L-1/T-2/IPE Date: 17/01/2021

BANGLADESHUNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B.Sc. Engineering Examination 2018-2019

Sub: **MME 195** (Engineering Materials I)

Full Marks: 180 Time: 2 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **FOUR** questions in this script. Answer any **THREE**.

1. (a) What is an equilibrium diagram? What is the importance of understanding the equilibrium diagrams of alloys? **(10)**

   (b) Metals X and Y of melting points 750°C and 920°C respectively are mutually soluble (completely) in the liquid state but partially soluble in the solid state. At 400°C a eutectic composition is formed with 60% X and 40% Y. At eutectic temperature the solubility of Y in X is 20% and that of X in Y is 15%, while at 0°C the solubility of Y in X is 8% and that of X in Y is 5%. Solid solution of Y in X is known as α phase and that of X in Y is known as β phase.

   Draw the X-Y equilibrium phase diagram on graph paper, assuming all the liquidus and solidus lines to be straight and label all the phase fields. For 70% X- 30% Y alloy composition, what are the relative amounts of the eutectic micro-constituent and the pro-eutectic phase at 399°C? **(12+8=20)**

2. (a) Identify the steel with the carbon concentration (wt. %) for which the fraction of total ferrite (both eutectoid and pro-eutectoid) at room temperature is 0.94? For the identified steel, calculate the wt. % of ferrite and cementite in the pearlite at room temperature. **(10)**

   (b) Sketch the microstructures of the steel containing 0.2% C at 730°C, 720°C and 25°C on equilibrium cooling. Comment on the change of the microstructure at 25°C if the percentage of carbon is increased from 0.2% to 0.6%C. **(20)**

3. (a) Select and describe an annealing heat treatment process suitable for toughening hyper-eutectoid steel. **(12)**

   (b) Why does normalizing heat treatment result in a stronger and harder steel than is obtained by annealing? **(12)**

   (c) Draw a schematic diagram showing the effect of tempering temperature on mechanical properties of a 1050 steel. **(06)**

Contd.....P/2

4. (a) Why are FCC metals more ductile than HCP metals? **(06)**

   (b) What are the raw materials commonly used for iron making? Briefly, mention their functions in iron making. **(12)**

   (c) Explain the strengthening mechanism of materials by grain size reduction. **(12)**

SECTION-B

There are **FOUR** questions in this script. Answer any **THREE**.

5. (a) Show two separate plots for density and strength of metals, ceramics, polymers, and composites; to which factor their locations in the plots can be attributed to? Based on these plots, discuss the importance of composites overs other three group of materials to be used in applications that requires high specific strength such as automobiles. **(15)**

   (b) Explain why mechanical properties of Zn is much different than that of Cu based on their crystal structures. **(15)**

6. (a) List the crystallographic planes for the plane group {111}. **(6)**

   (b) Draw crystallographic planes (121), (111) and (212) within three separate unit cells. **(12)**

   (c) Draw crystallographic directions [121], [111] and [212] within three separate unit cells. **(12)**

7. (a) Show the effect of temperature on a typical stress-strain curve of iron and explain the effect of temperature on the relevant mechanical properties. What is the effect of temperature reversal? **(20)**

   (b) With sketches, explain three different modes of crack surface displacement. **(10)**

8. (a) Differentiate between creep and fatigue failure and explain the mechanisms. **(17)**

   (b) Explain how plastic deformation is different from elastic deformation in term of crystallographic deformation mode with illustrating stress-strain curve. **(13)**

L-1/T-2/IPE Date:13/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

B. Sc. Engineering Examinations January 2020

Sub: **Phy 163** (Waves & Oscillations, Physical Optics and Wave Mechanics)

Full Marks: 180 Time: 2 hours

The figures in the margin indicate full marks. Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **FOUR** questions in this Section. Answer any **THREE**

1. (a) "Schrödinger equation cannot be derived from other basic principles of physics; it is a basic principle in itself", justify this statement. [20]

   (b) Estimate the penetration distance Δx for a very small dust particle of radius 10^{-8} m, density 10^3 kg/m^3, velocity 10^{-3} m/sec, if the particle impinges on a potential step of height equal to twice its kinetic energy in the region to the left of the step. [10]

