ALL THE FORMULAS YOU NEED IN PHY 104

$$Z=\sqrt{R^2+(X_L-X_C)^2}$$

PAST EXAMINATION QUESTIONS AND ANSWERS

PAST TEST QUESTIONS AND ASNWERS

SELF EXPLANATORY

PHY104 AT YOUR FINGER TIP

COMPILED BY DR-SMOKE

ALL THE FORMULAS YOU NEED

S/N	LAW	FORMULA

1.	Velocity	$V = \frac{d}{t}$ where d = displacement in meters and t is time in seconds
2.	Acceleration	$a = \frac{v}{t}$ where v is velocity in meters per seconds(m/s) and t is time in seconds
3.	Current (I)	$I = \frac{Q}{t}$ where Q is charge in coulombs and t is time in seconds
4.	E.m.f in an electric circuit	$E = \frac{W}{Q}$ where W is work in joules and Q is charge in coulombs
5.	Resistance in series	$R_t = R_1 + R_2 + R_3$
6.	Resistance in parallel	$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2}$
7.	Ohms Law	V=IR where V is voltage in volts, I is current in Ampers and R is resistance in Ohms
8.	Resistivity (**p**)	$p = \frac{RA}{l}$ where R is the resistance in Ohms, A is the area of the wire in m^2 and l is the length of the wire in meters.
9.	Work done in a given electric circuit (W)	$W = IVt = I^2Rt = \frac{V^2t}{R}$ where I is current in ampers, V is voltage in volts, R is resistance in Ohms, t is time in seconds
10.	Power of an electric circuit	$P = IV = I^2R = \frac{V^2}{R}$ where all the parameters have their usual meaning
11.	Coulombs Law	$F = 9\times10^9\frac{q_1q_2}{r^2}$ where r is the distance in meters between the two charges q_1 and q_2.
12.	Electric field or Electric field intensity E	$E = \frac{F}{q} = 9\times10^9\frac{q}{r^2}$ (Note: there is only one charge)

13.	Electric potential V	$V = Ed = 9\times10^9\frac{q}{r}$ where E is the electric field and d is distance between the two points (Note: there is only one charge and one r)
14.	Capacitance	$C = \frac{Q}{V}$ where Q is charge in coulombs and V is voltage in volts
15.	Capacitors when area and distance is involved	$C = \frac{k\in_0 A}{d}$ where k=constant relative permittivity of dielectric material, if not given then it is equal to 1, $\in_0$= permittivity of space in F/m is a constant = 8.85×10^{-12}F/m, A=area of plates in m^2, d=distance between the plates in meters (m) and C=capacitance in farads
16.	Capacitors in series	$\frac{1}{C_t} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$
17.	Capacitors in parallel	$C_t = C_1 + C_2 + C_3$.
18.	Energy stored in a capacitor	$W = \frac{1}{2}qV = \frac{1}{2}\frac{q^2}{C} = \frac{1}{2}CV^2$ where q = charge, V=voltage and C = capacitance in farads
19.	Conductivity	$\sigma = \frac{1}{p}$ where p= resistivity
20a.	Magnetic force on a charge moving in a magnetic field	F=qVBSinθ where q is the charge, V is velocity and B is the flux density in Tesla and θ is the angle between the magnetic field and the direction of the motion of the charge.
20b.	Magnetic force on a charge moving in a magnetic field	F = qVB when V and B are in the same direction and the angle θ is zero
21.	Induced E.m.f. in a straight conductor	E = Blv where B is the magnetic field or flux density, l is the length of the wire and v is the velocity of the conductor

