Total number of printed pages–7

63 (FY)SEM–1/MIN1/PHYMIN1014B

2024

PHYSICS

Paper : PHYMIN1014B

(Mechanics)

Full Marks : 50

Pass Marks : 20

Time : Two hours

The figures in the margin indicate full marks for the questions.

1. Choose the correct answer : 1×5=5

(a) If $\vec{A}$ and $\vec{B}$ are opposite to each other, then the angle between them is

(i) 0°

(ii) 180°

(iii) 360°

(iv) 90°

Contd.

(b) If 'm' be the mass and 'p' be the linear momentum of a body then the Kinetic Energy is given by

(i) mp

(ii) $\frac{2p^2}{m}$

(iii) p^2/m

(iv) $p^2/2m$

(c) The dimensional formula for Torque is

(i) $[ML^2T^{-2}]$

(ii) $[MLT^2]$

(iii) $[ML^{-2}T^2]$

(iv) $[ML^{-2}T^{-2}]$

The Equation for Simple Harmonic motion is given by

$\left(\frac{d^2x}{dt^2}\right)+16x=0$. Then the angular

locity is

4m/sec

(ii) 4radian/sec

(iii) 16radian/sec

(iv) $(16/2\pi)$ radian/sec

(e) An artificial satellite returns back to the earth surface if the orbital velocity

(i) is less than 7·9kM/sec

(ii) is greater than 7·9kM/sec

(iii) is equal to 7·9kM/sec

(iv) has no correlation with 7·9kM/sec

2. Answer ***any five*** of the following questions : 2×5=10

(a) What is degree and order of differential equation? Find the degree and order of the equation

$$\left(d^2y/dx^2\right)+5\left(\frac{dy}{dx}\right)-2y=0$$

(b) Find the impulse and its magnitude developed on a particle of mass $1kg$ which changes its velocity from $(\hat{i}-2\hat{j}+4\hat{k})m/sec$ to $(4\hat{i}+2\hat{j}+4\hat{k})m/sec$.

(c) Deduce the relation between Torque $(\vec{\tau})$ and angular momentum $(\vec{L})$ of a rotating body about its axis of rotation.

(d) What is inertial frame of reference? What are the characteristics of inertial frame of reference?

(e) Write down the laws of Keplar's planetary motion.

) If a particle executing Simple Harmonic motion, then the displacement equation is given by $y = a\sin\omega t$, where symbols have their usual meanings. Find the expression for angular velocity 'ω'.

(g) Define Poisson's ratio. Also find the expression of it.

Mention the dimensional formula for Poisson's ratio.

3. Answer ***any five*** of the following questions : 5×5=25

(a) Define centre of mass. Establish the expression for position vector of centre of mass of a system of N-particles. 1+4=5

(b) Derive the expression for total energy of a particle when the particle executing simple harmonic motion.

(c) What is Geo-staitonary satellite? Mention *two* essential features of a Geo-Stationary Satellite.

Find the expression for height of Geo-Stationary Satellite. 1+1+3=5

(d) Define Elastic Potential Energy of a deformed body.

Show that

Elastic Potential Energy

$= \frac{1}{2} \times$ tension $\times$ Extension. 1+4=

(e) Mention the basic postulates of Einstein's special theory of relativity. Discuss about time dilation. 2+3=5

(f) Define power. Mention its SI unit. If '*P*' be the instantaneous power, '*E*' be the mechanical energy and '*t*' be the time then show that $P = dE/dt$. 1+1+3=5

(g) Explain Searle's method for determination of Young's modulus of Elasticity '*Y*'.

(h) What is ordinary differential equation ? Solve the differential equation $Y' = X\tan(Y - X) + 1$. 1+4=5

Answer ***any one*** of the following questions : 10

(a) What is Elastic limit ?

Establish the expression for torsional couple per angular twist of the hollow cylinder. 2+8=10

(b) Derive expression for

(i) Work-Energy principle

(ii) Angular momentum of system of particles

5+5=10

Total number of printed pages–7

63 (FY)SEM–3/MIN/PHYMIN2014

2024

PHYSICS

Paper : PHYMIN 2014

(Thermal Physics and Statistical Mechanics)

Full Marks : 50

Pass Marks : 20

Time : Two hours

The figures in the margin indicate full marks for the questions.

