**SECOND SEMESTER EXAMINATION 2018/2019 SESSION**

**PHY 112.2: Introduction to Electricity and Magnetism Time: 1hr 30mins.**

**Instructions: Answer All Questions**

1. Two point charges are separated by a distance d apart and by a force F. What would be the force if the two charges are moved a distance apart? (a) 3F (b) (c) 9F (d)
2. The capacitance of a parallel plate capacitor is defined as (a) (b)

(d) (d)

1. Two point charges of and are separated by a distance of 3m. at what point on the line between the charge is the electric field equal to zero? (a) 1m from +4q (b) 1m from +q (c) m from +q (d) there is no such point
2. A charged insulator and a uncharged conductor (a) always repel each other (b) always attract each other (c) exert no electrostatic force on each other (d) may attract or repel depending on whether the charge is positive or negative
3. Electric field lines (a) circle clockwise around positive charges

(b) circle counterclockwise around positive charges (c) radiate outward from negative point charges (d) radiate inward towards negative point charges

1. The force of repulsion between two points charge C and C separate at a distance of 0.2m apart is? Given (a) 300N (b) 400N (c) 800N (d) 900N
2. A work of 50J is done in transferring 2mC of charge from a point B to a point A in an electric field. The potential difference between B and A is? (a) 25000V (b) 5000V

(c) 2000V (d) 5000V

1. A capacitor is discharged by 9V battery and receives a charge of C. What is the capacitance of the capacitor? (a) 0.33F (b) 527F (c) 0.30F (d) none of the above
2. How much energy can be stored by a 25F capacitor charged to a potential difference of 12V? (a) (b) 1.8 (c) 3.0 (d) 3.6J
3. What is the electric field intensity at a point 30cm from a charge of 0.10C? (a) N/C (b) N/C (c) N/C (d) N/C
4. A 5J of work is done in moving a 0.025C of positive charge from a point A to point B. What is the difference in potential at this two points A and B? (a) 0.125V (b) 200V

(c) 0.05V (d) None

1. A charge of 1C flows from 100V outlet through a 100W light bulb each second. How much work is done each second by this electrical source? (a) 1000J (b) 0.1J (c) 10J

(d) 100J

1. What is the force between positive charges 100C and 200 when it is separated by a distance of 3cm? (a) 20N (b) N (c) N (d) N
2. Which of this prevent overloading of electric circuits? (a) Fuses (b) Voltage (c) Current

(d) Capacitor

1. Find the electric field at a point 20cm from a charge 20C. (a) 22.5

(b) (c) (d)

1. Four capacitors of 16F each are connected in series, determine the effective capacitance of the combination (a) 64F (b) 32F (c) 4F (d) 2F



**Figure 1**

1. Find the current in the circuit shown in figure 1. (a) 0.5A (b) 1.5A (c) 1A (d) 0.667A
2. Find the current in the circuit shown in figure 1. (a) 0.5A (b) 1.5A (c) 1A (d) 0.667A
3. Find the current in the circuit shown in figure 1. (a) 0.5A (b) 1.5A (c) 1A (d) 0.667A
4. The force on a charge travelling in a magnetic field is maximum when charge is

(a) moving parallel to the field (b) moving perpendicular (c) moving at 60o to the field

(d) moving 45o to the field

1. A piece of copper has a resistance of 12.0. If it is compressed so that the length is halved and the area is tripled. What is the new resistance? (a) 6 (b) 5 (c) 4 (d) 2
2. Tungsten has a resistivity of . What is the resistance of a 1.2m long tungsten wire with a radius of ? (a) 0.30 (b) 0.021 (c) 0.05 (d) 0.001
3. Calculate the magnetic force on a conductor of length 10m carrying a current of 5A and placed perpendicular to magnetic field of 20T. (a) 1kN (b) 2kN (c) 3kN (d) 5kN
4. Three resistors 10, 200 and 300 are connected in series with a 12V battery. How much current flows from the battery? (a) 60mA (b) 1.2A (c) 0.3A (d) 50mA
5. What is the equivalent resistance of a parallel combination of seven resistors if each is equal to 280? (a) 280 (b) 40 (c) 60 (d)
6. Two resistors 4 and 8 are connected in series with a 12V battery. How much power is dissipated in the 4 resistor? (a) 4W (b) 8W (c) 81W (d) 36W
7. If a current of 10A flows for four minutes, find the quantity of electricity transferred

(a) 2400C (b) 2000C (c) 40C (d) 1000C

1. Calculate the resistivity of a wire of length 2.5m and cross-sectional area 0.02cm2 if its resistance is 6.0 (a) 0.000006 (b) 75000cm (c) 0.83333cm (d) 0.2
2. A small copper plate has a mass of 3g, the atomic number of Cu is 29 and the mass number is 63.5g/mol. What is the total charge of all electrons in the plate? (a) 24.8 (b) 2.84 (c) 8.24 (d) 2.84
3. A 12V automobile battery supplies 20C of charge in 5s to a stereo tape player. What is the electric current through the device? (a) 4A (b) 100A (c) 0.25A (d) 40A
4. How much is done by the battery of question 30? (a) 60J (b) 240J (c) 144J (d) 90J
5. Three capacitors of capacitances 0.4, 0.1F and 0.5F are in parallel and charged to a potential difference of 50V, determine the total charge acquired (a) 45C (b) 4.5

(c) 50 (d) 3.5



**Figure 2**

1. What is the potential at the centre of the square in figure 2, if the side of the square measure 1m. given that , , and

? (a) 500V (b) 300V (c) 250V (d) 120V

1. An electric heater 220V, 440W has a resistance. (a) 2 (b) 110 (c) 0.5 (d) 20
2. Suppose we have two charges of 4 and with an initial separation of . What is the change in potential energy if we increase the separation to 8m? (a) 45mJ

(b) 72mJ (c) 27mJ (d) 99mJ

1. The induced EMF in a coil of wire of many turns is equal to the rate of change of magnetic flux linking the coil. This is a statement of (a) Ampere’s Law (b) Lenz’s Law