22a.	Faradays law of electromagnetic induction	$E=\frac{d\varnothing}{dt}$ where ∅= magnetic flux in Weber (Wb) and t=time in seconds (s)
22b.	Faradays law of electromagnetic induction	$E=N\frac{d\varnothing}{dt}$ where N is the number of turns if given
23.	Magnetic flux ∅	∅ = BA where B is magnetic field or magnetic flux density in Tesla (T) and A = Area
24.	Transformer	$\frac{E_s}{E_p}=\frac{N_s}{N_p}=\frac{I_p}{I_s}$ Where E is voltage, N is number of turns and I is current ("p" primary coil and "s" secondary coil)
25.	Temperature coefficient	$\mathbf{R = R_0[1 + \propto (T - T_0)]}$ where R=final resistance, R_0=initial resistance, T=final temperature in ^{0}C, T_0= initial temperature in ^{0}C and ∝= temperature coefficient in Ohms/^{0}C.
26a.	Biot Savart Law (a)	$\mathbf{dB} = \frac{\mu_0 I dl \sin\theta}{4\pi r^2}$ where B is the magnetic flux density, dl the length of the conductor,$\mu_0=4\pi x10^{-7}$ permeability of free space, I = current enclosed by the path r = distance between the given point and the element.
26b.	Biot Savart Law (b) **Magnetic field on a long straight wire carrying a steady current**	$\mathbf{B} = \frac{\mu_0 I}{2\pi r}$
26c.	Biot Savart Law (b) **Magnetic field at the center of a circular coil carrying current**	$\mathbf{B} = \frac{\mu_0 I}{2r}$
27.	Ampers Law	$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$ where B is the magnetic flux

		density, dl the length of the conductor, $\mu_0 = 4\pi x 10^{-7}$ permeability of free space and I = current enclosed by the path.
28.	Magnetization (H)	**H =** $\frac{B}{\mu_0}$ where B and μ_0 have their usual meanings
29.	Capacitive reactance Xc	$Xc = \frac{1}{2\pi fC}$ where f = frequency and C = capacitor in farads
30.	Inductive reactance X_L	$X_L = 2\pi fL$ where L = inductor in Henry
31.	Voltage across capacitance	V = IXc
32.	Voltage across Inductance	$V = IX_L$
33a.	Impedance Z (a)	$Z = \sqrt{R^2 + X_c^2}$ when its just resistance and capacitance that are present in the circuit
33b.	Impedance Z (b)	$Z = \sqrt{R^2 + X_L^2}$ when its just resistance and inductor that are present in the circuit
33c.	Impedance Z (c)	$Z = \sqrt{R^2 + (X_L - X_C)^2}$ when both resistance, capacitance and inductor are present in the circuit
34.	Phase angle	$\text{Tan } \varnothing = \frac{X}{R}$ where X is either Xc or X_L
35.	Power factor	$\text{Cos } \varnothing = \frac{R}{Z}$ where Z is impedance
36.	Resonance frequency	$F = \frac{1}{2\pi\sqrt{LC}}$
37.	Root mean square current	$I_{r.m.s} = \frac{I_0}{\sqrt{2}}$ where I_0- is instantaneous current
38.	Root mean square voltage	$V_{r.m.s} = \frac{V_0}{\sqrt{2}}$ where V_0- is instantaneous voltage

39.	Relationship between $I_{r.m.s}$ and $V_{r.m.s}$	$I_{r.m.s} = \frac{V_{r.m.s}}{R}$
40.	**There is no shortcut to passing and becoming successful, you have to work hard and be disciplined. Have a nice semester.**	

UNIVERSITY OF ABUJA

FACULTY OF SCIENCE

DEPARTMENT OF PHYSICS

2016/2017 SECOND SEMESTER EXAMINATION OCTOBER 2017
COURSE CODE: PHY 104
COURSE TITLE: ELECTRICITY AND MAGNETISM UNITS:2
INSTRUCTIONS: ANSWER ALL QUESTIONS IN **SECTION A** AND ANYONE QUESTION FROM **SECTION B**

SECTION A

1. A machine in which electromagnetic inductance is used to produce voltage by rotating coils of wire through a stationary magnetic field or by rotating a magnetic field through stationary coils of wire is called (A) Motor (B) Generator (C) Transformer (D) Solar
2. Certain crystals such as quarix and Rochelle salts generated voltage when they are vibrated mechanically, this action is known as the (A)Piezoelectric effect (B) Photoelectric effect (C) Thermionic emission (D) Thermal production
3. A device that conveys fluid movement into electricity is called (A) Generator (B) Battery (C) Turbine (D) None of the Above
4. Two point charges Q1= +25nC and Q2= -75nC are separated by a distance of 30cm, what is the magnitude of the force between the two charges (A) 2.875×10^{-4}N (B) 4.875×10^{-4}N (C) 1.875×10^{-4}N (D) 0.875×10^{-4}N
5. At a point where a field line crosses an equipotential surface, the two are (A) Perpendicular (B) Parallel (C) At 60^0 to each other (D) None of the above
6. In a certain region of space, the electrical potential is $V(x,y,z) = Axy - Bx^2 + Cy$, where A,

