NS-1001:Applied Physics (AI,SE,Cyber Sec. &DS) Solution

Serial No:

Final Exam

Total Time: 3 Hours

Total Marks: 140

Signature of Invigilator

Saturday,23rd December,2023

Course Instructors

Mrs.Aisha Ijaz,Dr.Tashfeen, Mr.Junaid Khan, M.Kashif Ali

Student Name Roll No. Section Signature

DO NOT OPEN THE QUESTION BOOK OR START UNTIL INSTRUCTED.

Instructions:

1. Attempt on question paper. Attempt all of them. Read the question carefully, understand the question, and then attempt it.
2. No additional sheet will be provided for rough work. Use the back of the last page for rough work.
3. If you need more space write on the back side of the paper and clearly mark question and part number etc.
4. After asked to commence the exam, please verify that you have **Twenty four(24)** different printed pages including this title page. There are a total of **11** questions.
5. Calculator sharing is strictly prohibited.
6. Use permanent ink pens only. Any part done using soft pencil will not be marked and cannot be claimed for rechecking.

	Q-1	Q-2	Q-3	Q-4	Q-5	Q-6	Q-7	Q-8	Q-9	Q-10	Q-11	Total
Marks Obtained												
Total Marks	20	10	10	10	10	10	10	20	10	20	10	140

Question 1 [10+10]

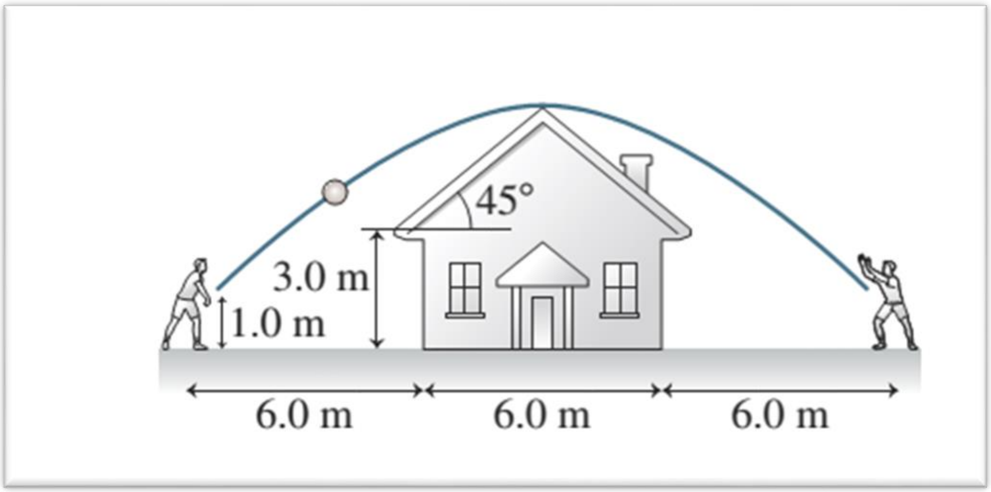
(a) Compute divergence and curl of the given vector function

$$\vec{F} = z^2 (y - x)\, \vec{i} + \frac{4y^2}{z^3} \vec{j} + \left(x^2 - 3z\right) \vec{k}$$

(b) A man pushing a mop across a floor causes it to undergo two displacemnts.The first has a magnitue of 150cm and makes an anlge of 120^{o} with the positive x axis.The resualtnat displacemnt has a magnitude of 140cm and is directed at angle of 35^{o} to the positiv x-axis.Find the magnitude and direction of the second displacement.

Question 2[10]

You're 6.0 m from one wall of the house seen in Figure. You want to toss a ball to your friend who is 6.0 m from the opposite wall. The throw and catch each occur 1.0 m above the ground. (i) What minimum speed will allow the ball to clear the roof ?(ii) At what angle should you toss the ball?