(c) Biot-Sarvart’s Law (d) Faraday’s Law

1. Consider two silver wires. One has twice the length and twice the cross-sectional area of the other. How does the resistance of the two compare? (a) both wires have the same resistance (b) the longer wire has twice the resistance of the shorter wire (c) the longer wire has four times the resistance of the shorter wire (d) the shorter wire has the greater resistance
2. Electric field lines are \_\_\_ their equipotential surfaces. (a) parallel to (b) anti-parallel to

(c) tangent to (d) perpendicular to

1. A galvanometer can be converted into an ammeter by connecting a resistor in\_\_\_\_ and the resistor is known as a \_\_\_ (a) series, shunt (b) parallel, shunt (c) series, multiplier

(d) parallel, multiplier

1. How much does it cost to burn a 100W light bulb for 24hrs if electricity cost 100 per hour? (a) 120 (b) 240 (c) 200 (d) 480
2. A parallel plate capacitor has plates of dimensions 2.0cm by 3.0cm separated by a 1.0cm thickness of paper. Find its capacitance (K for paper = 3.7 (a) 18.0F (b) 20F

(c) 15.0F (d) 20.0F

1. A battery of emf 12V and internal resistance 2 is connected to a resistor of 16. Which is the potential difference of the battery? (a) 21.2V (b) 10.66V (c) 0.75V (d) 24V
2. Which of the following is completely true about a capacitor? (a) Capacitor stores charge (b) Capacitor stores charge and energy (c) Capacitor amplifies charge

(d) Capacitor resists charge

1. What happens to a dielectric when inserted between the plates of a capacitor?

(a) the electric field is increased (b) the electric field is weakened

(c) the electric field is doubled (d) the electric field is zero

1. The potential difference between the terminals of a source when no current flows to an external circuit is called the \_\_\_\_ (a) net voltage (b) battery voltage

(c) electromotive force (d) equivalent voltage

1. Kirchhoff’s first rule is? (a) (b) (c) (d)
2. Three lamps each of 240 are connected in parallel across a 240V supply. Compute the power dissipated in the circuit (a) 24W (b) 720W (c) 19200W (d) 2160W
3. Which of the following is a natural magnet? (a) steel (b) magnesia (c) lodestones

(d) soft iron

1. Determine the electrostatic potential energy due to two charged bodies, with charges of 15C and 25C, separated by a distance of 10.0cm (a) 3372J (b) 3750J (c) 4170J

(d) 417J

1. A wire carries a current of 3A. If the current density is 24A/m2, calculate the cross-sectional area of the wire (a) (b) (c)

(d)

1. The magnetic field unit 1T is equal to? (a) 1Wb/m2 (b) 1Wb/m3 (c) 1N/A.m (d) 1Wb/m
2. The angle between the direction of the earth’s resultant field and the horizontal is called the? (a) angle of dip (b) angle of declination (c) dip circle (d) angle of variation
3. An ion enters a magnetic field of 1.2T at a velocity of , perpendicular to the field. Determine the field on the ion. (a) N

(b) N (c) N (d) N

1. A conductor of length 10m carries a current of 0.5A while kept in a magnetic field of magnetic flux density 2.0T. What is the maximum force acting on it? (a) 20N (b) 30N

(c) 50N (d) 40N (e) 45N

1. A proton moves with a velocity of m/s in a region in which the magnetic field of magnetic density 2.0T. What is the magnitude of the magnetic force is this charge experiencing? (a) 2.34N (b) 5.25N (c) 4.0N

(d) 0.5N

1. The angle between the geographical and magnetic meridians at a place is called the

(a) angle of declination (b) angle of dip (c) magnetic meridian (d) dip circle

1. Two resistors and are connected in parallel, being greater than .

The combined resistance is (a) less than (b) greater than (c) sum of and

(d) the difference of and

1. For moving charges, they experience a magnetic force in a magnetic field.

(a) (b) (c) (d)

1. Alpha particles are accelerated from rest through a potential difference of 1.0kV.

They then enter a magnetic field B = 0.20T perpendicular to their direction of motion. Calculate the radius of their path. (kg, ) (a) 0.064m

(b) 0.016m (c) 0.030m (d) 0.032m

1. The medium used between the plates of a capacitor is called \_\_\_\_ (a) polarization

(b) dielectric (c) insulators (d) ionic

1. Calculate the current in the loop of 15turns and radius of 20cm if the magnetic field generated is T (a) 10A (b) 20A (c) 15 (d) 16
2. Which of the following is not main effect of an electric current? (a) magnetic effect

(b) chemical effect (c) heating effect (d) nuclear effect

1. The current flowing through a resistor is 0.8A, when a p.d of 20V is applied, determine the value of the resistance (a) 25 (b) 20 (c) 15 (d) 16
2. A conductor of length 8m carries a current of 0.32A while kept in a magnetic field of magnetic flux density 2.0T. What is the maximum force acting on it? (a) 5.12N

(b) 1.28N (c) 0.64N (d) 0.32N

**A generator delivers an AC voltage given by the equation . Use this to answer question 65, 66 and 67.**

1. What is the peak voltage of the generator? (a) 120V (b) 55V (c) 12V (d) 60V
2. What is the frequency of the generator? (a) 553Hz (b) 120Hz (c) 88Hz (d) 60Hz
3. If the RMS current is 2A, the average power delivered to a circuit is \_\_\_\_\_

(a) 240W (b)1100W (c) 60W (d) 170W



**Figure 3**

**For the system of capacitors shown in figure 3, find:**

1. The equivalent capacitance of the system (a) 3.3F (b) 30F (c) 0.2F (d) 40F
2. The charge on each capacitor (a) and (b) and (c) and (d) and
3. The total energy stored by the system is \_ \_ \_(a) 13.4mJ (b) 20mJ (c) 2.5mJ (d) 4.0mJ

**PHY 112 2018/2019 SOLUTIONS**

1)

Let the two point charges be and separated a distance d

Force of attraction = F1

. .. . (i)

When the two point charges are separated by a distance, , force of attraction is

- - - (ii)

Divide equation (ii) by (i)

C

2) B

3)

Let the two point charges be +4q and +q

Distance of separation

3m

+4q

+q

o

o

o

The electric field will be zero at a point where the forces exerted by charges +q and +4q on a test charge qo are equal and opposite. Let this point be at a distance from and from

If is force due to charge and is force due to

Then

Eliminating common terms

Cross multiplying

By factorizing

or 1.

