pumps heat at 0^0C and emits it into the environment at 20^0C, receiving instead of work additional heat at 100^0C. How much heat must the refrigerator at least receive at 100^0C for every joule of heat absorbed at 0^0C?
23. A quantity of air at 27^0C and atmospheric pressure is suddenly compressed to half its original volume, find the final pressure and temperature.
24. Prove that $C_p - C_v = R$ for a perfect gas, using Maxwell's thermodynamical relations.
25. The efficiency of a Carnot's cycle is 1/6. If on reducing the temperature of the sink by 65^0C the efficiency becomes 1/3, find the initial and final temperatures between the cycle is working.
26. What are micro and macro states explain.
27. Calculate the change in entropy when 2 kg of ice at 0^0C is converted into steam at 100^0C.

SECTION C

ANSWER ANY THREE QUESTION **(3x15=45)**

28. Derive Planck's radiation formula. Show that Rayleigh-Jeans law and Wien's law are special case of Planck's law.
29. Describe Carnot's reversible heat engine. Deduce an expression for its efficiency.
30. Show that entropy remains constant in reversible process but increase in irreversible process.
31. Derive Maxwell's thermodynamical relations.
32. What are ensembles? Derive the Maxwell-Boltzmann distribution law for the molecules of a gas.

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