2. (a) How the energy eigen function of an electron that is bound to its atomic nucleus is different than that of a free electron. Draw schematically the allowed energy levels of a bound electron. [20]

   (b) Why 'Quantum Mechanical Tunneling' effect is so important in Solid State Physics? [10]

3. (a) Draw schematically the three statistical distribution functions for the same value of α. What comments can be drawn on their probability of occupancy of a state of energy at the absolute temperature T? [15]

   (b) Find the rms speed of O_2 at 0 ^{0}C. How does v_{rms} for H_2 molecules compare with v_{rms} for O_2 molecules under standard conditions? [15]

4. Write down the expression for the intensity distribution for Fraunhofer diffraction at N slits. Show that the intensity distribution function reduces to double slit diffraction pattern for N=2. If the Fraunhofer diffraction pattern produced by two parallel slits (each of width 'b') separated by a distance 'd' and λ is the wavelength of incident light, how does diffraction pattern change with 'd' at the same value of b and λ? [30]

SECTION-B

There are **FOUR** questions in this Section. Answer any **THREE**

5. (a) Draw an optical diagram for the Young's double slit experiment. Is there any loss of energy in the interference phenomenon? Justify your answer. Write down the conditions for getting a good quality of interference pattern from experimental point of view? What are the factors on which the fringe width depends? [22]

   (b) Light of wavelength $5500\dot{A}$ from a narrow slit is incident on a double slit. The overall separation of 4 fringes on a screen 180 cm away is 0.8 cm. Calculate the slit separation. [08]

6. (a) State Malus' law. Why analyzer is used to identify polarized light? Under what condition, the intensity of light transmitted through the analyzer will be half of the incident light intensity? [18]

   (b) Show that the refractive index of E-ray (μ_e) is less than that of the refractive index of O-ray (μ_o) everywhere except along the optic axis for calcite crystal. What happened when $\mu_e = \mu_o$ along the optic axis? [12]

7. Electrons in an oscilloscope are deflected by two mutually perpendicular electric field in such a way that at any time t the displacements are given by

   $x = a\cos\omega t$, and $y = a\cos(\omega t + \phi)$

   Describe the path of the electrons, and determine their equation when,

   i) $\phi = 0^0$

   ii) $\phi = 90^0$ [30]

8. Give the theory of decay of sound inside a room and obtain an expression for the reverberation time. [30]

L-1/T-2/IPE Date: 20/01/2021

Bangladesh University of Engineering and Technology, Dhaka

L1/T2 B.Sc. Examinations of January 2020

Subject: **Chem 143** (Chemistry of Materials)

Full Marks: 120 Time: 2 hours

Figure in the margin indicate the full marks

Use separate scripts for each section and upload in the LMS system separately

SECTION-A

(There are **FOUR** questions in the section. Answer any **THREE**

1. (a) What do you understand by the term co-polymer? Distinguish between homo-polymer and co-polymer. Give the stepwise mechanism of free radical polymerization. 10

(b) Define inorganic polymer. How would you classify the inorganic polymer? Differentiate between organic polymer and inorganic polymer. 06

(c) Write down the structures of the polymers whose monomers are 04

(i) $CH_2 = CHPh$ (ii) $CH_2= C(CH_3)CH=CH_2$

(iii) $CH_2 = CHCN$ (iv) $CH_2= CH- CH = CH_2$

2. (a) What are the properties of plastic polymers which render them suitable for industrial applications? 06

(b) How polymer can be converted into usable articles by using additives? 08

(c) Classify plastic polymers based on the mechanical properties. Distinguish between low density polyethylene and high density polyethylene. 06

3. a) All fibers are polymer but all polymers are not fiber-Explain the statement. 06

b) What do you mean by rayon? Describe the preparation and properties of cuprammonium rayon. 08

c) Discuss the synthesis and industrial applications of the following fibers.