The more suitable answer is , since distance must be positve

Now, the Electric field will be zero if test point charge is placed 1m from +q charge or 2m from +4q.

Correct option is **B**.

4) B

5) D

6)

Let the two point charges be and

; F = ?

Distance of separation,

D

7)

Work W

Charge,

V = ?

A

8)

Potential difference,

Charge,

Capacitance C = ?

A

9)

Capacitance C =

Potential difference,

Energy stored in a capacitor

B

10)

Given:

To determine Electric Field Intensity (E) at a distance r = 30cm

Using:

Where

A

11)

Work,

Charge =

Potential difference V = ?

Potential Difference B

12)

Charge,

Potential difference,

Power rating of light bulb = 100W

Work

**OR**

Work = Power x Time

Time = 1sec

Work = 100 x 1 = 100 J D

13)

Let the two positive charge be Q1 and Q2 respectively.

Distance of separation,

Force between the two positive charges,

F where

14) A

15)

Given:

To determine the Electric Field Intensity (at a distance, r of 20cm

Using

Where:

D

16)

Given that four capacitors are connected in series

ll

ll

ll

ll

The equivalent capacitance,

Taking the inverse of both sides:

The Equivalent Capacitance is C

20) B

21)

Let the initial Resistance be

Final resistance =

The Relationship between Resistance, Area and Length

- - - - (i)

resistivity

Initial conditions

Final conditions

Substituting

- - - (ii)

- - - -- - (iii)

Dividing (iii) by (ii)

i.e. New Resistance D

22)

Resistivity,

Length of copper,

Radius of tungsten wire,

Area;

Substituting values

∴ Resistance,

B

23)

Length, L of conductor =

Current,

Magnetic field strength,

since it is perpendicular

Force, F

(A)

24)

Given that:

And these three resistors are connected in series as shown in the diagram below:

I

12V

The Equivalent Resistance:

I

V = 12V

To calculate the amount of current in the circuit:

Making subject of the formula:

D

25)

Given that seven resistors are connected in parallel and

The Equivalent Resistance is given by:

Taking the inverse of both sides:

B

26)

Given

To get the Equivalent Resistance:

But P Where:

Applying to get I:

To find the power on the Resistor:

Recall that for resistors connected in series, the current across each resistor is the same

∴ The power in the Resistor is:

Let be the power in the Resistor:

Power

∴ The power dissipated in the Resistor is A

27)

Given

tminutes = (4 x 60) seconds = 240 seconds

Applying:

Q = A

28)

Given:

Area,

Resistivity,

Resistance,

Length of wire,

Using:

B

29)

Mass of cooper plate = 3g

Atomic number of copper = 29

Atomic mass = 63.5glmol

Let N be the number of atoms in 3g of copper.

Since 1 molecule of copper contains Avogadro’s number of atoms

1 molecule of copper = atoms

3g of copper will contain;

atoms

Since each copper atom has 29 electrons and charge of an electron is .

∴ Total charge

30) Given:

seconds ; ;

Applying

A

31)

From question 30;

Given: ; Work done W = ?

Using W

W

W B

32)

Given that three capacitors, C1, C2 and C3 are connected in parallel

Where:

For capacitors in parallel

∴ The Equivalent capacitance is

Recall that

To find the total charge, we use:

C

33

A

B

C

D

**O**

From Pythagoras’ theorem;

O is the midpoint of diagonal DB.

Electric potential,

A

34)

Power,

Voltage,

Resistance R = ?

making R the subject of the formula

B

35)

Let

Initial separation,

Potential energy to move the charge from infinity to the point P, distance r from a charge ,

Substituting the values

Joules

New, separation,

Joules

Change in potential energy

J.

J J (A)

36) Faraday’s Law of Electromagnetic Induction D

37) Let the 1st silver wire be A; let the 2nd silver wire be B.

Resistance of A = RA.

Resistance of B = RB.

Length of A be = L.

Length of B be = 2L.

Cross sectional Area of A = A

Cross-sectional Area of B = 2A

Recall that

Hence, the resistance of the silver wire will still be the same A

38) D

39) B

40)

Power =

Time = 24 hours

Cost of electricity per hour = N100

Total cost = 0.1kw x 24 x 100 = N240 B

41)

Length of plate

Width of plate

Area of plates

Dielectric constant, k for paper = 3.7

Thickness,

Capacitance,

B

42)

E.m.f = 12V ; Internal resistance,

External resistance

Potential difference of the battery = IR

B

43) B 44) B 45) C 46) D

47)

Resistors in parallel

Power

Power = B

48) C

49)

1st charge

2nd charge

Distance of separation

51) I Tesla =

52) A

53)

Magnetic field strength =

Velocity

Force

A

54)

Length of conductor = 10m

Current = 0.5A

Magnetic field strength = 2.0T

Maximum force = ?

Angle, theta = 90o

**No correct Option**

55)

Force, F is given by

We need to evaluate the cross product of V and B. First before multiplying through by;

Expressing the force in magnitude

A

56) Angle of declination A

57)

If and are connected in parallel, and is greater than the combined resistance is always less than .

Supposing

Combined resistance is

From this result, is always less than A

58)

Where charge

speed of the moving charges

strength of magnetic field C

59) The Energy acquired by an alpha particle of charge when moved through a potential difference, V is equal to the kinetic energy acquired by the alpha particle.

Work = Force x distance

Force

Work

But recall that V, voltage = .

Where Electric field strength

distance

m = mass of alpha; q = charge; V = potential difference; v = velocity of proton

Making v the subject of the formula

Given

V, potential difference

Since the velocity is perpendicular to the field, the alpha particle experiences a force.

.

But this force maintains the alpha particle in a circular orbit i.e. centripetal force.

∴ .

Making R the subject of the formula

Radius D

60) B

62) D – Nuclear Effect

50)

Given that:

Current,

Current density =

Cross-sectional Area, A = ?

Applying;

61) Given that:

Radius

Current (I) = ?

No of turns (N) = 15

Applying:

We have that ;

Where:

C

63)

Given that:

Current (I) = 0.8A

Voltage (V) = 20V

Resistance (R) = ?

