

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination  
Course Number: ME 4203  
Course Title: Dynamics

Summer Semester: 2021 - 2022  
Full Marks: 75  
Time: 1.5 Hours

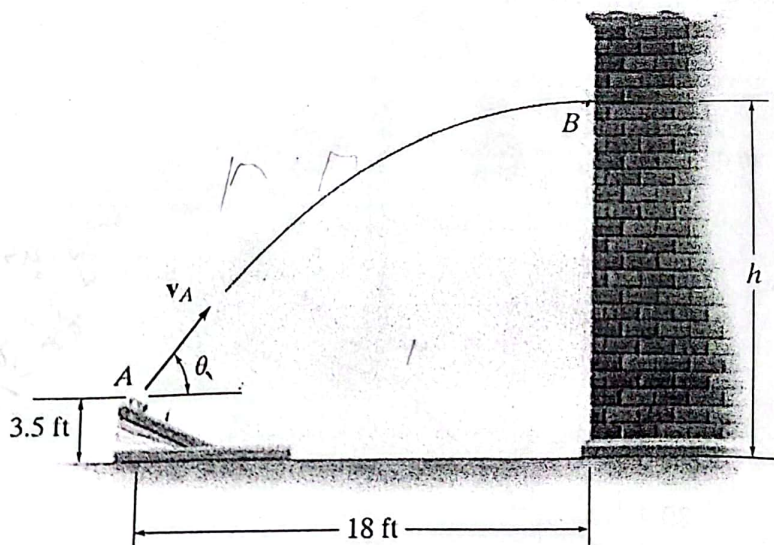
There are 03 (three) questions. Answer all questions. Marks in the Margin indicate full marks. Don't write on this question paper. Symbols carry their usual meanings. Assume reasonable values for any missing data. Programmable calculators are not allowed.

$$a = \frac{dv}{dt} \Rightarrow \int a dt = \int dv \Rightarrow v = at + C$$

- 1 (a) The acceleration of a particle traveling along a straight line is  $a = \frac{s}{4} \text{ m/s}^2$ , where  $s$  is in meters. If at  $t = 0$ , the particle is at rest ( $v=0, s=0$ ), determine the particle's acceleration, velocity and required time at  $s = 2 \text{ m}$ . ( $v > 0$ )
- (b) The catapult is used to launch a ball such that it strikes the wall of the building at the maximum height of its trajectory. If it takes 2 s to travel from A to B, determine the velocity at which it was launched, the angle of release and the height. [ $g = 32 \text{ ft/s}^2$ ]

(8)  
(CO1)  
(PO1/PO2)

(7)  
(CO1)  
(PO1/PO2)



