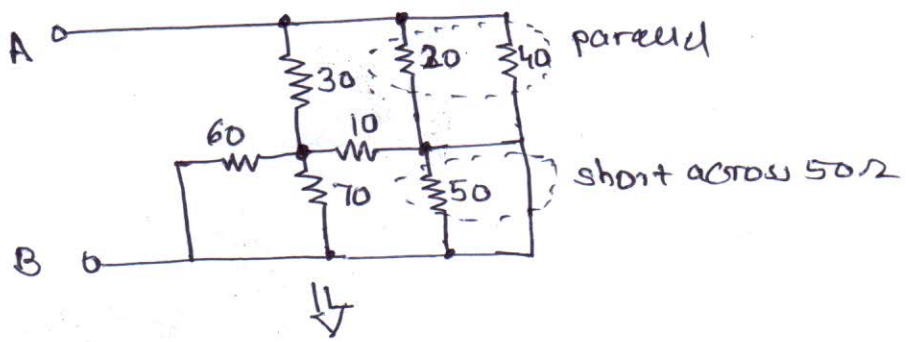
K. J. Somaiya College of Engineering, Mumbai-77
(Autonomous College Affiliated to University of Mumbai)
Semester: July 2014 - November 2014

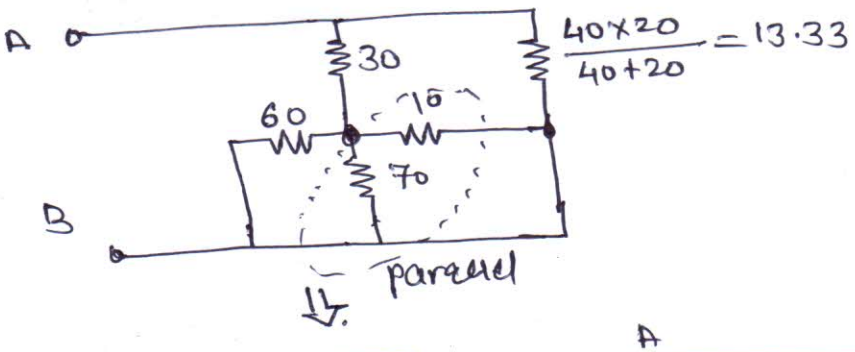
Max. Marks: 40 | Duration: 1hr.30 min.
Class: FE | Semester: I
Branch: Group A(COMP/IT/MECH(Div-I)
Test1 | Name of the Course: Basic Electrical and Electronics Engineering

Marks Distribution Along With Short Solution

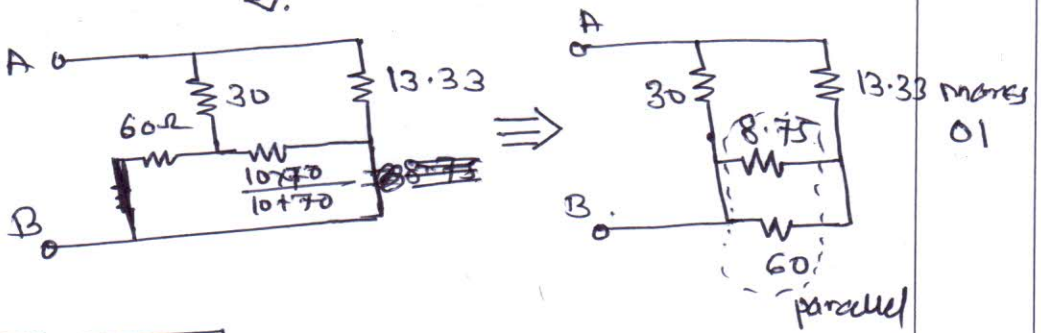
Question No.	Question / Short solution / steps / main contents of answer	Max. Marks
Q.1 (a)	Find the total resistance between terminals A and B in circuit shown below.	