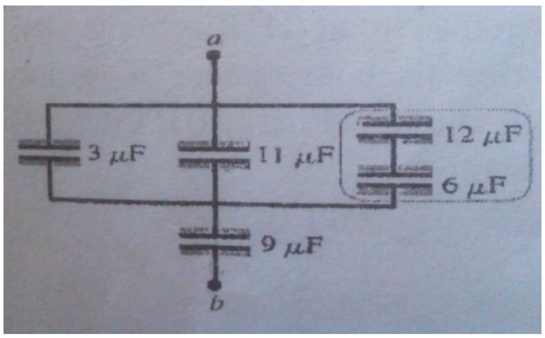
B and C are positive constants, what is the x-component of the electric field? (A) 2Bx – Ay (B) Ay – 2Bx (C) Ax + C (D) Zero

7. The parallel plates of a 3.0F capacitor are 1.00mm apart, what is their area? Given that $\in_0 = 8.85 \times 10^{-12}$F/m (A) $3.39 \times 10^8 m^2$ (B) $4.0 \times 10^8 m^2$ (C) $0.39 \times 10^8 m^2$ (D) $7.3 \times 10^8 m^2$

8. What is the capacitance of a capacitor that stores 10C of charge at 2V? (A) 20F (B) 8F (C) 12F (D) 5F

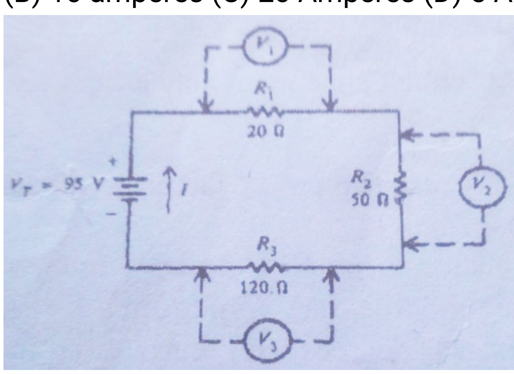
9. What is the total capacitance of a 3μF, 5μF and a 2μF capacitor connected in series? (A) 2.0μF (B) 3.03μF (C) 10.0μF (D) 0.97μF

10. What is the equivalent capacitance of the five capacitor network shown in the figure below? (A) 6μF (B) 41μF (C) 10μF (D) 11μF



11. Which of the following is not a property of electric field lines (A) They never intersect (B) They intersect to 90^0 (C) They point towards a positive charge (D) The tangent shows the direction of the field at that point

12. In a direct current series circuit containing three resistors, R_1, R_2 and R_3. If the current flowing through R_2 is 20Amperes what is the current flowing through R_3? (A) 30 amperes (B) 10 amperes (C) 20 Amperes (D) 5 Amperes