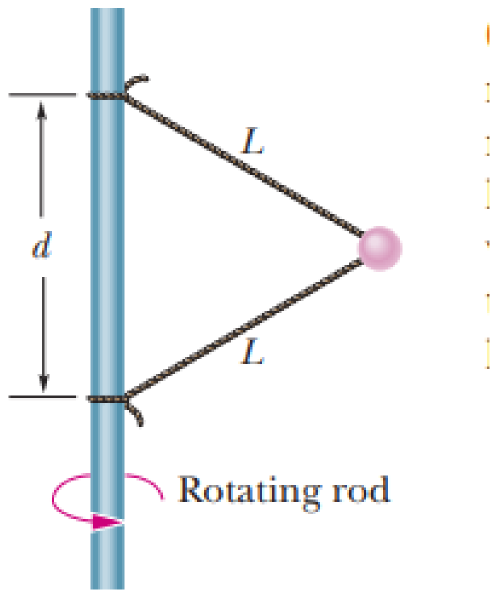


Question 3[10]

Block A in the figure has a mass m_A =8 kg and block B has mass m_B= 3 kg. The coefficient of kinetic friction between block B and the horizotnal plane is μ_k =0.40. The inclined plane is frictionless and at angle θ= 30°.The pulley serves only to change the direction of the cord connecting the blocks.The cord has negligible mass.
Find (i) the tension in the cord and (ii) the magnitude of the acceleration of the blocks.

Question 4[10]

In the figure given below, a 1.34kg ball is connected by means of two massless strings, each of length L=1.70m to a vertical rotating rod. The strings are tied to the rod with separation d= 1.70m and are taut. The tension in the upper string is 35N.What are the
(i) tension in the lower string,(ii) the magnitude of the net force on the ball and speed of the ball?



Question 5 [10]

An oscillator consists of a block attached to a spring (k = 400 N/m). At some time t, the position (measured from the system's equilibrium location), velocity, and acceleration of the block are x = 0.100 m, v = -13.6 m/s, and a = -123 m/s^2. Calculate (i) the frequency of oscillation, (ii) the mass of the block, and (iii) the amplitude of the motion.

Question 6 [10]

Two waves are described by

$$y_1 = 0.3\ \sin(5\pi x-200\pi t)$$
$$y_2 = 0.3\ \sin(5\pi x-200\pi t+\pi/3)$$

Where y_1, y_2, and x are in meters and t is in second.(i).By using principle of superposition find the resultant wave. What are the (ii) amplitude, wave speed and wavelength of the traveling wave?

Use $\sin\alpha + \sin\beta = 2\ \sin\frac{\alpha+\beta}{2}\cos\frac{\alpha-\beta}{2}$

Question 7 [10]

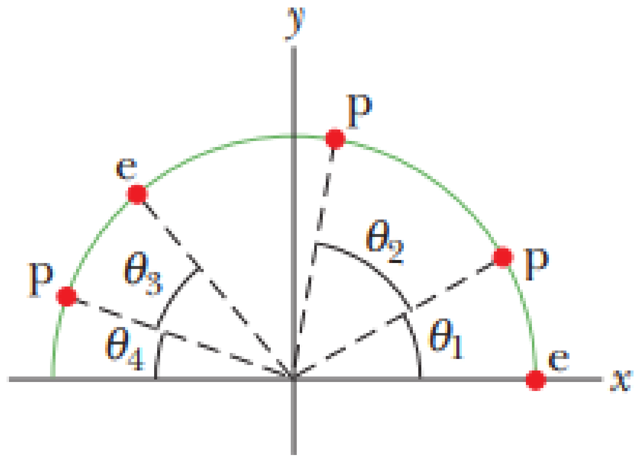
The equation of a transverse wave traveling along a very long string is

$$y = 6.0 \sin(0.020\pi x + 4.0\pi t),$$

where x and y are expressed in centimeters and t is in seconds. Determine (i) the amplitude, (ii) the wavelength, (iii) the frequency, (iv) the speed, (v) the direction of propagation of the wave, and (vi) the maximum transverse speed of a particle in the string. (vii) What is the transverse displacement at $x = 3.5$ cm when $t = 0.26$ s?