From: V = IR

R =

R =

R = A

64)

Given:

Force = ?

Using:

A

65)

Given that AC voltage is given by the equation:

… (1)

Comparing Eqn (1) with :

By comparison; peak voltage,

66)

From question 65, Angular velocity, By Comparison

Recall that

68)

Given that ;

are connected in series:

Take the inverse of both sides;

are connected in series;

Taking the inverse of both sides:

Resolving connected in parallel:

∴ The Equivalent Capacitance is A

69)

From question 68;

Using:

Where:

To get the charges on and

For

Where: charge on capacitor

Using:

For

Where: charge on capacitor

∴ A

70)

Let the energy stored by the system, be U

Where: Q = Equivalent charge =

Voltage =

∴ U

A

**SECOND SEMESTER EXAMINATION 2019/2020 SESSION**

**PHY 112.2: Electricity & Magnetism 1 Time: 1hr 30mins.**

**Instruction: Attempt All Questions**

1. A capacitor of F is larger than (a) 0.000020F (b) 200,000pF (c) 2,000pF (d) All of the above
2. Two series capacitors (one 2F, the other of unknown value) are charged from a 24V source. The 2F capacitor is charged to 16V and the other to 8V. the value of the unknown capacitor is (a) 1F (b) 2F (c) 4F (d) 8F
3. A parallel plate capacitor of plate area 2m2 and plate separation 1m, store the charge of 1.77x10-11C. What is the voltage across the capacitor? (a) 1V (b) 2V (c) 3V (d) 4V
4. An unknown resistor has 5mA current flowing through it when 10volts are applied to it. For the same resistor, the application of 20volts will result in the current flow of? (a) 2mA (b) 5mA

(c) 10mA (d) 50mA

1. What is the magnitude of the electrostatic force of attraction between an and an electron m apart (C) (a) 0.046N (b) 0.46N (c) 4.6N (d) 46N
2. Two copper wires have the same cross-sectional area but have different lengths. Wire X has a length L and wire Y has a length 2L. The ratio between the resistance of wire Y and wire X is? (a) Ry/Rx = 1/1 (b) Ry/Rx = ½ (c) Ry/Rx = 2/1 (d) Ry/Rx = 1/4 (e) Ry/Rx = 4/1
3. Kirchhoff’s first rule is? (a) (b) (c) (d)
4. Three points in an electric field A, B, C lie in a line and have potentials of 8.0V, 4.0V and respectively. A negative charge is placed at point B and released at rest. Which way will it move if it moves at all? (a) towards A (b) towards B (c) it will not move at all (d) towards C
5. A capacitor is to be built, which will store enough energy to light a 50W energy bulb for 30mins. If available potential difference is 200V, what capacitance is needed? (a) 90F

(b) 45F (c) 6F (d) 9F

1. A capacitor is charged by 9V battery and receives a charge of 3C. What is the capacitance of the capacitor? (a) 0.33F (b) 27F (c) 0.3F (d) it cannot be determined
2. A voltmeter is made up of a: (a) high resistance and galvanometer in series

(b) high resistance and galvanometer in parallel (c) low resistance and galvanometer in parallel (d) low resistance and galvanometer in series

1. Which of the is a natural magnet? (a) Steel (b) Magnesia (c) Lodestones (d) Soft iron
2. The point in a magnet where the intensity of magnetic lines of force is maximum is?

(a) Magnetic pole (b) Magnetic flux (c) Unit pole (d) South pole

1. 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
2. Which of the following is not a property of a magnet? (a) Attracts and repels other magnetic materials (b) Always settles in a N-S direction when freely suspended

(c) Magnetic pole strength is constantly varying (d) Can impart magnetic property to other materials

1. The relation between currents in the diagram below is: (a)

(b) (c) (d)



1. An electron in a particle accelerator has a speed of and encounters a magnetic field of 0.4T at an angle of 30o. What is the magnitude to the magnetic force on the electron (C) (a) N (b) N (c) N

(d) N

1. The SI unit of permittivity is? (a) N2m2/C2 (b) C2/Nm2 (c) Nm/C2 (d) Nm2/C (e) None
2. The medium used between the plates of a capacitor is called? (a) Polarization

(b) Dielectric (c) Insulators (d) Medium

1. If the length and diameter of conductor is double, the resistance (a) Remain same

(b) Double (c) Half (d) Four times

1. Force on a moving charge in a uniform magnetic field will be maximum. When angle between V and B is? (a) 0o (b) 30o (c) 60o (d) 90o
2. A force of 15N acts on a charge of C when placed in a uniform electric field. What is the magnitude of this electric field? (a) N/C (b) N/C

(c) N/C (d) N/C

1. What are the current and voltage in the 6 resistor in the figure below? (a) 3A and 12V (b) 3A and 6V (c) 2A and 6V (d) 1A and 6V



1. A parallel plate capacitor has plates with dimensions 3cm by 4cm, separated by 2mm. The plates are connected across a 60V battery, find the capacitance. (a) 3.2pF (b) 5.3pF

(c) 5.3F (d) 5.3F

1. The ability of a material to retain its magnetism after impact and removal of the magnetizing field is called? (a) Retentivity (b) Coercivity (c) Dipole (d) Remanence

(d) Monopole



1. The figure below shows three resistors, their combined resistance in ohms is (a) 12 (b)14 (c) 15/2 (d) 20//3
2. Find the current flows in the 18 resistances of the circuit (a) 1.25A (b) 0.5A (c) 1.3A

(d) 0.75A



1. Find the potential difference required to give a helium nucleus with eV of kinetic energy (a) V (b) V (c) V

(d) V

1. An electric heater 220V, 440W has a resistance (a) 2 (b) 110 (c) 0.5 (d) 20
2. To convert a galvanometer into an ammeter, we connect a low resistance in \_ \_ \_ to the galvanometer. (a) series (b) parallel (c) series or parallel (d) none
3. The terminal potential difference of a battery of internal resistance “r” and EMF “” is:

(a) (b) (c) (d)

1. Ohm’s law is valid for only current flowing in (a) Conductors (b) Transistors (c) Diodes (d) Electric Areas
2. When temperature increases, the resistance of conductor: (a) increases (b) decreases