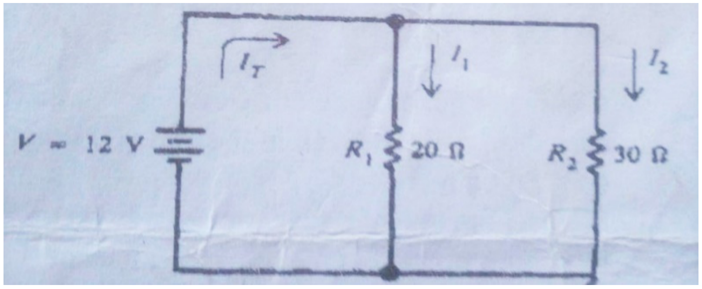
Use the diagram above to answer 13 - 15

13. What is the total resistance? (A) 120 ohms (B) 190 ohms (C) 70 ohms (D) none of the above

14. What is the current flowing through the network? (A) 0.5A (B) 0.79 (C) 4.75A (D) 1.0A

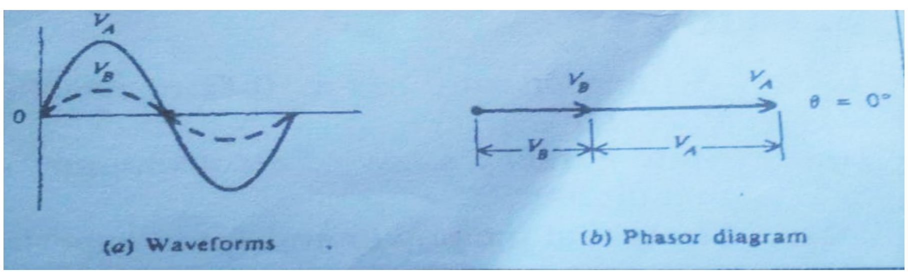
15. What is the voltage drop across R_2? (A) 95V (B) 50V (C) 25V (D) 20V

16. If the temperature coefficient of resistance is Zero, this means (A) Resistance increases with temperature (B) Resistance decreases with temperature (C) Resistance is Zero (D) Resistance is constant

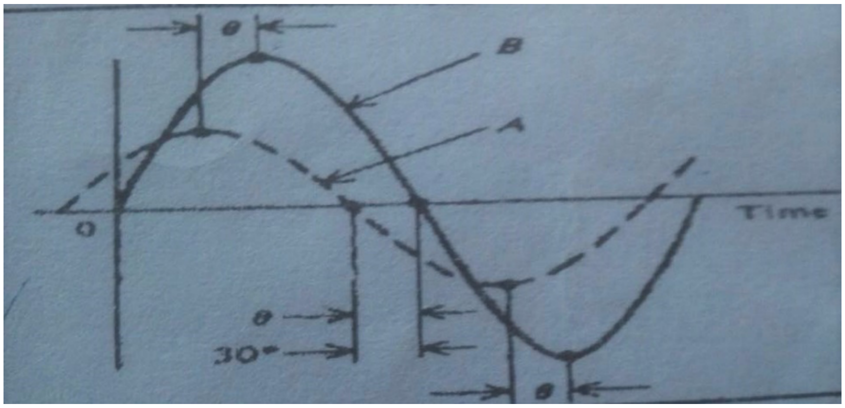


Use the circuit shown above to answer questions 17,18 and 19

17. What is the total resistance? (A) 50 ohms (B) 12 ohms (C) 30 ohms (D) 10 ohms
18. What is the voltage drop across R_2 (A) 12V (B) 6V (C) 30V (D) 5V
19. What is the value of the branch current I_2? (A) 2A (B) 1A (C) 0.4A (D) 30A
20. The steady current which will produce the same amount of heat as produced by the alternating current when flowing through the same resistance for the same time is called (A) Peak value (B) Average value (C) Maximum Value (D) Root mean square value
21. If Ø is the angle between the voltage and the current in an AC circuit, the power factor is given as (A) CosØ (B) TanØ (C) SinØ (D) none of the above



22. The diagram above shows the relationship between two waves A and B which of the following is correct (A) A leads B (B) A and B are in phase (C) A and B are out of phase (D) A lags behind B



23. In the figure above (A) B leads A by 30^0 (B) A and B are in phase (C) A and B are out of phase (D) A leads B by 30^0

24. In an AC-circuit containing only a capacitor, $I = I_o Sin(wt + \frac{\pi}{2})$ and $V = V_o Sinwt$. The power factor is (A) Zero (B) 1 (C) 0.5 (D) 0.75

25. At resonance in an RLC circuit, which of the following is true (A) Impedance Z < R (B) phase angle is 90 degrees (C) Current is minimum (D) Inductive reactance X_L = Capacitive reactance X_C

26. The magnitude of the induced EMF in a coil is directly proportional to the rate of change of the flux linkages, this is known as (A) Joule's law (B) Faradays law of Electromagnetic Induction (C) Lenz law (D) Coulomb's law

27. The point in a magnet where the intensity of the magnetic lines of force is maximum is (A) Magnetic pole (B) South pole (C) North pole (D) Unit pole

28. Electric motor is a device which converts electric energy to (A) Potential Energy (B) Rotational Energy (C) Kinetic Energy (D) Rotational Kinetic Energy