(i) Dacron, (ii) Orlon 06

4. a) How the monomers and polymers of the following rubbers can be synthesized and mention some of their important applications ? 14

(i) Neoprene (ii) Styrene Butadiene (iii) Silicon (iv) Polyurethane

b) What are the different types of solid lubricants? Write the advantages and disadvantages of solid lubricants. 06

SECTION-B

(There are **FOUR** questions in the section. Answer any **THREE**)

5. (a) How pitting corrosion occurs? The measurement parameters of pitting corrosion are different from uniform corrosion- explain? 12
   (b) Interpret the effect of cathodic and anodic inhibitors for the prevention of corrosion. 8

6. (a) Draw a typical stress-strain curve obtained from tensile test of polymers. Analyze different points of the curve. 12
   (b) Elaborate the effect of temperature on modulus of polymers. 8

7. (a) Ceramics are different from metals -discuss. 12
   (b) Summarize the functions and uses of nuclear ceramics. 8

8. (a) What are the constituents of paints? Clarify the function of binders and additives for good paints. 12
   (b) Classify lubricants based on the composition and explain their properties. 8

L-1/T-2/IPE Date: 24/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2018-2019

Sub: **MATH 193** (Vector, Matrix and Co-ordinate Geometry)

Full Marks: 240 Time: 2 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Symbols used have their usual meaning.

SECTION-A

There are **FOUR** questions in this section. Answer any **THREE**.

1. **(a)** Determine whether the terminal points of the set of vectors $\underline{a} = 2j + 2k$, $\underline{b} = i - j + 2k$, $\underline{c} = -i + 3j$, $\underline{d} = -i + 7j + 4k$ with initial points at the origin are (i) collinear, (ii) coplanar, (iii) both, (iv) none. **(20)**

   (b) Find (vectorially) the shortest distance of $P(1,-2,-1)$ from the plane passing through the points $A(2,4,1)$, $B(-1,0,1)$ and $C(-1,4,2)$. **(20)**

2. **(a)** Obtain a set of vectors reciprocal to the three vectors $i + j + k$, $i - 2j + k$, $i + j - 3k$, **(20)**

   (b) Show that the acceleration $\underline{a}$ of a particle which travels along a space curve with velocity $\underline{v}$ is given by $\underline{a} = \frac{dv}{dt}\underline{T} + \frac{v^2}{\rho}\underline{N}$. **(20)**

3. **(a)** Solve the following system of linear equations, if consistent **(20)**

   $2x + y - 2z - 2w = -2$

   $3x \qquad\quad - 3w = -3$

   (b) State Cayley-Hamilton theorem. Find A^{-1} by using Cayley-Hamilton theorem for the matrix **(20)**

   $$A. = \begin{bmatrix} 1 & -1 & 1 \\ 1 & 2 & 1 \\ 1 & 0 & 3 \end{bmatrix}.$$

4. **(a)** Find the eigenvalues and the corresponding eigenvectors of the matrix **(20)**

   $$A. = \begin{bmatrix} 5 & 6 & 2 \\ 0 & -1 & -8 \\ 0 & 0 & -1 \end{bmatrix}.$$

   (b) Reduce the quadratic form $q = x_1^2 + 2x_2^2 - 3x_3^2 + 8x_1x_2 + 10x_1x_3 - 16x_2x_3$ to the canonical form and hence find the corresponding linear transformation, rank, index and signature. **(20)**

SECTION-B

There are **FOUR** questions in this section. Answer any **THREE**.

5. Transform the equation $17x^2 + 18xy - 7y^2 - 16x - 32y - 18 = 0$ in rectangular co-ordinates using suitable translation and rotation of axes so as to remove the terms in x, y and xy. **(40)**

6. (a) Find the equation of the plane through the intersection of the planes **(20)**

$x + 2y + 3z + 4 = 0$ and $4x + 3y + 2z + 1 = 0$ and perpendicular to the plane

$x + y + z + 9 = 0$ and hence show that it is perpendicular to xz plane.

(b) A plane meets the co-ordinate axes in A, B and C such that the centroid of the triangle ABC is the point (p, q, r); show that the equation of the plane is **(20)**

$$\frac{x}{p} + \frac{y}{q} + \frac{z}{r} = 3$$

7. (a) Find the shortest distance between the lines $\frac{x-1}{4} = \frac{y-2}{3} = \frac{z-1}{-5}; \frac{x+1}{2} = \frac{y-3}{3} = \frac{z-4}{-4}$. **(25)**

In addition, find the equations of their common normal.