(c) remains constant (d) vanishes

1. Capacitance of a capacitor depends upon? (a) size of plate (b) distance between plates

(c) nature of dielectric between plate (d) all of the above

1. The space outside the magnet where it pole have force of attraction or repulsion on a magnetic pole is called? (a) magnetic field (b) electric field (c) electromagnetic field

(d) free space field

1. The phenomenon by which a magnetic substance becomes a magnet when it is placed near a magnet is? (a) magnetic effect (b) magnetic phenomenon (c) magnetic induction (d) electromagnetic induction
2. The force between two magnetic poles varies with the distance between them. The variation is \_ \_ \_ to the square of that distance. (a) equal (b) greater than

(c) directly proportional (d) inversely proportional

1. Which of the following is a semiconductor? (a) Germanium (b) Sodium (c) Magnesium

(d) Iron

1. A heater with a resistance of 5 connected to a potential of 100V, what is the energy output in 20seconds? (a) 10,000J (b) 20,000J (c) 40,000J (d) 25J
2. A F capacitor is desired. What is the area of the plates if they are separated by 5cm air-gap? (a) (b) (c) (d)
3. The magnetic field inside a long solenoid and far from the ends is given as? (a) E (b) R

(c) N (d) V

1. A positive test charge q is released near a positive fixed charge Q. as q moves away from Q, it will move with? (a) increasing acceleration (b) decreasing acceleration

(c) constant velocity (d) constant acceleration

1. Two series capacitors (one 2F, the other of unknown value) are charged from a 24V source. The 2F capacitor is charged to 16V and the other to 8V. the value of the unknown capacitor is? (a) 1F (b) 2F (c) 4F (d) 8F
2. A parallel plate capacitor of plate area 2m2 and plate separation 1m store the charge of 1.77x10-11C. What is the voltage across the capacitor? (a) 1V (b) 2V (c) 3V (d) 4V
3. Capacitor stores which type of energy? (a) kinetic energy (b) vibrational energy

(c) potential energy (d) heat energy

1. An unknown resistor has 5mA current flowing through it when 10volts are applied to it. For the same resistor, the application of 20volts will result in the current flow of?

(a) 2mA (b) 5mA (c) 10mA (d) 50mA

1. Four point charges , , and are placed at the four corners of a square 3cm on a side. Find the electric potential at the centre of the square. Each charge has a magnitude of 2.1C. (a) V (b) 3.6V (c) 46V (d) 5.6V
2. What is the magnitude of the electrostatic force of attraction between an and an electron m apart (e = 1.6x10-19C) (a) 0.046N (b) 0.46N (c) 4.6N (d) 46N
3. A 4F capacitor is desired. What is the area of the plates if they are separated by 5cm air gap? (a) (b) (c) (d)
4. Faraday’s law of electromagnetic induction is expressed as? (a) (b) (c) (d)
5. A coil of 600 turns is threaded by a flux of Wb, if the flux is reduced to Wb, find the average induced EMF. (a) 4.4V (b) 0.2V (c) 2.0V (d) 0.4V
6. When a bar magnet is placed in the midst of iron fillings, much concentration of iron fillings will be found at? (a) North pole (b) South pole (c) Center (d) both poles of the magnet
7. A continuous breaking of magnet into pieces will always result into? (a) destruction of the poles (b) both north and south poles (c) north pole only (d) south pole only
8. Magnetic field lines of magnet are plotted from? (a) north pole to south pole (b) north pole to north pole (c) south pole to south pole (d) south pole to north pole
9. Magnitude of exerted force in a magnetic field is? (a) (b) (c) (d)
10. A magnetic phenomenon to determine the sign of a charge carrier, either positive or negative is called? (a) Probe effect (b) Photovoltaic effect (c) Hall effect (d) Cyclotron
11. Coulomb’s law of force between two point charges is given by? (a)

(b) (c) (d)

1. One electron-volt (1Ev) is equivalent to? (a) J (b) V

(c) J (d) J

1. The potential difference between the terminals of a source when no current flows to an external circuit is called the? (a) a net voltage (b) battery voltage (c) electromotive force of the source (d) equivalent voltage
2. The region around a point charge in which an electric force can be experienced by a charged body is called? (a) electric flux (b) magnetic flux density (c) electric field

(d) field point

1. The study of electrical phenomenon that are associated with charges and charge systems at rest is? (a) electricity (b) dynamics (c) electrostatics (d) Coulomb’s law
2. When a charged particle enters a uniform magnetic field, it describes a \_\_\_\_ motion.

(a) parabolic (b) circular (c) rectangular (d) straight line

1. Electric charges are acquired by bodies during rubbing process through:

(a) loss of charges by rubbed bodies (b) transfer of charges between the two bodies

(c) gain of charges by the two bodies (d) none of the above

1. The law of conservation of charges states that: (a) total quantity of charge in any process does not change (b) energy and momentum of the charges is conserved

(c) charges are the smallest unit of matter (d) charges are immobile

1. Which of the following is not true? (a) Coulomb’s law is valid for point charges only

(b) Coulomb’s law is the force on either charge due to the other (c) Coulomb’s law decreases as the distance from source increases (d) the direction of the Coulomb’s force is anti-parallel to the line joining the charge bodies.

1. Calculate the electrostatic force between two protons of charges C separated by a distance of m (a) 15N (b) 30N (c) 40N (d) 60N
2. Which of the following is incorrect? (a) electrical field intensity is F/q (b) the unit of electric field intensity is Vm-1 (c) the electric field intensity is a scalar quantity

(d) if we rub a hard rubber rod with further rubber acquires a negative charge

1. An electric kettle draws a current of 4.0A when operated by a 230V source. Calculate the power rating of the kettle. (a) 460W (b) 920W (c) 920kW (d) 8.7W
2. Which of the following are conservative forces? (a) electrical force/electric field strength (b) electric flux/electric field strength (c) gravitational force/electrostatic force

(d) gravitational force/electromotive force

1. Electric dipole can be defined as (a) distance between two equal charges (b) two equal and opposite charges separated by a distance (c) two equal charges acted upon by an electrostatic force (d) two unequal charges in an electric field.

