

SPH 308 SOLID STATE PHYSICS**15 copies****DATE: 11-4-2023****TIME: 8:30 am**

2b) Imagine you are constructing a siren-based burglar alarm. Suppose the siren is rated as 1000 W and 48 V. The panels in the market are rated as 12 V 5 A. Draw a circuit showing your burglar alarm set up. (6 marks)

4c) Draw solar IV characteristic curves in a common axis for

- i. a single cell,
 - ii. for two cells in parallel and
 - iii. for two cells in series
- (6 marks)

SPH 100 MECHANICS 1 15 copies**DATE 20-4-2023****TIME 11 am**

Q1

a) A student in an experiment takes the light intensity readings of LEDs (light emitting diodes) as follows

LED	A	B	C	D	E	F	G	H	I
Intensity (I)	11.13	12.46	12.68	12.79	12.88	12.57	12.55	12.44	12.25

Calculate

- i. Average deviation
 - ii. Standard deviation
 - iii. Variance
- (6 marks)

b) A Ferry transporting passengers and cars to the main land at a speed of 10 m/s, accidentally its back is tilted downwards making car A with its occupants a woman and a child, slide into water with a velocity of 3 m/s as shown by the arrow. The water has a flow rate of 5 m/s eastwards. Study the figure and answer the questions that follow

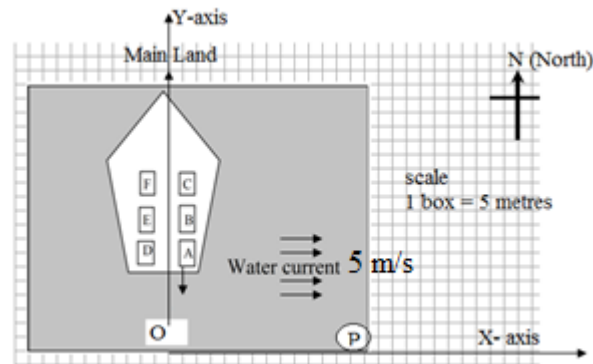


Figure 1

Calculate

- i. velocity of the car as it slides into the water relative to an observer in the Ferry (3 marks)
- ii. velocity of the car relative to the observer labeled O standing on the shore, i.e. velocity relative to shore, in absence of water currents (3 marks)

d) Derive the dimensions of

- i. Force (3 marks)
- ii. Pressure (3 marks)

e) Show that centripetal force of a particle executing a circle of radius r with angular speed (ω) is given by $a = r\omega^2$ (4 marks)

QUESTION TWO

- a) A shopper is in a hurry to catch a bargain in a department store. She walks up the escalator, rather than letting it to carry her, at a speed of 2.5 m/s relative to the escalator. If the escalator is 30 m long and it takes her 12.5 sec for the shopper to get to the next floor, calculate the speed of the escalator. (5 marks)
- b) Show that $\mu = \tan \theta$ for a body resting on an inclined plane making an angle θ with horizontal. Illustrate with a well labeled diagram. (5 marks)
- c) In an experiment to determine acceleration due to gravity, length of the pendulum is measured as 40.2 cm and periodic time T as 2.2 sec. Find
 - i) gravitational acceleration (3 marks)
 - ii) error in gravitational acceleration (3 marks)
- d) An automobile drives around a traffic circle with a maximum permissible speed of 30 m/s. If the wheels of the automobile can withstand a maximum transverse acceleration of 8 m/s^2 without skidding, Calculate radius of the circle? (4 marks)

c) Given that N is the number of molecules and N_A is the Avogadro constant. Show that

$$PV = nN_A k_B T \quad (6 \text{ marks})$$

d) A medical worker is exposed to a radioactive isotope which provides a dose of 0.30 Gy. By calculation, show which

SPH 351 PHYSICS OF ENVIRONMENT AND ENERGY/ 15 COPIES
ENS 240 ENVIRONMENTAL PHYSICS

DATE: 18-4-2023**TIME: 8:30 am****Question One**

a) Solar PV cell is a significant source of renewable energy, Describe

i) application of photoelectric effect in the solar cell. (2 marks)

ii) the three step process involved in the conversion of solar light to electric current. (6 marks)

b) The sun is a gaseous body composed mostly of hydrogen, explain how energy in this average star is generated. (2 marks)

c) Almost all known physical and biological cycles in the Earth system are driven by the solar radiation reaching the Earth. Explain how (3 marks)

d) Ozone layer protects us from excessive levels of harmful ultraviolet (UV) radiation.

i. Define what is ozone layer depletion (3 marks)

ii. With aid of chemical equations, explain how chlorofluorocarbons result to ozone layer depletion, include chemical equations (4 marks)

iii. Explain why chlorofluorocarbons are more dangerous as far as destruction of ozone layer is concerned. (2 marks)

e) Figure 1 shows IV characteristics curves of a solar PV cell.

i. Describe how to determine the short circuit current (I_{sc}) and open circuit voltage (V_{oc}). (4 marks)

ii. Show the maximum power point and state its significance (2 marks)

iii. Draw IV characteristics curve for three solar panels arranged in parallel (2 marks)