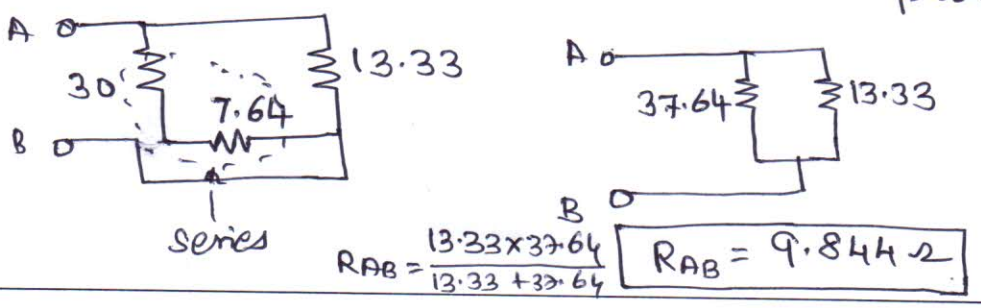
marks 01



marks 01



marks 01



marks 01

marks 01

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Q1 (b)	What is the purpose of electrical earthling?	
Ans→	(1) To provide an alternative path for the fault current to flow so that it will not endanger the user and ensure the safety of Human Life or Building or Equipment. (2) To protect buildings, machinery & appliances under fault conditions. (3) To ensure that all exposed conductive parts do not reach a dangerous potential. (4) Lightning, line surges or unintentional contact with higher voltage lines can cause dangerously high voltages to the electrical distribution system. Earthing provides an alternative path around the electrical system to minimize damages in the System and dissipate lightning and short circuit currents. (5) To provide stable platform for operation of sensitive electronic equipment's i.e. to maintain the voltage at any part of an electrical system at a known value so as to prevent over current or excessive voltage on the appliances or equipment.	01Mark for one valid Point
	OR	
Ans→	What is Circuit breaker?	
	A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit.	Mark 01
	Its basic function is to detect a fault condition and interrupt current flow.	Mark 01
	Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. Circuit breakers are made in varying sizes, from small devices that protect an individual household appliance up to large switchgear designed to protect high voltage circuits feeding an entire city.	Mark 01
Q1 (c)	List the typical ratings of an electrical switch.	
	1. Voltage AC /DC 2. Current Rating AC(with nature of the load)/DC	Mark 01 each

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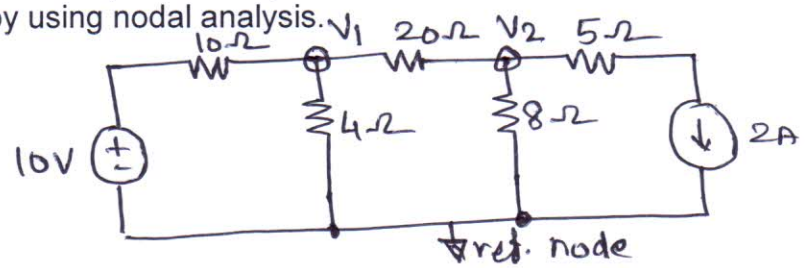
Question No.	Question / Short solution / steps / main contents of answer	Max. Marks
Q2 (a)	Find the power dissipated in the 20 Ω resistor of the circuit shown below by using nodal analysis.  KCL at node ① $\frac{V_1-10}{10}+\frac{V_1-V_2}{20}+\frac{V_1}{4}=0$ $8V_1-V_2=20$ ---(I) KCL at node ② $\frac{V_2-V_1}{20}+\frac{V_2}{8}+2=0$ $V_1-3.5V_2=40$ ---(II) Solving (I) & (II) $V_1=1.11V$, $V_2=-11.11V$ $I_{20\Omega}=\frac{V_1-V_2}{20}=\frac{1.11-(-11.11)}{20}=0.61A$ $P_{20}=(0.61)^2\times 20=18.60mW$	marks (01) marks (02) marks (02) marks (01) marks (01)
Q2 (b)	Define the following terms. Also specify their value for a sinusoidal signal. 1. Form Factor 2. Crest 1. **Form factor** the ratio is of the effective value (RMS Value) of a periodic function, such as an alternating current, to its average value. Form Factor =RMS value/ average value 2. **Crest factor** is the peak amplitude of the waveform divided by the RMS value of the waveform. Crest factor = Peak value/RMS 3. For sinusoidal voltage with peak value V, RMS value is $V/\sqrt{2}$ average value is $2V/\pi$. So Form Factor is 1.11 and crest factor is 1.414.	Mark 01 Mark 01 Mark 01

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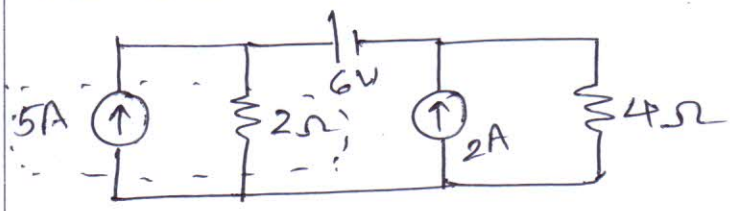
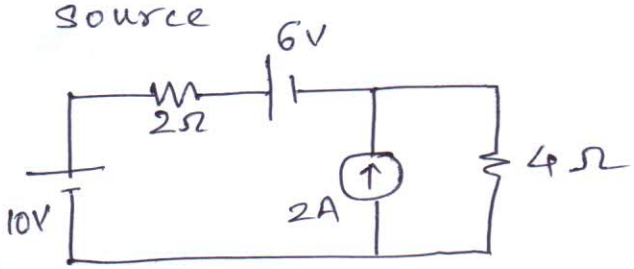
One can prepare hand written solution and scan it quest