**PHY 112.2 2019/2020 SOLUTIONS**

F

Compare this value with the given capacitance values in the options

F

F

F

F

Compare with the capacitance in option A

F

F

(C is not greater than )

Compare with option B

F

(C is not greater than )

Compare with option C

F

Now

**The correct option is C**



FF

Since and are connected in series, they have the same charge Q across each

**C**

; C; ; V = ?

F

volt **A**

volts volts

From Ohm’s law

Since the resistance R is constant

**C**



For alpha particle

That is, , , , C

F = ?

Applying Coulomb’s Law

N

**A**

;

Since cross sectional area A is constant

where k is a constant

**C**

1. **D**
2. **A**

From the conservation of energy

Electrostatic energy stored by capacitor = Electrical energy consumed by bulb

F **B**

C

**A**

1. **A**
2. **C**
3. **A**
4. **A**
5. **C**

From Kirchhoff’s current law (KCL),

At the node or junction,

Total currents entering = Total currents leaving

**D**

, ,

**B**

1. **A**
2. **B**

Where d is diameter of conductor

Since 4, e, are constant

Where k is constant

Where , (given)

That is, resistance is halved **C**

1. **D**

, C

29N/C **B**

Reduce the given circuit progressively to get the equivalent circuit having a single equivalent resistance



is the parallel equivalent of and resistances

is the series equivalent of and resistance

Applying Ohm’s law, current flowing in circuit (through ) is

Since is the equivalent of and in series

current flowing through

Voltage across is

Since is the equivalent of and in parallel

voltage across voltage across

Current through

**D**

length breadth

F

**B**

1. **A**

Reduce the given circuit to the equivalent circuit, with a single equivalent resistance



**C**



Current flowing in resistance,

Apply KCL at node

- - - - - - - - - - - - - - (1)

Apply Kirchhoff’s Voltage Law (KVL) in loop abefa

**B**

C ;

4V **C**

volts; ;

**B**

1. **B**



**B**

**Note:** Terminal potential difference is the voltage drop across the external resistance R

1. **A**
2. **A**
3. **D**
4. **A**
5. **C**
6. **D**
7. **A**

; ;

J **C**

;

From

26

**B**

1. **D**



FF

Since and are connected in series, they have the same charge Q across each

**C**

C V = ?

F

volt **A**

1. **C** – electrostatic potential energy

volts volts

From Ohm’s law

Since the resistance R is constant

**C**



The center of the square is at the intersection of the two diagonals that is, point P.

Electric potential at P is V = ?

Length of square

C

Length of each diagonal cm

Distance of each charge from P is cm

V **B**



For alpha particle

That is, , , , C

F = ?

Applying Coulomb’s Law

N

**A**

;

From

26

**B**

1. **B**

; ;

Time interval ;

**C**

1. **D**
2. **B**
3. **A**
4. **C**
5. **C**
6. **D**
7. **C**
8. **C**
9. **C**
10. **C**
11. **B**
12. **B**
13. **A**
14. **D**

**No correct option**

1. **C**

; ;

**B**

1. **C**
2. **B**

**SECOND SEMESTER EXAMINATION 2021/2022 SESSION**

**PHY 112.2: Introduction to Electricity & Magnetism Time: 1½hrs**

**Instruction: Attempt All Questions**

1. The electric field is zero everywhere inside the conductor suggesting that the net charge is (a) zero (b) one (c) none of the above (d) all of the above
2. The magnetic field unit 1Tesla is equal to (a)1 (b)1 (c)1

(d) 1

1. The medium used between the plates of a capacitor is (a) Polarizer (b) Dielectric

(c) Insulator (d) Ion

1. The current of length through a resistor is 0.8Awhen a p,d of 20V IS applied. Determine the value of the resistance (a) 25 (b) 20 (c) 15 (d) 16
2. A conductor of length 8m carries a current of 0.32A while kept in magnetic field of magnetic flux density 2.0T. What is the maximum force acting on it? (a) 5.12N (b) 1.28N (c) 0.64N (d) 0.32N
3. Two resistors and are connected in parallel, being greater than . The combined resistance is (a) less than (b) greater than (c) sum of and (d) difference of and
4. Electrical conductors are materials (a) that do not allow charges to flow freely (b) that allow charges to flow freely (c) that do not have charges (d) that are insulators (e) none of the above
5. A battery of emf 12V and internal resistance 2 is connected to a resistor of 16. Which is the potential difference of the battery? (a) 21.3V (b) 10.667V (c) 0.75V (d) 24V
6. The magnetic force on a wire of length L, carrying a current I immersed in a uniform magnetic field B and at an angle 0 to the magnetic field is? (a) (b) (c) (d)
7. The potential difference between the terminals of a source when no current flows to an external circuit is called the (a) net voltage (b) battery voltage (c) electromotive force

(d) equivalent voltage

1. If one speaks of measuring an AC voltage of 120V from an electric outlet using an AC voltmeter, it will read about (a) 170V (b) 85V (c) 170A (d) 85A
2. Calculate the magnetic force on a conductor of length 10m carrying a current of 5A and placed perpendicular to magnetic field of 20T. (a) 1kN (b) 2kN (c) 3kN (d) 5kN
3. Semiconductors partly conducts and partly insulates. Examples are, excerpt (a) Silicon

(b) Tungsten (c) Germanium (d) Gallium Arsenide (GaAs)

1. A flat plate having an area of 9 is rotated in a uniform electric field whose magnitude is 5N/C. Calculate the electric flux through this area when the electric field is perpendicular to the surface of the plate. (a) 45N (b) 7N (c) 4.5N (d) 1.4N
2. If it is parallel to the surface in Q14, (a) 4.5 (b) 0 (c) 5 (d) 9
3. If it makes an angle of with the plane of the surface in Q14 (a) 22.5

(b) 7 (c) 9 (d) 1.4

1. Three resistors 10, 200 and 30 are connected in series with a 12V battery, how much current flows from the battery? (a) 60mA (b) 1.2A (c) 0.3A (d) 50mA
2. What is the equivalent resistance of a parallel combination of seven resistors if each is equal to 280? (a) 280 (b) 40 (c) 60 (d) 70
3. The force of repulsion between two points charges 5 and 8 separated by a distance of 0.02m apart is? Given (a) 300N (b) 400N (c) 800N (d) 900N
4. Calculate the resistivity of a wire of length, 2.5m and cross-sectional area 0.02, if its resistance is 6.0Ohms (a) 0.000006 (b) 0.00048 (c) 75000 (d) 0.83333
5. A generator delivers an AC voltage given by equation V=120Sin553t. What is the peak voltage of the generator? (a) 120V (b) 55V (c) 12V (d) 60V
6. The phenomenon whereby a charge appears on an initially uncharged conductor due to close proximity is known as (a) electrostatic induction (b) electrostatic insulation