Question 8 [10+10]

(a) Figure shows an uneven arangement of electrons (e) and protons (p) on a circular arc of radius r= 2cm, with angles θ_1=30º, θ_2=50º,θ_3=30º, and θ_4=20º.What are the magnitude and direction of the net electric field produced at the center of the arc? The charge of an electron is −1.6×10−19 and the charge of proton is +1.6×10−19 coulomb (C).

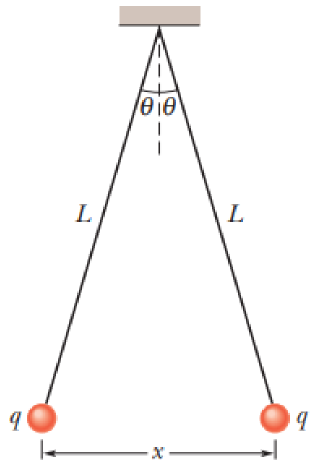


(b) In the figure, two tiny conducting balls of identical mass m and identical charge q hang from nonconducting threads of lenth L. Assume that θ is so small that tan θ can be replaced by its approximate equal sinθ.

(i) Show that

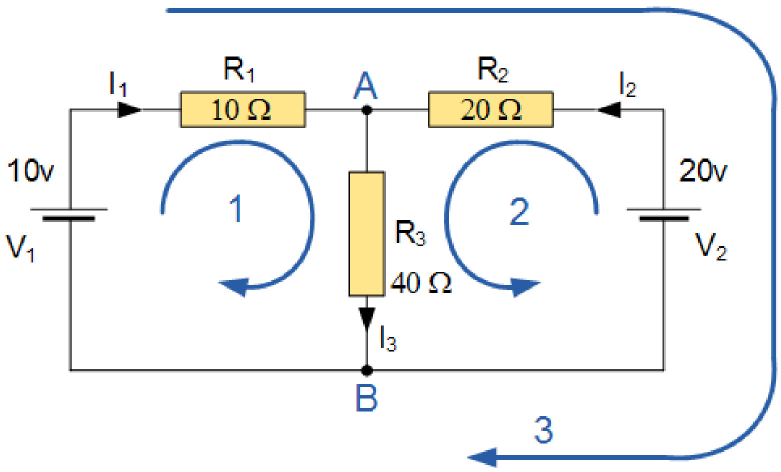
$$x = \left(\frac{q^2 L}{2\pi\varepsilon_0 mg}\right)^{1/3}$$

(ii) If L= 120cm, m=10g, and x=5cm, What is 'q'?



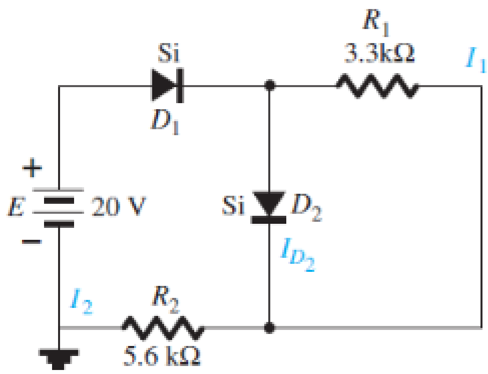
Question 9 [10]

Use KVLand KCL to solve the following circuit to find unknown currents.



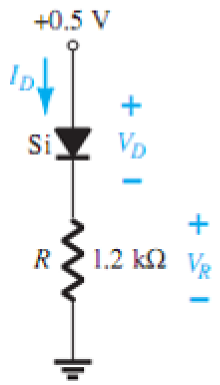
Question 10 [5+5+5+5]

(a) Determine the I_1, I_2, I_{D2}. Threshold voltages for silicon diode is 0.7

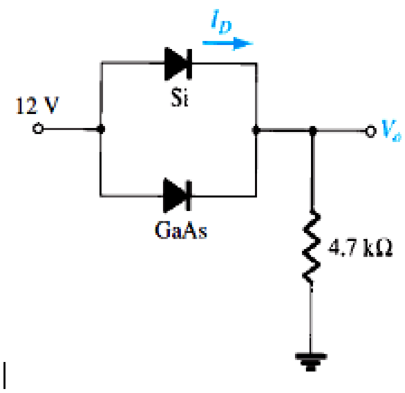


(b)