29. Direction of magnetic force is governed by deflection of (A) Voltage (B) EMF (C) Current (D) both A and C

30. Changes in number of magnetic field lines induces (A) current in coil (B) EMF in coil (C) Frequency in coil (D) both A and C

31. If current in one coil becomes steady, the magnetic field in that coil becomes (A) Zero (B) Constant (C) less than before(D) more than before

32. Direction of magnetic field inside a bar magnet is (A) from north pole to south pole (B) from south pole to north pole (C) from side to side (D) there are no magnetic field lines

33. Transformers only work with (A) DC (B) AC (C) charges (D) radioactive substances

34. Magnetic effect of current is called (A) Magnetism (B) Steady current (C) Electric current (D) Electromagnetism

35. Transformers are used to (A) Increase AC (B) Decrease AC (C) both A and B (D) keep AC

constant

36. In a transformer, if secondary voltage is more than primary voltage, then it is called (A) Step up transformer (B) Step down transformer (C) Inductor (D) Resistor
37. Magnitude of induced EMF depends on (A) Speed of motion of coil and magnet (B) Number of turns of coil (C) Current passing through coil (D) Both A and B
38. If the cross-sectional area of a magnetic field increases, but the flux remains the same, then the flux density will (A) Increase (B) Double (C) Remain the same (D) Decrease
39. When the speed at which a conductor is moved through a magnetic field is increased, the induced voltage (A) Decreases (B) Remains constant (C) Reach zero (D) Increases
40. An induced voltage across a coil with 250turns that is located in a magnetic field that is changing at a rate of 8Wb/s is (A) 3125V (B) 2000V (C) 3,125 (D) 1000V
41. A coil of wire is placed in a changing magnetic field. If the number of turns in the coil is decreased, the voltage across the coil will (A) increase (B) decrease (C) be excessive (D) remain constant
42. In Flemings left hand rule, thumb shows direction of (A) Current (B) field (C) motion (D) Charge
43. Magnetic field can be produced by using (A) permanent magnet (B) Electric current (C) temporary magnet (D) both A and B
44. The total number of magnetic lines of force in a magnetic field is called (A) Magnetic flux (B) Magnetic flux density (C) Magnetic flux intensity (D) Magnetic potential
45. Whenever a conductor cuts magnetic force, an EMF is induced in it. This is known as (A) Coulombs law (B) Joules law (C) Faradays law (D) Ohms law
46. Who demonstrated the theory of electromagnetic induction in 1831 (A) Michael Faraday (B) Andre Ampere (C) James Clerk Maxwell (D) Charles Coulombs
47. A substance that attracts pieces iron (A) Conductor (B) Semi-Conductor (C) Magnet (D) All of the above
48. The process by which an EMF and hence current is generated or induced in a conductor when there is a change in the magnetic flux linking the conductor is called (A) Electromagnetic Induction (B) Mutual induction (C) Faradays law (D) Electromagnetic interference
49. ___________ is defined as a closed path in which magnetic induction or flux flows (A) Electric circuit (B) Magnetic circuit (C) Electronic circuit (D) Electromagnetic circuit
50. Lenz law is the consequence of the law of conservation of (A) Energy (B) Charge (C) Field lines (D) Momentum

SECTION B

1. A tungsten wire has a 10 ohms resistance at 20^0C. Find its resistance at 120^0C (Temperature coefficient α = 0.005 ohm/^{o}C)

(b) State Faradays law of electromagnetic Induction and hence show the ways by which EMF can be induced in a circuit

2. Show that the power and force experienced by a conductor when an EMF is induced on it is given by

$$P = \frac{(Blv)^2}{R} \qquad F = \frac{B^2l^2v}{R}$$

Show that for an AC series circuit containing a resistor R, a capacitor C and an Inductor L, the resonance frequency is given by

$$F = \frac{1}{2\pi\sqrt{LC}}$$

TEST QUESTIONS

Majority of the test questions have been repeated in the exam questions, so I will focus on the questions that were not repeated.

1. ProoveBiotSarvart theorem
2. A transformer has 500 turns in the primary coil and 300 turn in the secondary coil, if the voltage of the primary coil is 220V, what is the voltage in the secondary coil?