1. Choose the correct answer : 1×5=5

শুদ্ধ উত্তৰটো বাচি উলিওৱা :

(i) Zeroth law of thermodynamics gives the concept of

থার্মোডিনামিক্সৰ জিৰ'থ সূত্রই তলৰ কোনটো ধাৰণা দিয়ে?

(a) Temperature

(b) Heat

Contd.

(c) Work

(d) Internal energy

(ii) The entropy of a system in all irreveresible processes

অপৰিবর্তনীয় প্রক্রিয়াত এনট্রপিৰ মান

(a) increases

(b) decreases

(c) remains constant

(d) first increases and then decreases

(iii) Which of the following is Maxwell's thermodynamic relation

তলৰ কোনটো মেক্স'ৱেলৰ তাপগতিবিজ্ঞানৰ সম্বন্ধ

(a) $\left(\frac{\partial T}{\partial P}\right)_P = \left(\frac{\partial V}{\partial P}\right)_P$

(b) $\left(\frac{\partial S}{\partial T}\right)_T = \left(\frac{\partial P}{\partial V}\right)_T$

(c) $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$

(d) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial P}{\partial V}\right)_T$

(iv) Root mean square velocity of a gas molecule of mass M at a given temperature is proportional to

এক নির্দিষ্ট উষ্ণতাত M ভৰৰ কোনো অণুৰ বেগ মিন স্কোৱাৰ বেগ তলৰ কোনটোৰ সমানুপাতিক?

(a) $\sqrt{M}$

(b) M

(c) $\frac{1}{\sqrt{M}}$

(d) $\frac{1}{M}$

(v) Maxwell's distribution of velocity is confined in

তলৰ কোনটো পৰীক্ষা মেক্সৱেল ভেলচিটি ডিষ্ট্রিবিউচনত আৱদ্ধ?

(a) Stern's experiment

(b) van der Waals' experiment

(c) Joule's experiment

(d) Doppler's experiment

Contd

2. Answer the following questions : **(any five)** 2×5=10

তলৰ যিকোনো পাঁচটাৰ উত্তৰ দিয়া :

(i) What is first law of thermodynamics? Discuss its Physical significance. 1+1=2

তাপগতিবিজ্ঞানৰ প্ৰথম সূত্ৰটো কি? ইয়াৰ প্ৰাসঙ্গিকতা ব্যাখ্যা কৰা।

(ii) What is Clausius inequality ?

Clausius inequality বুলিলে কি বুজা?

(iii) What is the physical significance of thermodynamic potentials ?

থাৰ্মোডাইনামিক পটেনচিয়েলৰ ভৌতিক প্ৰাসঙ্গিকতা কি?

(iv) Why temperature less than absolute zero is not possible ?

এবচলিউট জিৰোএকৈ কম উষ্ণতা কিয় সম্ভব নহয়?

(v) Define co-efficient of thermal conductivity.

তাপ পৰিবাহীতাৰ গুণাংকৰ সংজ্ঞা লিখা।

(vi) Write the statement of Stefan-Boltzmann law.

Stefan-Boltzmann ৰ সূত্ৰটো লিখা।

(vii) Define the terms Macrostate and Micro-state with the help of an example. 2

উদাহৰণসহ মাইক্ৰ'ষ্টেট আৰু মেক্ৰষ্টেট ৰ সংজ্ঞা লিখা।

Answer the following questions : **(any five)** 5×5=25

তলৰ যিকোনো পাঁচটাৰ উত্তৰ লিখা :

(i) Deduce Planck's law of black body radiation.

ব্লেক বডি ৰেডিয়েচনৰ প্লাংকৰ সূত্ৰটো ওলিওৱা।

(ii) Write difference between Fermi-Dirac and Bose-Einstein distribution laws.

ফাৰ্মি-ডিৰাক আৰু ব'চ-আইনষ্টাইন ডিষ্ট্ৰিবিউচনৰ পাৰ্থক্য লিখা।

(iii) Name the transport phenomena that present in gases and explain in brief the involvement of momentum, energy and mass transfer.

গেচৰ ক্ষেত্ৰত তাপ পৰিবহণৰ বিভিন্ন প্ৰকাৰসমূহ কি কি আৰু ইয়াৰ লগত ভৰবেগ, শক্তি আৰু ভৰসঞ্চাৰৰ সম্পৰ্ক ব্যাখ্যা কৰা।

Contd.