(b) Show that the lines $\frac{x+5}{3} = \frac{y+4}{1} = \frac{z-7}{-2}$ and $3x + 2y + z - 2 = 0 = x - 3y + 2z - 13$ are coplanar and find the equation of the plane in which they lie. **(15)**

8. (a) A plane passes through a fixed point (a, b, c) and cuts the axes in A, B, C. Show that the locus of centre of the sphere OABC is $ax + by + cz = 2$. **(20)**

(b) Find the equation of the sphere which passes through the circle **(20)**

$x^2 + y^2 + z^2 = 5, x + 2y + 3z = 3$ and touches the plane $4x + 3y = 15$.

L-1/T-2/IPE Date: 10/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-II B.Sc. Engineering Examination 2018-19

Sub: **EEE 167** (Basic Electrical and Electronic Circuits)

Full Marks: 240 Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 6 pages in this question paper.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**

All the symbols have their usual meanings.

1. (a) Find the values of all the voltages and currents shown in the following circuit (Figure 1). Given, V_c (rms) = 120∠0° V. (20)

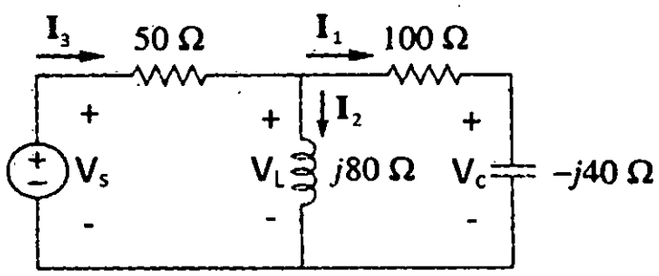

Figure 1

(b) Draw the phasor diagram of all the voltages and currents in one diagram. (15)

(c) Find the power delivered by the voltage source. (5)

2. (a) A Y-connected balanced three phase generator is connected to a Y-connected balanced load with an impedance of 20 + j20 Ω per phase. The line joining the generator and the load has an impedance of 0.5 + j0.6 Ω per phase. Assuming a positive sequence for the source voltages and that V_{an} = 120∠0° V, find: (i) the line voltages at load side, (ii) the line currents. (20)

(b) A 1 KW load is connected to a 220V (rms) 50 Hz power source as shown in Figure 2. The power factor of the load is 0.65. Find the value of the capacitor that needs to be connected in parallel to the load to make the overall power factor equal to 1. (20)

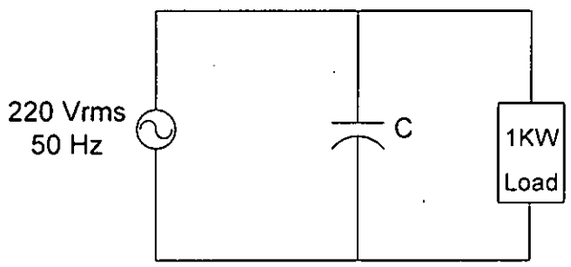

Figure 2

3. (a) Assuming that the diodes in the circuits of Figure 3(a) are ideal, find the values of the labeled voltages and currents in the two circuits. (20)

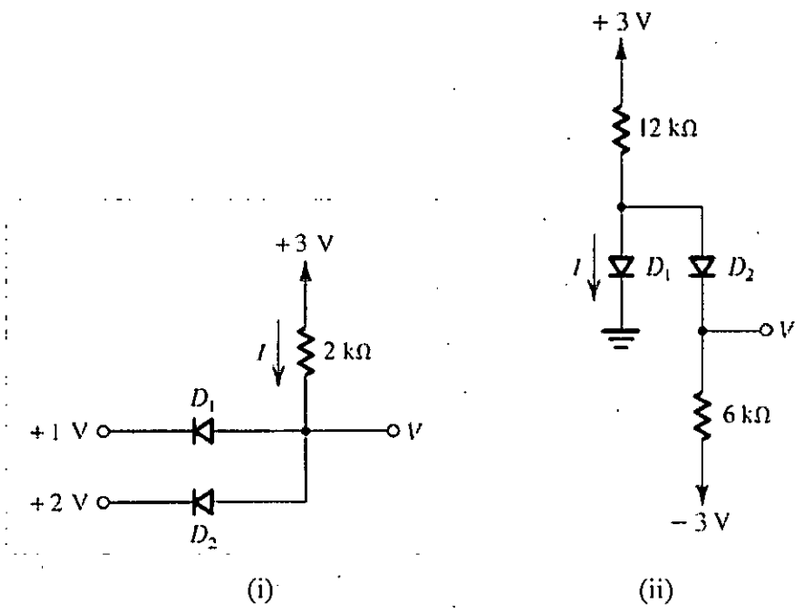

Figure 3(a)