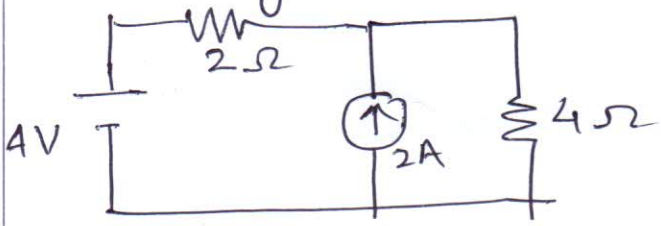
Q3 A. By source transformation, find current in 4Ω resistor



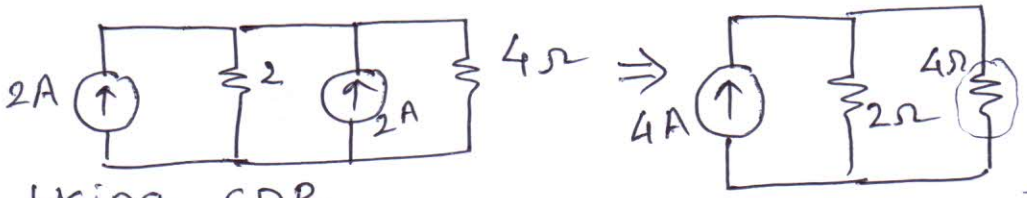
Converting 5A & 2Ω to eqt voltage source



Adding voltage sources



Converting 4V and 2Ω to eqt current source



02

Using CDR

$$I_{4\Omega} = 4 \times \frac{2}{2+4} = \frac{8}{6} = 1.33\,A \downarrow$$

1

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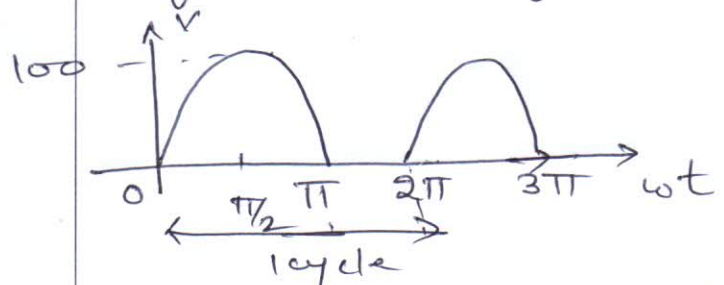
Marks Distribution Along With Short Solution

Question No.	Question / Short solution / steps / main contents of answer	Max. Marks
Q3B	One can prepare hand written solution and s Calculate the Average value, effective value and form factor of O/p voltage wave of HWR	



Soln In a cycle, positive half cycle ≠ Negative Halfcycle

∴ waveform is unsymmetrical

Interval	Equation
$0<\theta<\pi$	$V=100\sin\theta$
$\pi<\theta\pi 2\pi$	$V=0$

→ 01

$$V_{Avg} = \frac{\text{Area of full cycle}}{\text{Base length of full cycle}}$$

→ 01

$$= \frac{\int_0^{2\pi} V\,d\theta}{2\pi} = \frac{1}{2\pi}\left[\int_0^{\pi} V\,d\theta + \int_{\pi}^{2\pi} 0\,d\theta\right]$$

$$= \frac{1}{2\pi}\left[\int_0^{\pi} 100\sin\theta\,d\theta\right] = \frac{100}{2\pi}\left[-\cos\theta\right]_0^{\pi}$$ 01

$$= \frac{100}{2\pi}\left[-\cos\pi-(-\cos 0)\right]$$

$$= \frac{100}{2\pi}\times 2 = \frac{100}{\pi} = 31.83\,V$$

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One can prepare hand written solution and s