(iv) Deduce Clausius-Clapeyren equation from Maxwell's second thermodynamic relation.

মেক্সৱেলৰ দ্বিতীয় তাপগতিবিজ্ঞানৰ সূত্ৰৰ পৰা Clausius-Clapeyren ৰ সূত্ৰটো উলিওৱা।

(v) Derive the relation

তলৰ সম্বন্ধটো স্থাপন কৰা

$$Tds = C_v dT + T\left(\frac{\partial P}{\partial T}\right)_v dv$$

The symbols have usual meanings.

(vi) Prove that the work done during isothermal process is

প্ৰমাণ কৰাযে আইচ'থার্মেল বিক্ৰিয়াত কার্য্যৰ মান

$$W = 2.3026RT\log_{10}\left(\frac{V_2}{V_1}\right)$$

(vii) Find the change in internal energy of the gas to reduce its volume by compressing adiabatically with work done of $500J$ on it.

৫০০ জুল কার্য্য কৰি কোনো গেচৰ এডায়েবেটিক সংকোচন কৰি আয়তন কমালে সলনি হোৱা অর্ন্তনিহিত শক্তিৰ মান উলিওৱা।

(viii) Explain the entropy-temperature diagram for Carnot cycle.

কাৰ্নট চাইকলৰ এনট্ৰপি-টেম্পেৰেচাৰ চিত্ৰ ব্যাখ্যা কৰা।

4. Answer the following question : ***(any one)*** 10×1=10

তলৰ *যিকোনো এটাৰ* উত্তৰ লিখা :

(i) Derive the expression for Maxwell's law of distribution of velocities. How can it be verified experimentally.

মেক্সৱেলৰ ভেলচিটি ডিষ্ট্ৰিবিউচনৰ সূত্ৰটো ওলিওৱা। পৰীক্ষাগাৰত ইয়াক কেনেকৈ প্ৰমাণ কৰা হয় লিখা।

(ii) What is Carnot's theorem ? Prove the theorem. 2+6+2=10

কার্নট'ৰ তত্ত্ব বুলিলে কি বুজা। এই তত্ত্ব প্ৰমাণ কৰা।

(iii) A Carnot engine takes 2×10^6 *cal* of heat from a reservoir at 527°C and gives it to sink at 27°C. Calculate the work done by the engine.

এটা কার্নট ইঞ্জিনে 527° চেলচিয়াচত থকা ৰিজাৰভাৰৰ পৰা 2×10^6 *cal* তাপ লয় আৰু ই 27°C থকা চিংকত এৰি দিয়ে। ইঞ্জিনৰ কার্য্যৰ পৰিমাণ গণনা কৰা।

Total number of printed pages–5

63 (FY)SEM–3/SEC/PHYSEC2013

2024

PHYSICS

Paper : PHYSEC2013

(Electrical Network and Loads)

Full Marks : 40

Pass Marks : 16

Time : Two hours

The figures in the margin indicate full marks for the questions.

1. Choose the correct answer : $1\times5=5$

(a) Which of the following is passive element ?

(i) Diode

(ii) Transistor

(iii) Both *(i)* and *(ii)*

(iv) Capacitor

Contd.

(b) Superposition theorem is applied only to circuits having _____ elements.

(i) Resistive

(ii) Passive

(iii) Non-linear

(iv) Linear bilateral

(c) For maximum transfer of power, internal resistance of the source should be

(i) Equal to load resistance

(ii) Less than the load resistance

(iii) Greater than the load resistance

(iv) Equal to half of the load resistance

(d) A circuit of unity power factor behaves as

(i) inductive circuit

(ii) Capacitive circuit

(iii) resistive circuit

(iv) R-C circuit

(e) In a three phase system, phase voltage differ by

(i) 180°

(ii) 120°

(iii) 90°

(iv) 360°

2. Answer the following questions : ***(any five)*** 2×5=10

(a) What are active and passive elements ? Give examples.

(b) State Ohm's law. Write the limitations of Ohm's law.

(c) Write down the basic differences between single and three phase alternating voltage source.

(d) State and explain Kirchhoff's law.