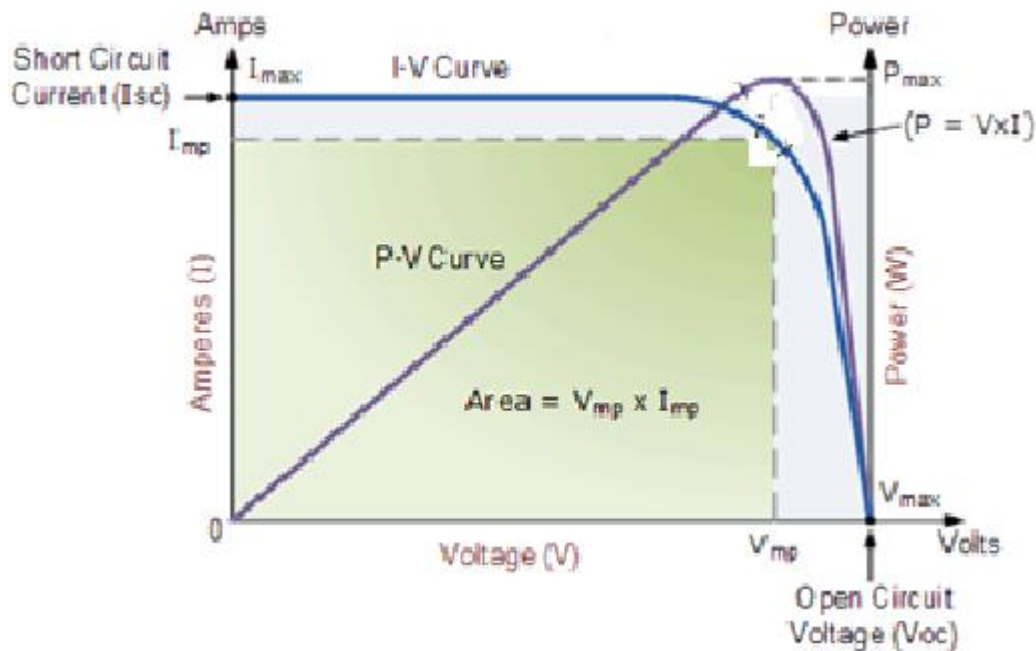


Figure 1: I-V characteristics of Solar PV cell

Question Three

a) You have been hired by Tropical Power Company to install a wind energy power plant in North Kinangop. The density of air is 1.3 kg/m^3 and the speed of wind is 20 m/s in that place. Calculate the wind's kinetic energy. (6 marks)

b) Name four examples of a heat pump (4 marks)

Question Four

a) The device shown in figure 2, transfers heat energy from a heat source to a destination called heat sink. Study the diagram (Figure 2) and answer the following questions. Explain

- i. the role of expansion device and why the fluid outside the room is at low pressure (7 marks)
- ii. whether the device warms or cools the room (3 marks)

Question Five

a) An internal combustion motor vehicle engine converts heat into work and dissipates excess heat into a heat sink.

- i. In a motor vehicle engine, which part is the heat sink (2 mark)
- ii. Illustrate with a drawing
 - A. The intake stroke, (2 marks)
 - B. The compression stroke, (2 marks)

C. The ignition stroke, (2 marks)

D. The exhaust stroke of the engine. (2 marks)

b) A nuclear reactor produce high pressure steam of 290 °C. After the steam is used to spin a turbine, it is condensed (by using water from nearby river) back to water at 20 °C. The excess heat is deposited in the river. What is the maximum possible efficiency can this plant achieve (6 marks)

c) A refrigerator takes in 20 J of work and exhausts 50 J of heat. What is the refrigerant's COP? (4 marks)

SPH 202/SPT 207: MODERN PHYSICS 180 copies

DATE: 19-4-2023

TIME 2.00 pm

Useful constants

	Name	Value
1	Plank constant (h)	$6.63 \times 10^{-34} \text{ m}^2 \text{ kg/s}$
2	Permittivity of free space (ϵ_0)	$8.854 \times 10^{-12} \text{ F.m}^{-1}$
3	Permeability of free space (μ_0)	$1.2566 \times 10^{-6} \text{ NA}^{-2}$
4	speed of light (c)	$2.998 \times 10^8 \text{ m/s}$

SPT210: GEOPHYSICS TECHNOLOGY

15 copies

DATE: 13-4-2023

TIME: 8:30 am

Useful constants

Name	value
Earth radius	$R_E = 6.380 \times 10^6 \text{ m}$
Universal Gravitation constant	$G = 6.672 \times 10^{-11} \text{ Nm}^2/\text{kg}$
mass of the earth	$m_E = 5.98 \times 10^{24} \text{ kg}$
Gravitation acceleration on the sun's surface	274 m/s^2
mass of the sun	$1.9891 \times 10^{30} \text{ kg}$
Distance of the moon from the earth	$3.844 \times 10^5 \text{ Km}$
mass of the moon	$7.34767309 \times 10^{22} \text{ Kg}$
radius of the sun	$6.96 \times 10^8 \text{ m}$

Question 1

f) Given that gravitational acceleration on the earth surface is 9.8 m/s^2 , find gravitation acceleration on a spaceship 3 Km above the earth surface (4 marks)

g) Draw a graph showing how gravitational acceleration varies inside and outside the earth surface