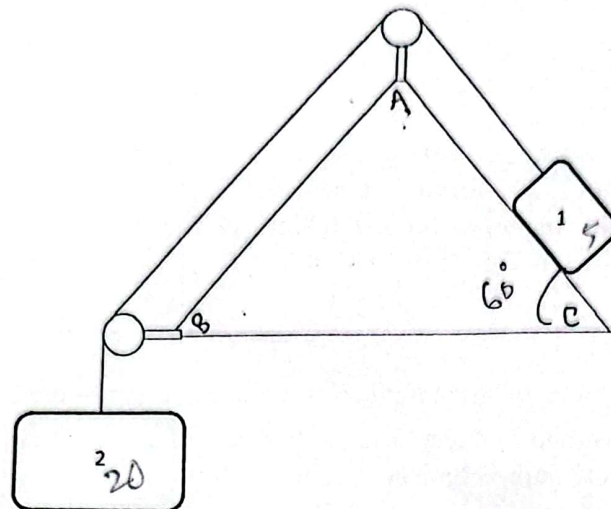
$$h = \frac{v_A^2 \sin^2 \theta}{2g}$$

$$h = 60.5$$

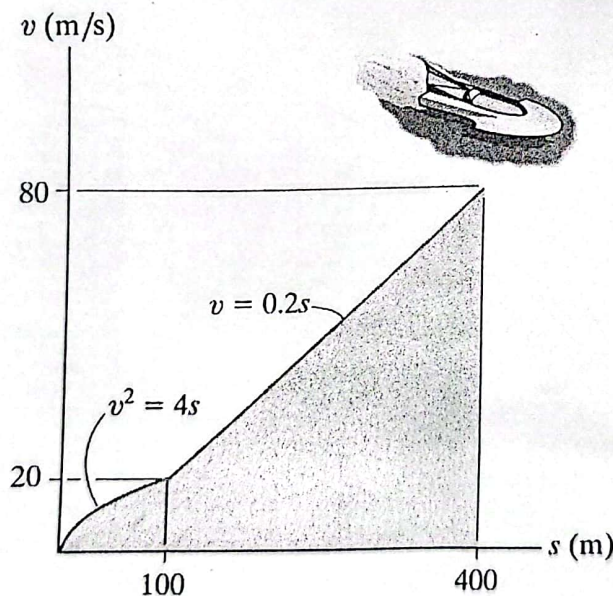
$$y = v_A \sin \theta - \frac{g x^2}{2 v_A^2 \cos^2 \theta}$$

$$y = 26.0 \left( \frac{x}{p} \right)$$

- (c) A mass-pully arrangement is shown in the figure below has two masses, where  $m_1 = 5 \text{ kg}$  and  $m_2 = 20 \text{ kg}$ . In the given ramp,  $AB=BC=AC$ . Kinematic friction co-efficient of the surface is 0.3.
- Apply Newton's second law of motion on both  $m_1$  and  $m_2$  upon showing the freebody diagrams.
  - Determine the velocity of mass 1 after 3 seconds.



- 2 (a) The boat travels along a straight line with the speed described by the graph.
- Construct the  $s-t$  and  $a-s$  graphs. ( $s = 0$  when  $t = 0$ )
  - Construct the  $v-t$  and  $a-t$  graphs. ( $s = 0, v=0$  when  $t = 0$ )
  - Also, determine the velocity, acceleration and time required for the boat to travel a distance  $s = 350 \text{ m}$  if  $s = 0$  when  $t = 0$ .



(15)  
(C01)  
(PO1/PO2)

$$\frac{1}{2} \times 5 \times 2$$

$$\frac{1}{2} \times 5 \times 2$$

$$\frac{1}{2} \times 5 \times 2$$

$$v = \sqrt{4s}$$

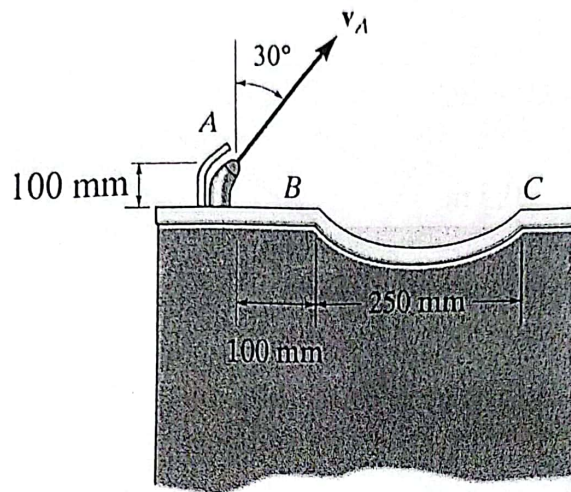
$$\frac{dv}{ds} = \frac{2}{\sqrt{4s}}$$

$$\frac{dv}{ds} = \frac{1}{\sqrt{s}}$$

$$v = \frac{1}{2} \sqrt{s}$$

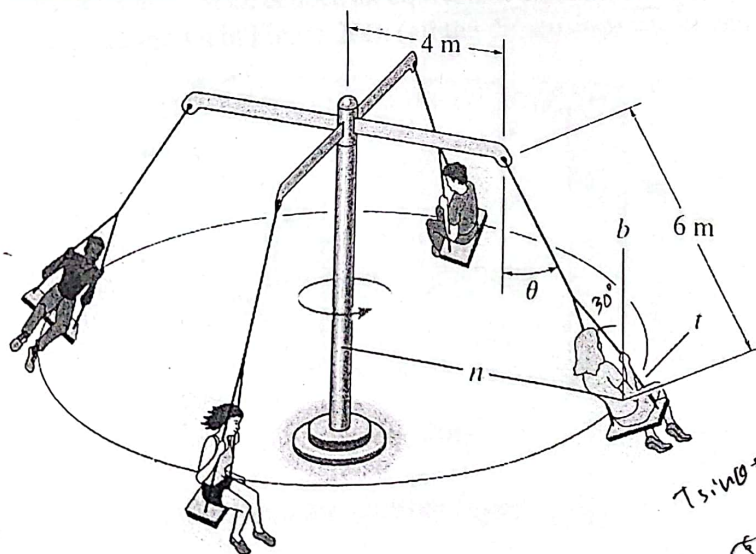
- (b) The drinking fountain is designed such that the nozzle is located from the edge of the basin as shown. Determine the maximum and minimum speed at which water can be ejected from the nozzle so that it does not splash over the sides of the basin at B and C. [ $g = 10 \text{ m/s}^2$ ]