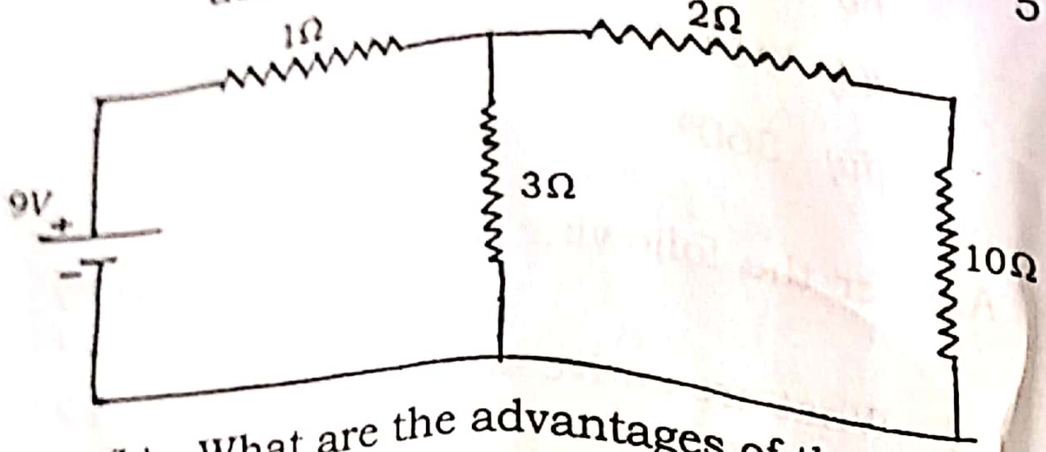
(e) How would you connect resistances 1Ω, 2Ω and 3Ω so as to get an equivatent resistance of 3.66Ω ? Draw the required circuit diagram.

(f) State superposition theorem.

(g) Define (i) Apparent power (ii) Power factor.

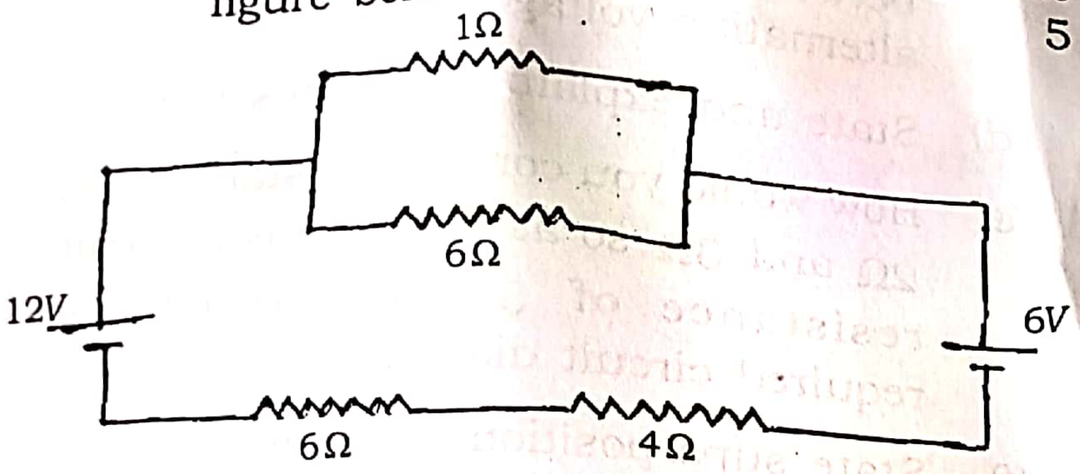
3. Answer the following questions : **(any three)** 5×3=15

(a) Find the current through 10Ω resistor using Thevenin's theorem. 5



(b) What are the advantages of three phase voltage system over single phase voltage system ? 5

(c) Determine the electric current that flows in the circuit as shown in the figure below. 5