SOLUTIONS TO EXAM QUESTIONS

1. B
2. A
3. C
4. Using coulombs law $F = 9\times10^9\frac{q_1q_2}{r^2}$ Where q_1=25nC = 25×10^{-9}C, q_2= 75nC = 75×10^{-9}C, r=distance between = 30cm/100= 0.3m

   Therefore, $F = 9\times10^9\frac{q_1q_2}{r^2}$ = $F = 9\times10^9\frac{25\times10^{-9}\times 75\times10^{-9}}{0.3^2}$ = **1.875×10^{-4}N Ans = C**
5. A
6. To get the x-component of the electric field,weshould differentiate the electric

potential with **respect to x**, we will have dV/dx = -(Axy – Bx^2 + Cy)

Short lesson on how to differentiate

Differentiating $2x^3$ will be $3x2x^{3-1}$= $6x^2$**(With respect to x)**

Differentiating x will be 1**(with respect to x)**

Differentiating 2x will be 2 because x= 1 after differentiating **(with respect to x)**

Differentiating 2x = 0 **(with respect to y)**

Differentiating 2xy = 2y because x = 1 after differentiating **(With respect to x)**

Differentiating 2xy = 2x because y = 1 after differentiating **(With respect to y)**

Differentiating $2x^2y$ = $2x2x^{2-1}y$ = 4xy **(With respect to x)**

Differentiating 2yz = 0 because there is no x in the eqn**(With respect to x)**

Differentiating 2yz = 2z because y = 1 after differentiating **(With respect to y)**

Differentiating $2y^2x$ = $2y^2$because x = 1 **(with respect to x)**

Back to our question

Differentiating Axy = Ay because x=1 after differentiating **with respect to x**

Differentiating Bx^2 = $2xBx^{2-1}$ = 2Bx**with respect to x**

Differentiating Cy = 0 because x is absent **with respect to x**

dV/dx = -(Axy – Bx^2 + Cy) will be –(Ay - 2Bx + 0)

–(Ay - 2Bx + 0) will be –Ay + 2Bx opening the bracket

–Ay + 2Bx can still be **2Bx– Ay**

Ans = A

7. The formula for capacitor when an area is involved is $C = \frac{k\in_0 A}{d}$ Where

k=constant relative permittivity of dielectric material, if not given then it is equal to 1, $\in_0$= permittivity of space in F/m is a constant that will always be given to you, A=area of plates in m^2, d=distance between the plates in meters (m) and C=capacitance in farads (F). In this question, k=1, C=3.0F, A=?, d=1.0mm = 0.001m and $\in_0$=$8.85x10^{-12}$F/m

Making A the subject formula, we will have $A = \frac{dC}{k\in_0} = \frac{0.001 \times 3}{1 \times 8.85 \times 10^{-12}}$ = $3.39x10^8 m^2$

(**A**)

8. Formula for a capacitor C = $\frac{Q}{V}$ where Q = charge 10C, and V = voltage 2V, therefore, our capacitance C= $\frac{Q}{V}$ = $\frac{10}{2}$ = **5F (D)**
9. The total capacitance for capacitance in series is given by $\frac{1}{C_t} = \frac{1}{C_1}+\frac{1}{C_2}+\frac{1}{C_3}$

   Therefore, for this question we will have $\frac{1}{C_t} = \frac{1}{3} = \frac{1}{5} = \frac{1}{2}$

   $\frac{1}{C_t} = \frac{1}{3}+\frac{1}{5}+\frac{1}{2}$ will be $\frac{1}{C_t} = \frac{62}{60}$ by finding the L.C.M and multiplying
   $\frac{1}{C_t} = \frac{62}{60}$ by cross multiplying, we will have 62 x Ct = 1 x 60
   62Ct = 60 dividing both sides by 62, we will have Ct = 60/62 = **0.97F (D)**
10. The total capacitance for capacitors in series is given by $\frac{1}{C_t} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$ and the total capacitance for capacitors in parallel is given by $C_t = C_1 + C_2 + C_3$.