RMS Value

$$V_{rms} = \sqrt{\frac{\text{Area of full cycle of squared wave}}{\text{Base Length of full cycle}}}$$

$$V_{rms} = \sqrt{\frac{\int_0^{2\pi} v^2 \, d\theta}{2\pi}}$$ 01

$$= \sqrt{\frac{1}{2\pi}\left[\int_0^{\pi} v^2 d\theta + \int_{\pi}^{2\pi} 0 \, d\theta\right]}$$

$$= \sqrt{\frac{1}{2\pi}\int_0^{\pi} 100^2 \sin^2\theta \, d\theta}$$

$$V_{rms}^2 = \frac{10000}{2\pi}\int_0^{\pi} \sin^2\theta \, d\theta$$ 02

$$= \frac{10000}{2\pi}\int_0^{\pi} \frac{1-\cos 2\theta}{2} \, d\theta$$

$$= \frac{10000}{2\pi \times 2}\left[\int_0^{\pi} 1 \, d\theta - \int_0^{\pi} \cos 2\theta \, d\theta\right]$$

$$= \frac{2500}{\pi}\left[\theta\right]_0^{\pi} - \left[\frac{\sin 2\theta}{2}\right]_0^{\pi}$$

$$V_{rms}^2 = \frac{2500}{\pi} \times \pi = 2500 \text{ V}$$

$$\therefore V_{rms} = 50 \text{ V}$$

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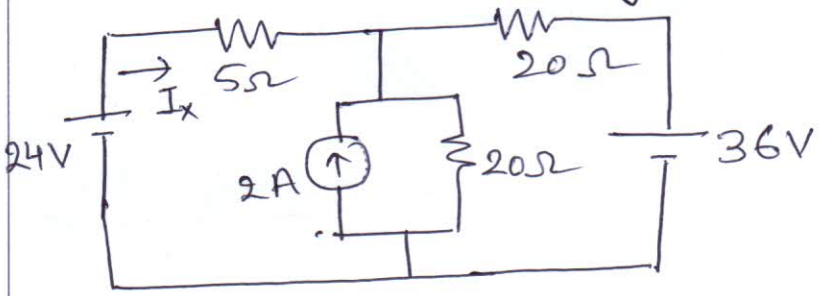
form factor = $\frac{\text{rms value}}{\text{Avg value}}$

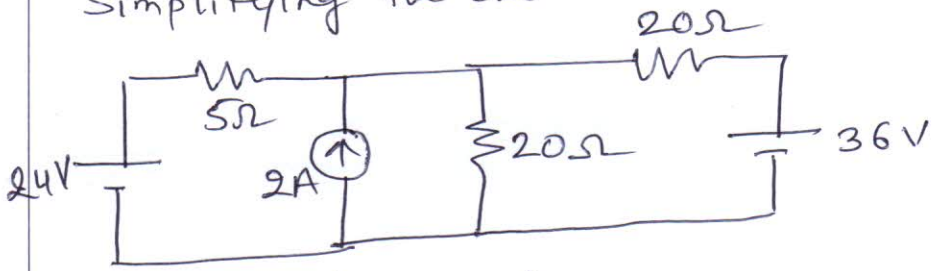
$= \frac{10}{6.366} = 1.57$

$= \frac{2500}{31.83} \quad \frac{50}{31.83} = 1.57$ — 01

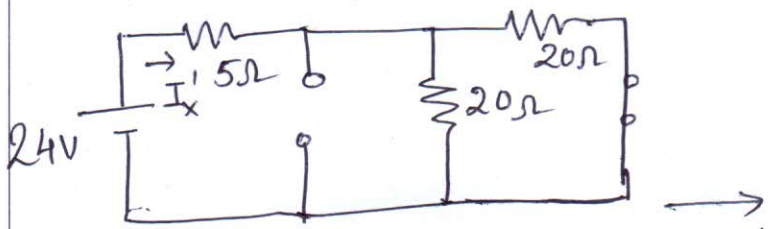
Q4 Find current I_x using Superposition theo.



Simplifying the ckt



(1) 24 V Acting alone



$I_x' = \frac{24}{5 + [20 \| 20]} = 1.6\ A$ — 03

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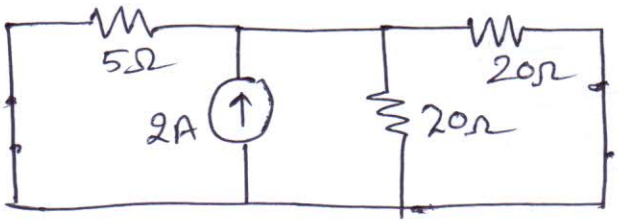
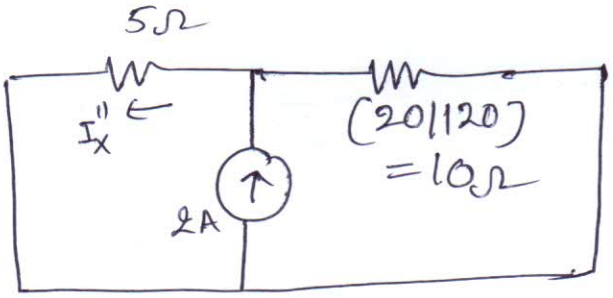
II 2 A Acting Alone



