16/10/19

**VCD S.Y. B.Sc. PHYSICS-I III- SEMESTER 2019-20 100 MARKS 3HRS.**

**Note: i) All the questions are compulsory.**
**ii) figures to the right indicate full marks.**
**iii) Use of non programmable calculator is allowed.**

**Note : Numbers indicate in the right hand side are marks**

**Q1A) Select the correct option** **(12M)**

1) The highest velocity attained by a rocket is called----------
i) exhaust velocity ii) escape velocity iii) burnt out velocity iv)critical velocity

2) Oscillation are damped due to --------
i) restoring force ii) frictional force iii) damped force iv) driving force

3)A Carnot engine whose temperature of the source is 400K takes 200 calories of heat at this temperature and rejects 150 calories of heat to the sink. The temperature of sink is
i)320K ii)300K iii)220K iv)200K

4)The unit of entropy is ----
i) $JK^{-1}$ $mol^{-1}$ ii)$KJ^{-1}mol^{-1}$ iii) $KJmol^{-1}$ iv) $J^{-1}K^{-1}mol^{-1}$

5)A reversible heat engine can be 100% efficient if the temperature of the sink is ---
i)$0^0$c ii) less than that of source iii) $0^0$K iv)equal to that of source

6)Liquid helium undergoes a transition at temperature 2.17K called λ point.
i) Below λ point helium is called helium-I
ii)Above λ point helium is called helium-II
iii) Below λ point helium is called helium-II
iv)none

**Q1B) Answer in one sentence.** **(3M)**

i)Give the Expression for time period of compound pendulum.
ii)Draw T-S diagram for a reversible Carnot cycle.
iii)If Diesel and Otto engine have same compression ratio then which one is more efficient?

**Q1C) Fill in the blanks.** **(5M)**

1) Energy of damped harmonic oscillator decreases ..... with time.
2) The equation of motion of a body is x=Asin(wt+δ).The acceleration of the body is.....
3) The process in the porous plug experiment is.....
4) In Diesel engine the heat is absorbed at constant .....

5) The entropy can be created but it is not.....

**Q. 2A) Answer the following questions.(ANY 1)** **(8M)**

i)Show that when two perpendicular linear simple harmonic motion of the same amplitude and frequency but differing in phase by are superposed, the resultant motion is a uniform circular motion.

ii) Show that the total angular momentum of a system of particle is equal to the angular momentum of its center of mass plus angular momentum due to its motion about the center of mass.

**Q. 2B) Answer the following questions.(ANY 1)** **(8M)**

i) What is compound pendulum? Set up the equation of motion of a compound pendulum and obtain an expression for its time period.

ii) Set up the equation of motion of a driven damped oscillator .Comment on nature of equation and the solution.

**Q. 2C) Answer the following questions.(ANY 1)** **(4M)**

i) Four masses 1Kg,2Kg,3Kg and 4Kg are located at ( -1, -2,2),(3,2,-1),(1,-2,4)and (3,2,1)respectively . Find the center of mass of this system.

ii)A rocket is initially moving with a speed of 2500 m/s. If its exhaust velocity is $2\times10^5$ m/s, what fraction of its mass will exist when its mass will exhaust when its velocity is 4500m/s?

**Q. 3A) Answer the following questions.(ANY 1)** **(8M)**

1) State and prove Carnot's theorem.
2) Explain the concept of Entropy. Hence show that for any reversible or irreversible process

$$S(f)- S (i) \geq \int_i^f dH/T$$

**Q. 3B) Answer the following questions.(ANY 1)** **(8M)**

1) Derive an expression for entropy of a perfect gas in terms of its temperature and Volume.
2) Derive the expression of efficiency for Carnot's engine in terms of temperature.

**Q. 3C) Answer the following questions.(ANY 1)** **(4M)**

1) Find efficiency of a Carnot engine working between 127 $^0$c and 27 $^0$c. It absorbs 80 Calories of heat. How much heat is rejected?
2)State second law of thermodynamics in various forms.

**Q. 4A) Answer the following questions.(ANY 1)** **(8M)**

1) Explain the construction and working of otto engine with neat labeled diagram.
2) Describe Joule's experiment. What was the outcome of it?

**Q. 4B) Answer the following questions.(ANY 1)** **(8M)**

1) Explain the porous plug experiment. What are its result? Is the process reversible or irreversible?
2) Derive the Maxwell thermodynamic relation

**Q. 4C) Answer the following questions.(ANY 1)** **(4M)**

1) In double acting steam engine the average pressure of steam is $1.2 \times 10^5$ $N/m^2$. the length of a stroke is 1m and the area of piston is 0.15 sqm. Find the power of the engine if it makes 4 strokes per second.
2) Write the uses of Liquid Helium.

**Q. 5 : Answer the following questions.( Any 4)** **(20 M)**

1) Find the centre of mass of a uniform thin circular ring.
2) A Carnot engine whose lower temperature heat sink is at $27^oc$ has its efficiency 40%.What is the temperature of heat source? By how much should the temperature of the source increased if the efficiency is to be raised to 70%.
3) Distinguish between otto engine and Diesel engine.
4) When 100 g of water is heated from $10^oc$ to $90^oc$ find by how much does the entropy of water changes? Given : specific heat of water S=1 cal/gm-K.
5)Write any five properties of liquid helium.
6) Derive the relation between inversion, Boyle and critical temperature.