Determine the values for V_D, I_D, and V_R



(c) Determine V_o and I for the networks of given figure. ($V_B = 0.7$ for silicon, $V_B = 1.2$ for GaAs)



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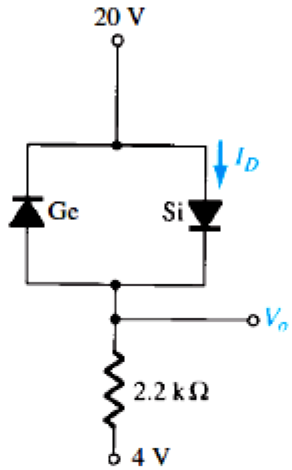
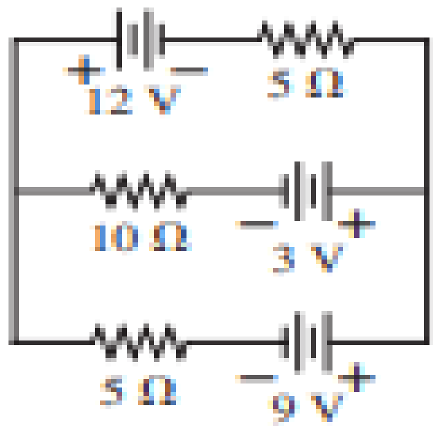
(d) Determine V_o and I for the networks of given figure. ($V_B = 0.7$ for silicon, $V_B = 0.3$ for Ge)



Question 11 [10]

For the figure given below find the current passing through 10 Ω resistor.



Formula Sheet

The general equations of motion that we derived for motion in 1D:

$$\boxed{\Delta x = v_0 t + \frac{1}{2}at^2} \quad \boxed{v = v_0 + at} \quad \boxed{v^2 = v_0^2 + 2a\Delta x}$$

Can be used to solve 2D problems by simply applying them separately in each of the two dimensions:

$$\Delta x = v_{0x}t + \frac{1}{2}a_x t^2 \qquad \Delta y = v_{0y}t + \frac{1}{2}a_y t^2$$

$$v_x = v_{0x} + a_x t \qquad v_y = v_{0y} + a_y t$$

$$v_x^2 = v_{0x}^2 + 2a_x\Delta x \qquad v_y^2 = v_{0y}^2 + 2a_y\Delta y$$

Free fall

$$V_f = V_i - gt$$

$$\Delta y = V_i t - \frac{1}{2}gt^2$$

$$V_f^2 = V_i^2 - 2g\Delta y$$

Projectile motion formulas:

$$y = (\tan\theta_0)x - \frac{gx^2}{2(v_0\cos\theta_0)^2}, \qquad t = \frac{2v_0\sin\theta}{g}, \quad H = \frac{v_0^2\sin^2\theta}{2g}$$

$$R = \frac{v_0^2\sin 2\theta}{g}$$

$$\omega = \sqrt{\frac{k}{m}} \quad \text{(angular frequency)}$$

$$f_{s,\max} = \mu_s F_N, \qquad T = 2\pi\sqrt{\frac{m}{k}} \quad \text{(period).}$$

$$f_k = \mu_k F_N,$$

For ideal SHO

$$x = x_m\cos(\omega t + \phi),$$

$$v = -\omega x_m\sin(\omega t + \phi)$$

$$a = -\omega^2 x_m\cos(\omega t + \phi)$$

$$\omega = \frac{2\pi}{T} = 2\pi f$$

$$\omega = \sqrt{\frac{k}{m}} \quad \text{(angular frequency)}$$

$$T = 2\pi\sqrt{\frac{m}{k}} \quad \text{(period).}$$

For Damped SHO

$$x(t) = x_m\, e^{-bt/2m} \cos(\omega' t + \phi),$$

$$\omega' = \sqrt{\frac{k}{m} - \frac{b^2}{4m^2}}.$$

$$E(t) \approx \tfrac{1}{2} k x_m^2\, e^{-bt/m}.$$

Or $E(t) = E_o\, e{-t/\tau}$ $\tau = m/b$

……………………………………Best Of Luck…………………………………