(10)  
(CO1)  
(PO1/PO2)



- (a) Determine the constant speed of the passengers on the amusement-park ride if it is observed that the supporting cables are directed at  $\theta = 30^\circ$  from the vertical. Each chair including its passenger has a mass of 80 kg. Also, what are the components of force in the n, t, and b directions which the chair exerts on a 50-kg passenger during the motion?

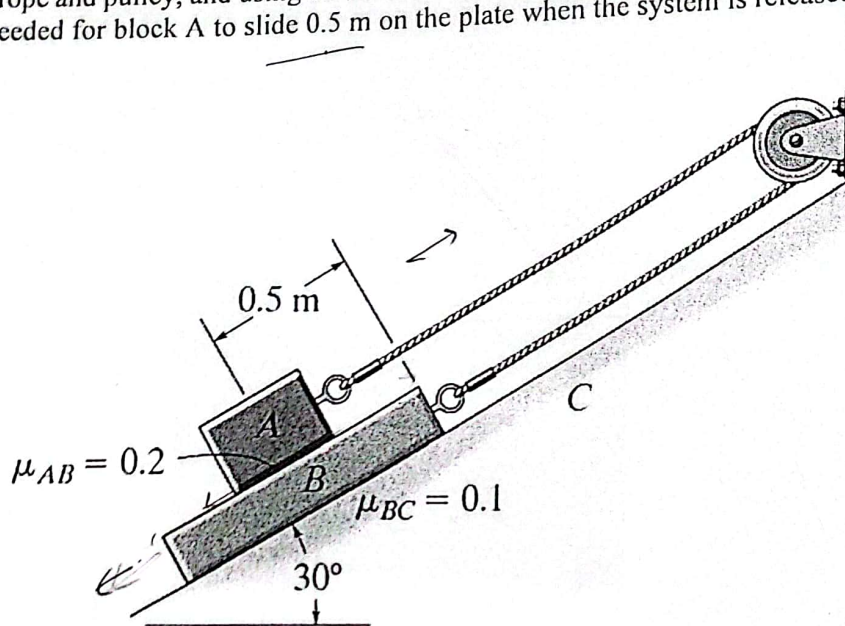
(10)  
(CO2)  
(PO1/PO2)





- (b) The 10-kg block A rests on the 50-kg plate B in the position shown. Neglecting the mass of the rope and pulley, and using the coefficients of kinetic friction indicated, determine the time needed for block A to slide 0.5 m on the plate when the system is released from rest.

(15)  
(CO2)  
(PO1/PO2)



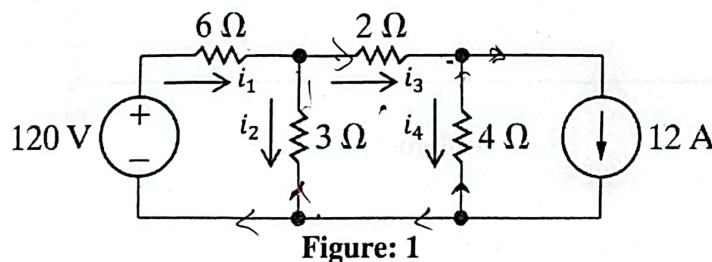
ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination  
Course No.: EEE 4281  
Course Title: Basic Electrical Engineering

Summer Semester, A. Y. 2021-2022  
Time: 90 Minutes  
Full Marks: 75

There are 3 (three) questions. Answer all 3 (three) questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