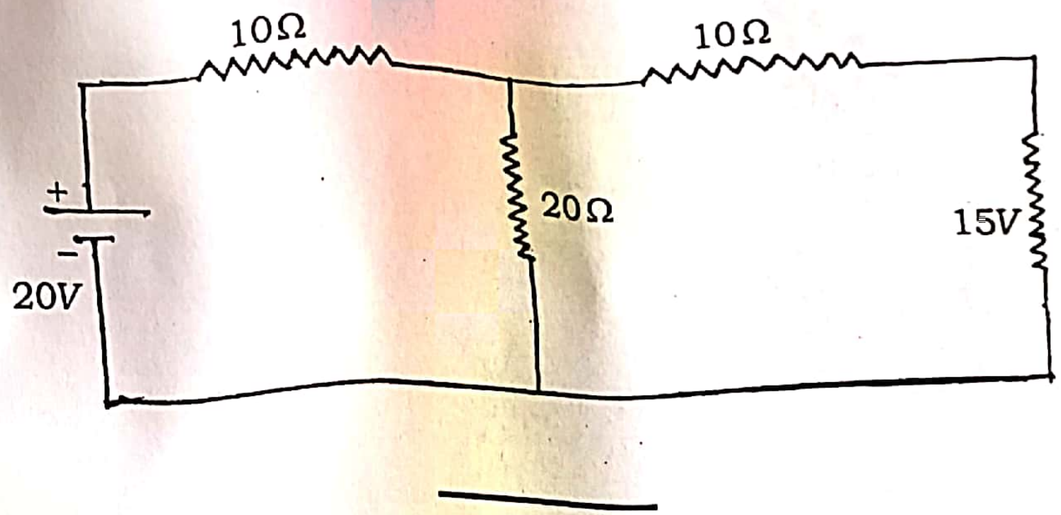
(d) Discuss different types of loads present in distribution system and explain their characteristics. 5

(e) State and explain Thevenin's theorem with suitable diagram. How does it differ from Norton's theorem ? 4+1=5

4. Answer the following questions : **(any one)** 10×1=10

(a) State and explain maximum power transfer theorem and derive and expression for maximum power. 5+5=10

(b) State and explain Norton's theorem. Using this theorem, determine the current in 20Ω resistor in the network shown below – 5+5=10



Total number of printed pages = 7

63 (FY) SEM-3/MAJ/PHYMAJ2024

2024

PHYSICS

Paper : PHYMAJ2024

(Waves and Optics)

Full Marks : 50

Pass Marks : 20

Time : Two hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : 1×5=5

(a) Lissajous figure at 45° means

(i) circle

(ii) ellipse

(iii) straight line

(iv) parabola

Contd.

(b) In a standing wave the distance between a node and its nearest antinode is

(i) $\lambda/2$

(ii) $\lambda/4$

(iii) λ

(iv) $3\lambda/4$

(c) If monochromatic light in Young's double-slit experiment is replaced by white light, then

(i) no fringes are observed

(ii) all bright fringes are white

(iii) all bright fringes are coloured but the central fringe is white

(iv) all bright fringes are coloured including central fringe

(d) In Fraunhofer diffraction of a single slit with monochromatic light of wave-lenght λ, the width of the slit is 'd' and the screen is at a distance D from the slit. If the slit width is decreased, the width of the central maximum

(i) will increase

(ii) will decrease

(iii) remains unchanged

(iv) may increase or decrease depending on the relative values of D and λ.

(e) A spherical wave front arises from

(i) a point source

(ii) a slit

(iii) an extended source

(iv) a double slit

2. Answer ***any five*** of the following questions : 2×5=10

(a) Calculate the velocity of sound in a gas in which two waves of wavelengths 5 m and 5.5 m produces 6 beats per second.

(b) Fundamental frequency of a stretched string of length 50 cm and mass 10 gm is 300 HZ. What is the tension applied?

(c) Write about plane wave briefly.

(d) What are the conditions for sustained interference of light?

(e) Mention two differences between Fresnel and Fraunhofer diffractions.

(f) Write the conditions under which circular fringes are formed in Michelson interferometer.

(g) Define wave front. Write any two properties of wave front.

3. Answer ***any five*** of the following questions : 5×5=25

(a) Obtain the differential equation for the motion of transverse wave along a string.

(b) What do you mean by beats? Show that the number of beats produced per second is equal to the difference in the frequencies of the two surrounding bodies.

(c) A simple harmonic motion is represented by

$$Y = \left(10\sin(10t - \pi/6\right),$$

Here Y is measured in metres, t in seconds and the phase angle in radians. Calculate

(i) Frequency

(ii) Time period

(iii) Maximum displacement

(iv) Maximum velocity

(v) Maximum acceleration

(d) Explain a method to determine the wavelength of sodium light using Newton's rings.