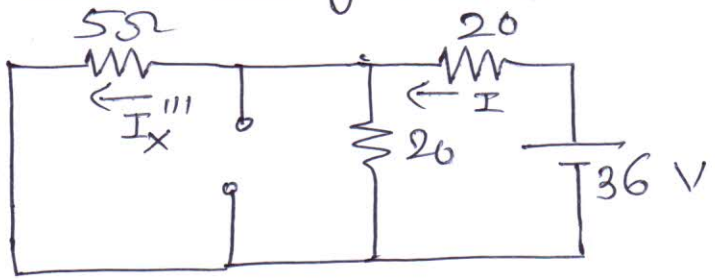
03



By CDR

$$I_x'' = \frac{2 \times 10}{10+5} = \frac{20}{15} = 1.33\ A\ (\leftarrow)$$

III 36 V Acting Alone..



03

$$I = \frac{36}{20+(5\|20)} = 1.5\ A$$

$$I_x''' = \frac{1.5 \times 20}{25} = 1.2\ A\ (\leftarrow)$$

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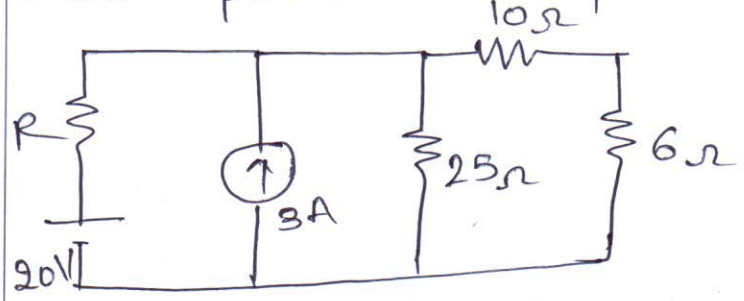
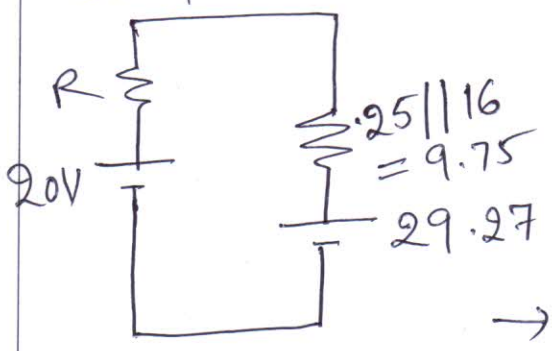
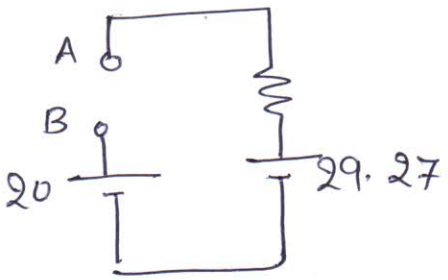
	$\therefore$ Net $I_x = \bar{I}_x' + \bar{I}_x'' + \bar{I}_x'''$	
	$= +33\ 1.6 - 1.33 - 1.2$	01
	$= 0.93A(\leftarrow)$	
	OR	
Q4	Calculate value of R that will absorb Maxm power & compute value of Maxm power	
		
	Using Source Transformation	
		
	V_{TH}	
		04
	Traversing from B to A, $-20 + 29.27 + 0 =$	
	$9.27\ V$	

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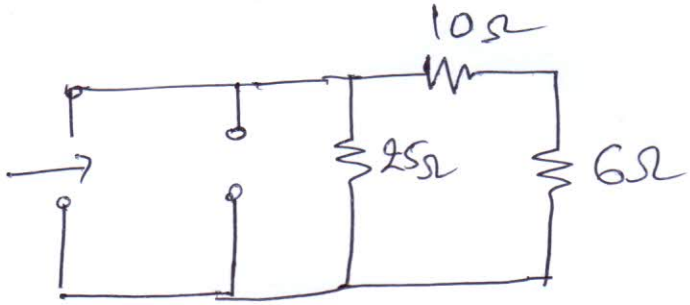
To find R_{TH}



04

$$R = R_{TH} = 25 \,||\, (10+6)$$
$$= 9.756\ \Omega$$

To find Pmax

$$P_{max} = \frac{V_{TH}^2}{4R_{TH}}$$

02

$$= \frac{9.27^2}{4 \times 9.756}$$

$$= 2.202\ W$$