1. a) State the theorem of superposition for DC circuit analysis. Clarify the reason(s) for implementing this theorem. Describe the steps to obtain the total response of a linear circuit using the superposition theorem. 12  
(CO1, PO1)
- b) Determine the unknown currents from the circuit shown in Figure 1 using the superposition principle. 13  
(CO1, PO1)



$$e = -N \frac{d\phi}{dt}$$

$$V = -L \frac{di}{dt}$$

2. a) State Faraday's law of electromagnetic induction and discuss the relevance of Lenz's law to this phenomenon. Also, deduce an equivalent electrical circuit from the given magnetic system as shown in Figure 2(a). (all the dimensions are in centimeters) 12  
(CO3, PO3)

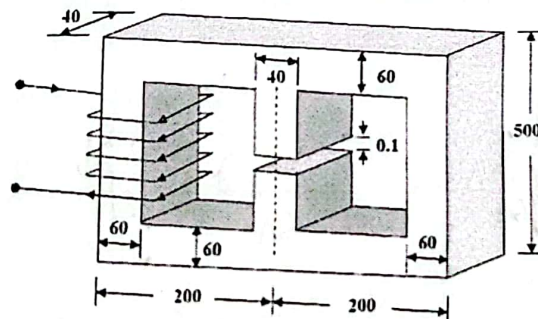
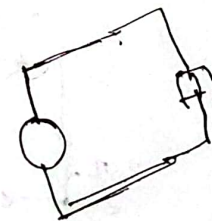


Figure: 2(a)



- b) Find the current in the phasor domain (I) from Figure 2(b).

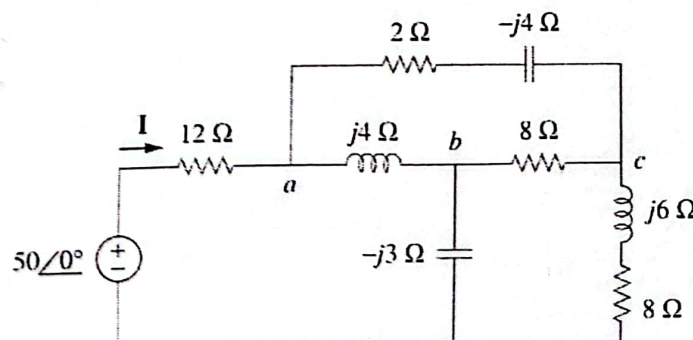
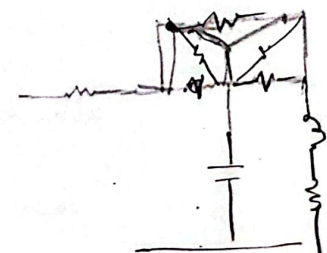


Figure: 2(b)

13  
(CO2, PO2)



$$V = -L \frac{di}{dt}$$

3. a) An academic building of IUT has recently started the renovation by rewiring the electrical lines and requested your expert opinion regarding the choice of poly-phase electrical connection. State your preferred opinion and justify your answer.

12  
(CO4,  
PO4)

- b) For the circuit shown in Figure 3, determine the line voltage, line current, phase voltage, and phase current of the source and load, respectively. (all the symbols have their usual meaning)

13  
(CO4,  
PO4)