(b) Assuming constant voltage drop (0.7V) model for diode in forward bias, find: (i) voltage transfer function, (ii) output voltage waveform for v_i = 10sin(20πt) V for the circuit shown in Figure 3(b). (20)

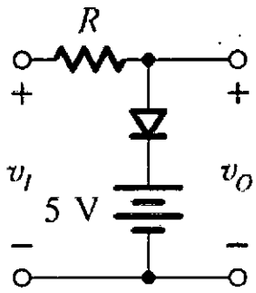

Figure 3(b)

4 (a) What are the modes of operation of a BJT device. State the conditions of the two junctions under different modes of operation. (10)

(b) Determine the voltages at all nodes and the currents through all branches in the circuit shown in Figure 4. Assume $\beta = 100$ and $V_{BE} = 0.7V$ in active mode. (20)

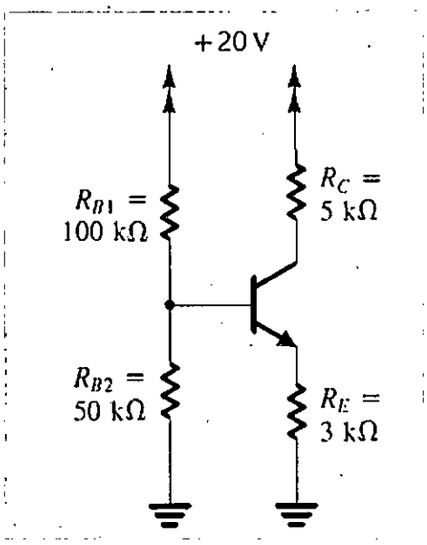

Figure 4

(c) What are the three basic configurations of BJT amplifiers? Draw an emitter follower BJT amplifier circuit. (10)

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**

All the symbols have their usual meanings.

Assume reasonable values for missing data.

5. (a) Find the equivalent resistances, R_{ab} and R_{cd} in the circuit shown in Fig. for Q. 5(a). (15)

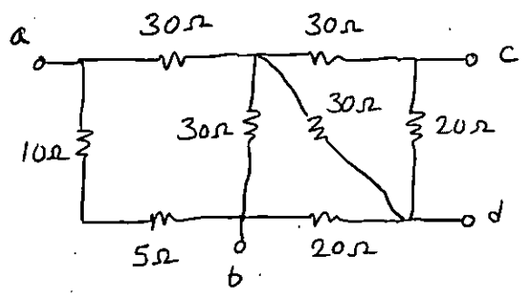

Fig. for Q. 5(a)

(b) Using the nodal analysis method, find the node voltages at points 1, 2, 3, and 4 in the circuit shown in Fig. for Q. 5(b). (25)

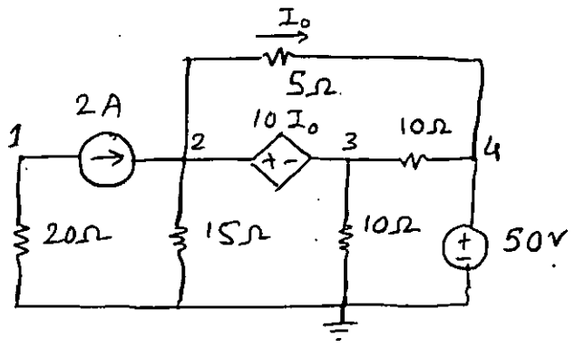

Fig. for Q. 5(b)

6. (a) Find the mesh currents in the circuit shown in Fig. for Q. 6(a) using mesh analysis. (25)

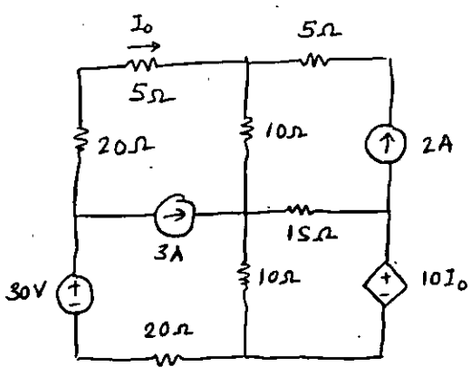

Fig. for Q. 6(a)