(c) current (d) voltage

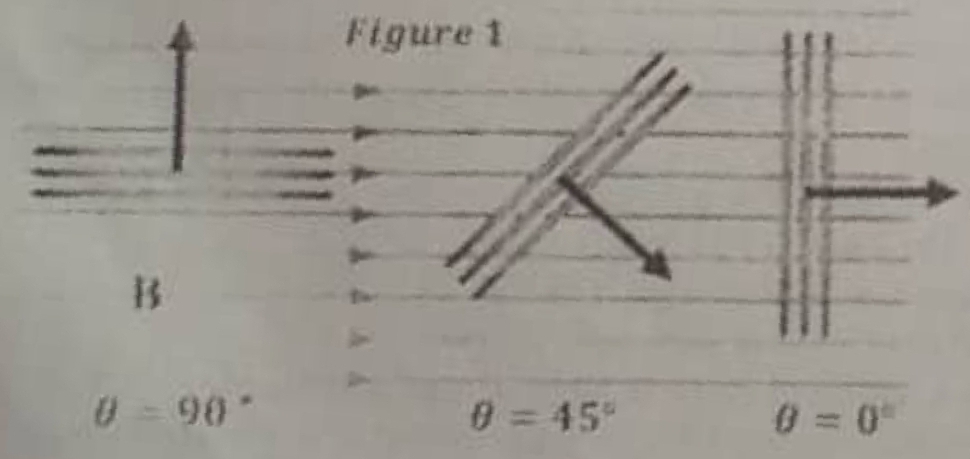
1. The number of cycles the alternating current completes in one second is (a) frequency

(b) amplitude (c) period (d) wavelength

1. Consider two points of charge and which are separated by a distance 3m. At one point on the line between the charges is the electric field zero? (a) 1m from the +4q charge (b) 1m from the +q charge (c) 3/4m from the +q charge (d) there is no such point possible (e) none of the above
2. In the determination of the poles of a bar magnet, the north pole of the earth is actually the (a) north pole of the bar magnet (b) south pole of the earth (c) south pole of the bar magnet (d) magnetic pole of the magnet
3. Two point charges are separated by a distance d, and feel a force F. What would be the force if the two charges are moved a distance d/3 apart? (a) the force would be 3F (b) the force would be F/3 (c) the force would be 9F (d) the force would be
4. A work of 50J is done in transferring 2mC of charge from a point B to a point A in an electric field. The potential difference between B and A is? (a) 25000V (b) 5000V

(c) 2000V (d) 50000V

1. A capacitor is charged by a 9V battery and receives a charge of C. What is the capacitance of the capacitor? (a) (b) 27 (c) (d) none of the above
2. How much energy can be stored by a capacitor charged to a potential difference of 12V? (a) J (b) 1.8J (c) 3.0J (d) 3.6J
3. Two charged objects attract each other with a certain force F. The objects may be treated as point charges. If the charges on both objects are doubled with no change in separation, the force between them becomes? (a) F (b) 2F (c) 8F (d) 4F
4. If the current carried by lightening discharge is 20kA. Calculate the quantity of charges released to the earth during a 3.0seconds discharge. (a) 2C (b) 5C (c) 2C (d) 6C
5. The force on a charge travelling in a magnetic field is maximum when charge is (a) moving parallel to the field (b) moving perpendicular (c) moving at to the field (d) moving at to the field
6. What is in the three cases in figure 1 below. (a) 0, BA, BA (b) BA, 0, BA (c) BA, BA, 0 (d) 2BA, BA, BA



1. The measure of number of electric field lines penetrating some surface is (a) magnetic flux (b) current (c) electric flux (d) voltage
2. The vector quantity that describes the flow of charges through any given area is (a) current density (b) drift velocity (c) velocity (d) charge

**PHY 112.2 2021/2022 SOLUTIONS**

1. **A**

Where, Newtons (N), I = current measured in Ampere (A) and L = length (m)

**C**

1. **B**

, ,

**A**

, , , , (maximum angle)

**A**

1. **A**
2. **B**

, , , V = ?

But,

**B**

**A**

1. **C**

The voltmeter reads the root mean square voltage Vrms

Vrms =

Vrms = 85V B

, , (perpendicularity), ,

**A**

1. **B**

, ,

(perpendicular)

**A**

(parallel, )

**B**

**A**

(in series)

= 5 x 10-2A = 50 x 10-3A – 50mA D

**B**

, , ,

**D**

, ,

**B**

But,

Where Peak voltage

**A**

1. **A**
2. **A**

, ,

or

**E**

1. **C**

, ,

**C**

, ,

**A**

, , C = ?

**A**



C = 2525 x 10-6F

V = 12 volts; U = ?

U =

=

= 1.8 x 10-3J B

, doubled each

**D**

, ,

**D**

1. **B**

At ,

At 45,

At ,

**A**

1. **C**
2. **A**

**SECOND SEMESTER EXAMINATIONS 2022/2023 SESSION**

**COURSE: PHY 112.2 INTRODUCTION TO ELECTRICITY AND MAGNETISM TIME:**

1. The materials or conductors that obey Ohm's Law are called (a) ionic (b) Ohmic (c) Homic

(d) Metal

2. The following are conductors except (a) silver (b) copper (c) aluminum (d) plastic

3. The following are the properties of electric charges (a) charges are conserved (b) charges are quantized (c) all of the above (d) none of the above

4. The material between the plates of a capacitor is (a) Polarization (b) Dielectric (c) Charge

(d) ionic

5. What is the force between two positive charges 100µC and 200µC when it is separated by a distance of 3 cm (a) 20N (b)2 (c) 2×105N and (d) 6103N