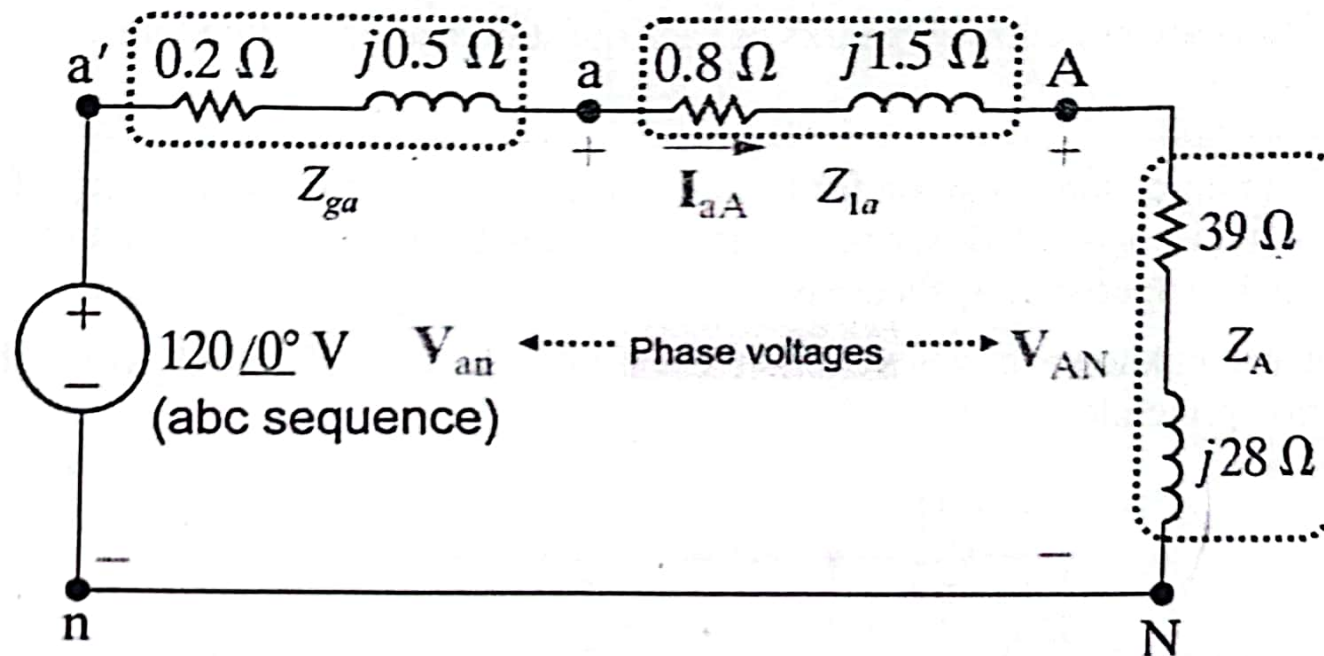


Figure: 3



Program: B. Sc. Engg. (ME/IPE)  
Semester: 2<sup>nd</sup> Semester

Date: 20 February, 2023  
Time: 2:00 PM – 3:30 PM

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
**ORGANISATION OF ISLAMIC COOPERATION (OIC)**  
**DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING**

Mid Semester Examination  
Course Number: Math 4211  
Course Title: PDE, Special Functions, Laplace and  
Fourier

Summer Semester: 2021 - 2022  
Full Marks: 75  
Time : 1.5 Hours

There are 3 (three) questions. Answer all questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

1. a) Let,  $f(x) = \sum_{n=1}^{\infty} \frac{(x-3)^n}{2^n n}$  is a power series, determine its interval of convergence and radius of convergence. [10] CO1 PO1
- b) A differential equation is given below: [5] CO1 PO1  
$$(x^2 + 1)y'' + xy' - y = 0$$
  
(i) Determine the singular points of the above differential equation and classify whether they are regular or irregular.  
(ii) Find the power series solution of the above given differential equation about an ordinary point. [10]
2. a) Define Beta and Gamma function. Using Beta and Gamma relations, evaluate  $\int_0^1 x^{5/2} (1-x)^{5/2} dx$ . Also, Prove that  $\Gamma(n+1) = n\Gamma n = n!$  [10] CO1 PO2
- b) Find a series solution of Bessel's differential equation near a regular singular point using Frobenius method where  $v^2 = \frac{1}{4}$ . [15] CO1 PO1
3. a) (i) Find the Fourier series expansion of the function: [15] CO2 PO1  
$$f(x) = \begin{cases} -x, & -\pi \leq x \leq 0 \\ x, & 0 < x \leq \pi \end{cases}$$
  
(ii) Sketch the graph of  $f(x)$  for the values of  $x$  from  $-5\pi$  to  $5\pi$ .
- b) Evaluate the followings: [5] CO2 PO1

(i)  $L\{f(t)\}$  where  $f(t) = \begin{cases} 0, & 0 \leq t < 3 \\ 2, & t \geq 3 \end{cases}$  [5]

(ii)  $L^{-1} \left\{ \frac{s^2 + 6s + 9}{(s-1)(s-2)(s+4)} \right\}$  [5]

The End

Name of the Program: B.Sc. in ME  
Semester: 2nd

Date: 22 February, 2023  
Time: 2:00 pm – 03:30 pm

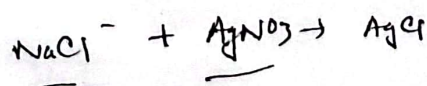
ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid-Semester Examination  
Course No.: Chem 4215  
Course Title: Chemistry of Engineering materials