    12F and 6F are arranged in parallel, and their equivalent Capacitance = 12 + 6 = 18F,

    Now 3F, 11F and 18F are in series and their equivalent capacitance $\frac{1}{C_t} = \frac{1}{3} + \frac{1}{11} + \frac{1}{18}$

    $\frac{1}{C_t}$ = 0.3 + 0.1 + 0.1 will be $\frac{1}{C_t}$ = 0.5 then by cross multiplying $0.5xC_t = 1$ we will have $0.5C_t=1$, dividing both sides by 0.5 we will have $C_t = 1/0.5 = 2F$

    Then finally 2F and 9F are in parallel and the equivalent capacitance= 2 + 9 = **11F (D)**
11. **C**
12. **C** because the same quantity of current will flow through the circuit.
13. Note: The resistors are connected in series not in parallel i.e. they are connected by a single line. Total resistance for resistors in series is given by $R_t=R_1+ R_2+ R_3$

    And total resistance of resistors in parallel is given by $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

    For this question, R_1= 20, R_2=50 and R_3= 120 since they are all in series the total resistance in the circuit is R_t = 20+ 50 + 120 = **190 ohms (B)**

14. From the formula for Ohms law, V=IR, making I the subject formula we will have I = V/R

    V is the voltage of the circuit, and it is given in the diagram V=95V and R is the total resistance of the circuit = 190 ohms, therefore I = V/R = 95/190 = 0.5A **(A)**

15. Voltage drop across R_2 van be gotten from Ohms law also, V=IR, Where I is the total current flowing through the circuit = 0.5A from question 14, and R_2=50 Ohms. Therefore V=IR = 0.5 x 50 = 25V **(C)**

16. **D**Whenever the resistance is constant, the temperature coefficient is zero.

17. Total resistance of resistors in parallel is given by $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2}$ where R_1= 20 and R_2=30. Then we will have $\frac{1}{R_t} = \frac{1}{20} + \frac{1}{30}$ which will be $\frac{1}{R_t} = \frac{5}{60}$ then cross multiplier,

    1 x 60 = 5 x R_t

    60 = 5R_t dividing both sides by 5, R_t = 60/5 = 12 Ohms **(B)**

18. To get the voltage drop at any point, you should know the total current flowing through the circuit, and it is not given in this question, so you have to solve for it using Ohms law. V= IR, where V= voltage flowing through the circuit = 12V and R = total resistance 12 Ohms. Making I the subject formula, we will have I = V/R = 12/12 = 1.0A

    The voltage drop across R_2 is given by V_2=IR_2 where I = 1.0A and R_2=30 Ohms

    Therefore V_2= IR_2= 1.0 x 30 = 30V **(C)**

19. From Ohms law V=IR, the branched current I_2=V/R_2 Where V is the voltage of the circuit = 12V and R_2 is the second resistance = 30 Ohms. I_2= V/R_2 = 12/30 = 0.4A **(C)**

20. **D**
21. **A**
22. **B**
23. **C**
24. **A**
25. **D**
26. **B**
27. **A**

28. **D**
29. **D**
30. **B**
31. **C**
32. **B**
33. **A**
34. **D**
35. **C**
36. **A**
37. **D**
38. **D**
39. **D**
40. Induced EMF E is the rate of change of magnetic flux, $E=\frac{d\varnothing}{dt}$ which could also be $E= N\frac{d\varnothing}{dt}$ where N = number of turns, if given. For this question, $\frac{d\varnothing}{dt}$ which is the rate of change of the magnetic flux is already given to be 8Wb/s and the number of turns N = 250, therefore, $E=N\frac{d\varnothing}{dt}$ =250 x 8 = **2000V (B)**
41. **B**
42. **C**
43. **A**
44. **A**
45. **C**
46. **A**
47. **C**
48. **A**
49. **B**
50. **A**

SOLUTIONS TO SECTION B

1. Formula for resistance in terms of temperature coefficient is given by

   $R = R_0[1 + \propto (T - T_0)]$ where R=final resistance, R_0=initial resistance, T=final temperature in ^0C, T_0= initial temperature in ^0C and ∝= temperature coefficient in Ohms/^0C. for this question R=? R_0=10, T_0=20^0C, T=120^0C and ∝= 0.005Ohms/^0C

   $R = R_0[1 + \propto (T - T_0)]$ will be R = 10[1 + 0.005(120 - 20)] which will be

   R = 10[1 + 0.005(100)] will be R = 10[1 + 0.5] will be R=10[1.5] and finally **R= 15 Ohms**

   (b) Faradays law of electromagnetic induction states that whenever there is a change in the magnetic lines of force, an e.m.f is induced; the strength of which is proportional to the rate of change of the flux linked with the circuit.