(b) For the circuit shown in Fig. for Q. 6(b), find V_o/V_s in terms of g, R_1, R_2, R_3, and R_4. If $R_1 = R_2 = R_3 = R_4 = 10\Omega$, what value of g will produce $|V_o/V_s| = 5$? (15)

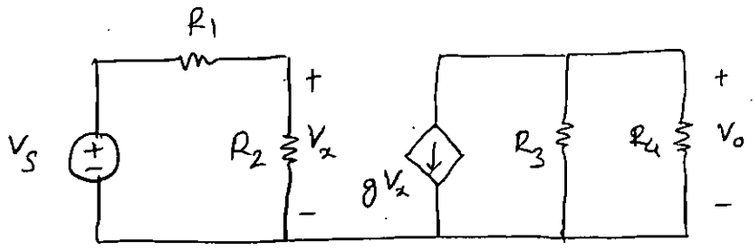

Fig. for Q. 6(b)

7. (a) Use superposition principle to find V_o and I_o in the circuit of Fig. for Q. 7(a). (25)

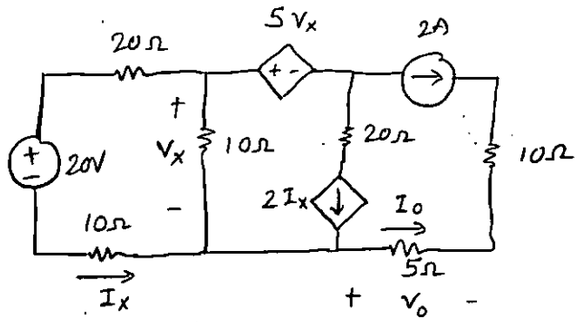

Fig. for Q. 7(a)

(b) Find V_o in the circuit shown in Fig. for Q. 7(b) using source transformation. (15)

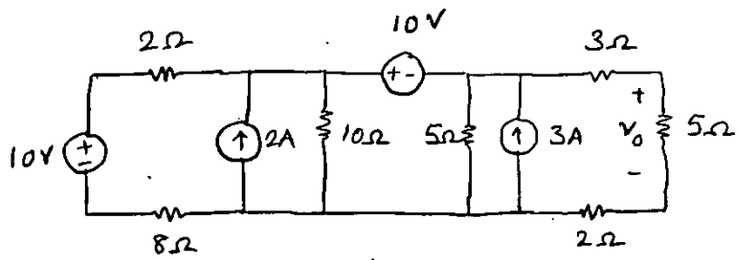

Fig. for Q. 7(b)

8. (a) Find the Thevenin and Norton equivalent circuits between terminals a and b of the circuit shown in Fig. for Q. 8(a). (25)

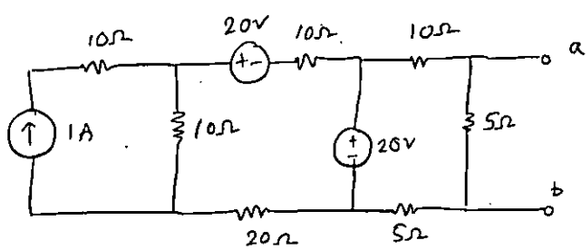

Fig. for Q. 8(a)

(b) Find the value of R_L that will transfer maximum power to R_L in the circuit shown in Fig. for Q. 8(b). (15)

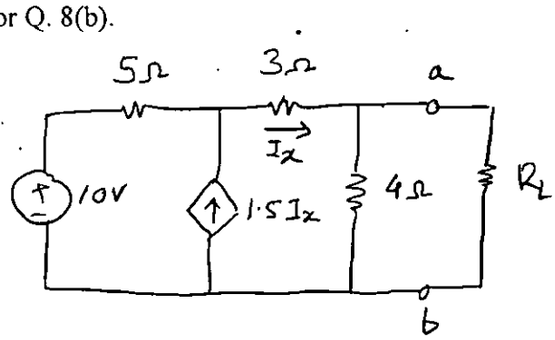

Fig. for Q. 8(b)