Summer Semester, A. Y. 2021-2022  
Time: 1 hour 30 minutes  
Full Marks: 75

There are 3 (three) questions. Answer all 3 (three) questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

1. a) Describe how corrosion can be prevented by modification of metal and the environment. 7  
CO1  
PO1  
b) Discuss the different types of corrosion with related example. 8  
CO2  
PO1  
c) Illustrate the effect of dissolved salts and pH on the rate of under-water corrosion. 10  
CO3  
PO2
2. a) Define latex stating its composition and explain the converting process of latex into rubber. 7  
CO1  
PO1  
b) Briefly discuss the synthesis followings with necessary illustration. 8  
i) Melamine ii) Teflon iii) Neoprene rubber iv) Polystyrene. CO2  
PO1  
c) Explain the term polymerization and hence interpret the mechanism of addition polymerization. 10  
CO3  
PO2
3. a) Describe the effect rocks and minerals on under-ground water. 7  
CO1  
PO1  
b) Explain hardness of water. 100 mL of sample water require 11 mL AgNO<sub>3</sub> solution to react completely with chloride ion. Estimate the amount of Cl<sup>-</sup> present in the sample water. Given that 25 mL 0.5 N NaCl solution is required to standardize 26.5 mL AgNO<sub>3</sub> solution. 8  
CO2  
PO1  
c) Interpret scale and sludge, causes, disadvantage, and the prevention method of scale and sludge formation. 10  
CO3  
PO2





Program: B.Sc.in Mechanical Engineering/IPE Semester : 2 <sup>nd</sup> Semester		Date : 23 February, 2023 Time: 2:00 PM-3:30 PM
ISLAMIC UNIVERSITY OF TECHNOLOGY(IUT) ORGANISATION OF ISLAMIC COOPERATION (OIC) DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING		
Mid Semester Examination Course Number : Phy4213 Course Title : Physics		Summer Semester: 2021-2022 Full Marks : 75 Time: 1.5
There are 3 (THREE) questions. Answer all questions. The symbols have their usual meaning. Marks of each question and the corresponding CO and PO are written in the brackets		
1.a	Define simple harmonic motion (SHM). Name different types of pendulums. Discuss oscillations of a torsional pendulum	5
b	A block of mass $m$ tied with a fixed wall by a spring of spring constant $k$ is resting on a frictionless surface and is fixed to a wall. i) Describe its motion. ii) Determine the total energy of the mass spring system. iii) Draw a diagram showing the potential and kinetic energies as a function of its displacement. iv) Discuss the correlation of this mechanical system with its corresponding electrical analogy.	12
c	Define the damping force. A mass ' $m$ ' tied to a spring is executing vertical oscillation with a frequency $\omega$ . A circular disc is attached to the mass and immersed in a liquid. Show that the new frequency of oscillation is given by $\omega' = \sqrt{(k/m) - (\frac{b}{2m})}$ where the symbols have their usual meaning.	8
2.a	Discuss Lissajous figures and hence show how two perpendicular waves of certain amplitudes, and phases could combine to form Lissajous figures.	8
b	What do you mean by reduced mass? Two bodies of masses $m_1$ and $m_2$ are connected to each other by a massless spring whose uncompressed length is ' $l$ '. Show that the equation of motion of the combined system of masses can be represented by $d^2x/dt^2 + (k/\mu)x = 0$ , where the symbols have their usual meaning.	12
c	Electrons in an oscilloscope are deflected by two mutually perpendicular electric fields in such a way that at any time ' $t$ ' the displacement is given by $x = A \cos \omega t$ , and $y = A \cos(\omega t + \phi)$ , describe the path of the electrons and determine the equation when $\phi = 0, 30, 90$ degrees	5
3.a	What do you understand by converging and diverging lenses? Show that the Lens makers formula for a real image by a convex lens is given by $1/f = (\mu - 1)[1/R_1 - 1/R_2]$ , where the symbols have their usual meaning	10
b	What is lens aberration? What are the causes of lens aberration? Show that the approximate value of longitudinal spherical aberration caused by a spherical surface is given by $\Delta f_h = h^2/2 (\mu - 1)^2 f_p$ where the symbols have their usual meaning	10
c	A convex lens of focal length 20 cm is in contact with a concave lens of focal length 25 cm. Calculate the focal length and power of the combination of lenses.	5