6. A magnet has two poles, it is therefore called a magnetic (a) dipole (b) monopole (c) pole

(d) field

7. A piece of copper has a resistance of 12.0. If it is compressed so that the length is halved and the area is tripled. What is the new resistance? (a) 6 (b) 5 (c) 4 (d) 2

8. Four capacitors of 16µF each are connected in series, determine the effective capacitance of the combination (a) 64µF (b) 32µF (c) 4µF and (d) 2µF

9. Tungsten has a resistivity of What is the resistance of a 1.2m long tungsten wire with a radius of (a) 0.30 (6) 0.021 (c) 0.05 (4) 0.001

10. A material that provides zero resistance to electrical currents at a certain temperature called the critical temperature is called (a) dielectric (b) capacitor (c) superconductor (d) insulator

11. When a 5nC test charge is placed at a point, it experiences a force of . What is the

electric field E at that point? (a) 4 x 104 N/C (b).4x10-4 N/C (c) 4x10-5N/C (d) 4x105N/C

12. The potential difference between the terminals of a source when no current flows in an external circuit is called the (a) net voltage (b) Battery voltage (c) Electromotive force

(d) Equivalent voltage

13. Kirchhoff's first rule is: (a)(b) (c) (d)

14. The current flowing through a resistor is 0.8A when a p.d of 20V is applied. Determine the value of the resistance (A) 25 (B) 20 (C) 15 (D) 16

15. If the electric potential difference between two points is 42 volts, what work it done by an agent in moving a charge from one point to the other at a constant speed? (a) (b) (c) (d)

16. The potential difference required to give a helium nucleus ( ) eV of kinetic energy is (a) volts (b) volts (c) volts

(d) volts

17. The expression for electric potential energy of an isolated point charge Q at a distance r relative to infinity is given as (a) (b) (c)

(d)

18. Which of these statements is not correct? (a) No work is done when a charged particle is carried along an equipotential surface. (b) The electric field for a point charge can be given as (c) A 12V battery means that the potential difference between the two battery terminals is 12V (d) every point on each line of an equipotential surface is of different potential

19. The capacitance of a parallel plate capacitor whose plates have area A and separated by a

distance d can be obtained from the expression (a) (b) (c)

(d)

20. The equivalent charge of three capacitors 3µF, 12 µF and 4 µF that are connected in series across a potential difference of 12V is (a) 18µC (b) 1.5µC (c) 0.1µC (d) 12µC

21. What is the potential difference between a 10µF capacitor plates if the stored energy is

22. The plates of a 4.0F capacitor is separated by 2.5mm air gap. Calculate the area of the plates.

23. The electric force between two point charges with a magnitude of +700nC and +500nC is 25N. How far apart are the two charges from each?

24. A battery of internal resistance 2 is connected in series with a resistor of 20. If the potential different across the resistor is 6V. Calculate the e.m.f. of the battery.

25. Calculate the resistance of a 2000m length of aluminum overhead power cable if the cross sectional area of the cable is 100m². Take the resistivity of aluminum to be 0.03 x 10-2 m

26. A charge of 1.0 x 10-5C experiences a force of 80N at a certain point in space. What is the electric field intensity?

27. A resistor of resistance, R is connected across a cell. If the terminal p.d of the cell is reduced to one-quarter of its e.m.f., express the internal resistance, r of the cell in terms of R.

28. An electric kettle connected to a 240V mains produces 6.0 x 105J of heat energy to boil a quantity of water in 5minutes. Find the resistance of the kettle.

29. Calculate the strength and direction of the electric field due to a point charge of 2.00nC at a distance of 5.00 mm from the charge.

30. Calculate the electric flux on the surface of a rectangular plate with length 20cm and breadth 15cm placed in an electric field of 350N/C at an angle of 50degrees

31. Calculate the electric flux through the surface of a plate of area 5m2 placed in a uniform field whose magnitude is 7.4x105 N/C

32. An X-ray tube takes a current of 7.0x10-3A and operates at a potential difference of 80x103V, what power is dissipated?

33. If three resistors, R1=2, R2=6 and R3=9 are connected in parallel and a 120V battery is connected across the combination, calculate the current I3 on the third resistor in the circuit.

34. Find the current in the circuit in figure 1.

4 Ω

24V

+ \_-

b

14 Ω

6 Ω

8 Ω

8V

C

d

a

+ \_-

**Figure 1**

35. Find the electrical force of repulsion in figure 2.

15x10-2C

20x10-3C

0.5m

**Figure 2**

**PHY 112.2 2022/2023 SOLUTIONS**

1. B - Ohmic materials are materials which strictly obey Ohm’s Law.

2. D

3. C

**Properties of electric charges include;**

* Charge is conserved
* Like charges repel each other
* Charge is quantized
* Charge has mass
* Charge is invariant. Etc.

4. B

5.

r

6. A - A magnetic dipole is a magnetic north pole and a magnetic south pole

separated by a small distance.

7.

From

and

Equating (1) and (2) gives

By substitution

8.

For capacitors in series, the equivalent or effective capacitance is given as;

9.

B

10. C - A superconductor is a material that conducts current at zero resistance.

This is achieved by decreasing the temperature to a certain temperature

called the critical temperature.

11.

A

12. C - Electromotive force is the potential difference between the terminals of a

source when it is not delivering current to an external circuit.

13. D - Kirchhoff’s first rule is the current law and it states that the algebraic sum

of current flowing into and out of a junction is equal to zero, i.e.

14.

A

15.

16.

A

17. C

18. D

19. B

20.

The equivalent charge is

A

21.

22.

, ,

Using

**Refer to Johnson’s PHY 112 GUIDE Chapter 4**

23.

24.

= I(R + r)

From V = IR

25.

; R = ?

26.

27.

Using - - - - - - (1)

4V

Substitute V = IR

28.

From E

29.

30.

;

**Refer to Johnson’s PHY 112 GUIDE Chapter 2**

31.

;

32.

33.

Therefore the current on the third resistor is;

34.

4 Ω

24V

+ \_-

b

14 Ω

6 Ω

8 Ω

8V

C

d

a

+ \_-

Taking loop abcda and applying Kirchhoff’s Voltage Law: (Refer to Figure 1)

32

35.

15x10-2C

20x10-3C

0.5m

; F = ?