   Mathematically **$E \propto \frac{d\varnothing}{dt}$**

2. E.m.f. (E) is the same as voltage (V)i.e [E = V]. E.M.F (E) induced in a straight conductor of length l moving with a velocity v and a magnetic field B is given by **E=Blv…….Eqn1**

   Remember power P= $\frac{V^2}{R}$ and V=E. Power could also be P= $\frac{E^2}{R}$ **……………….Eqn2**

   Substituting Eqn1 in Eqn2

   We will have P= $\frac{(Blv)^2}{R}$ …………………….Eqn3

   Also, there is relationship between force and power is F =$\frac{P}{v}$Where v is velocity.

   F = $\frac{P}{v}$ …………………Eqn4

   Substitute Eqn3 in Eqn4

   $F = \frac{(Blv)^2}{R} \div v$ will be $F = \frac{B^2l^2v^2}{R} \times \frac{1}{v} = \frac{B^2l^2v^2}{Rv} = \frac{B^2l^2v}{R}$

Therefore $\mathbf{F} = \frac{B^2l^2v}{R}$……………………**Eqn4**

(b) The resonance frequency is the frequency when the capacitive reactance X_c is equal to the Inductive reactance X_Li.e ($X_c = X_L$)

$X_c = \frac{1}{2\pi fC}$and $X_L = 2\pi fL$

$\frac{1}{2\pi fC} = 2\pi fL$ by cross multiplying, we will have $2\pi fL \times 2\pi fC = 1 \times 1$

$4\pi^2 f^2 LC = 1$ dividing both sides by $4\pi^2 LC$ we will have $f^2 = \frac{1}{4\pi^2 LC}$

$f = \sqrt{\frac{1}{4\pi^2 LC}} = \frac{1}{2\pi\sqrt{LC}}$ **Therefore,** resonance frequency $F = \frac{1}{2\pi\sqrt{LC}}$

SOLUTIONS TO TEST QUESTION

1. Thereare two ways of proving biotsarvart law, there is a complex method, and there is a simple method. I will explain the simple method here, but you can also check up the complex method in other text books or you can as well google it.

   Simple method

   First you will have to state the law

   Secondly you will write out the law mathematically

   Finally you will combine all the mathematical equations together.

   Let's start.

   Biotsarvart law states that the magnetic flux density dB at any point P is directly proportional to the length of the material dl, and it is also directly proportional to the current I flowing through the material, also directly proportional to the sine of the angle between the material and point p (Sin θ) and it is inversely proportional to the square of the distance between the material and point p (r^2).

From this definition, we will bring out the equations individually

dB αdl …………………..Eqn 1

dB α I …………………….. Eqn 2

dB α Sin θ ……………… Eqn 3

dB α$\frac{1}{r^2}$ ………………….. Eqn 4

Combining Eqn 1, 2, 3 and 4

dB α$\frac{IdlSin\theta}{r^2}$but we have to remove the proportionality sign

dB = K $\frac{IdlSin\theta}{r^2}$where K is constant, and the value of K = $\frac{\mu_0}{4\pi}$ and $\mu_0$is a constant for permeability of free space = $4\pi x10^{-7}$

Therefore, dB = K $\frac{IdlSin\theta}{r^2}$will be dB =$\frac{\mu_0}{4\pi}\frac{IdlSin\theta}{r^2}$ = $\frac{\mu_0 IdlSin\theta}{4\pi r^2}$

dB = $\frac{\mu_0 IdlSin\theta}{4\pi r^2}$ and this is biot savart law.

2. From the formula for transformers, $\frac{E_s}{E_p} = \frac{N_s}{N_p}$

Es = ? Ep = 220V, Ns=300 and Np=500

$\frac{E_s}{E_p} = \frac{N_s}{N_p}$ will be $\frac{E_s}{220} = \frac{300}{500}$ cross multiply

500 x Es = 300 x 220

500Es = 66000

Es = 66000/500 = 132V