2. (e) What is half-period zone? Find the area of second half-period zone. What will be the area of third half-period zone ?

(f) What is diffraction grating? Give the theory of plane diffraction grating.

(g) Write briefly about Fabry-Perot interferometer.

(h) Derive an expression for the velocity of sound in a gaseous medium. On What factors, the velocity of sound in such medium depends.

4. Answer ***any one*** of the following questions : 10×1=10

(a) Describe and explain diffraction due to a straight edge.

An object is placed at 20 cm from a zone plate and the brighter image is situated at 20 cm from zone plate. The wavelength of light wave is 4000 Å. Find the numbers of Fresenel's zones in a radius of 1 cm of the plate. 7+3=10

(b) Write short notes on *any two* of the following : 5+5=10

(i) Fizeau fringes

(ii) Haidinger fringes

(iii) Lissajous figures

(iv) Fourier theorem

Total number of printed pages–4

63 (FY)SEM–3/MAJ/PHYMAJ2014

2024

PHYSICS

Paper : PHYMAJ2014

(Electricity and Magnetism)

Full Marks : 50

Pass Marks : 20

Time : Two hours

The figures in the margin indicate full marks for the questions.

1. Choose the correct answer : 1×5=5

(a) In $\vec{E} = -\vec{\nabla} U$, the negative sign signifies

(i) E is opposite to U

(ii) E is negative

(iii) E increases when U decreases

(iv) E is directed in the direction of decreasing U

(b) Gauss's law in differential form is

(i) $\vec{\nabla} \times \vec{E} = \rho/\varepsilon_0$

(ii) $\vec{\nabla} . \vec{E} = \rho/\varepsilon_0$

(iii) $\vec{\nabla} \times \vec{E} = 0$

(iv) $\vec{E} = -\dfrac{\partial \vec{v}}{\partial \vec{r}}$

Contd.

(c) Curl of a magnetic field is

(i) 0

(ii) $\mu_0 \vec{J}$

(iii) $-\mu_0 \vec{J}$

(iv) $\vec{\nabla} \times \vec{A}$

(d) The magnetic flux link with a coil of n turns and area of cross-section A held with its plane parallel to the magnetic field $\vec{B}$ is

(i) $nAB/2$

(ii) nAB

(iii) $nAB/4$

(iv) zero

(e) The r.m.s. value of alternating current is related to its peak value by equation-

(i) $I_{rms} = \sqrt{2}\, I_0$

(ii) $I_0 = \sqrt{2}\ I_{rms}$

(iii) $I_{rms} = 2I_0 / \pi$

(iv) $I_0 = 2I_{rms} / \pi$

swer the following questions : ***(any five)*** 2×5=10

State Gauss's law is electrostatics. Write two properties of electric field lines.

Show that $\gamma = xyz$ satisfies Laplace's equation.

(c) Define magnetic susceptibility and magnetic permeability.

(d) Define self inductance and mutual inductance.

(e) Define sharpness of resonance. Under what condition does a circuit become more selective ?

(f) State Norton's therom and Thevenin's theorem of electrical network.

(g) State and explain Biot-Savart's law.

3. Answer the following questions : ***(any five)*** 5×5=25

(a) Derive an expression for capacitance of a parallel-plate capacitor.

(b) State and explain maximum power transfer theorem.

(c) Explain reciprocity theorem of mutual induction.

(d) Show that $\vec{\nabla} \times \vec{B} = \mu_0 \vec{j}$, where the symbols have their usual meanings.

(e) Applying Ampere's circuital law, derive an expression for magnetic field inside a long solenoid carrying current.

(f) Derive an expression for Faraday's law of electromagnetic induction in integral form.

(g) Define current and charge sensitivity of a ballistic galvanometer. Derive an expression for torque on a current loop in a uniform magnetic field.

(h) Derive an expression for magnetic force between current elements.

4. Answer the following questions: ***(any one)*** 10×1=10

(a) (i) Define the terms dielectric constant and electric susceptibility. Deduce the relation between them. 2+3=5

(ii) Derive an expression for energy stored in an inductor. Calculate the energy stored in the magnetic field of a solenoid of inductance $20mH$ when a current of $3mA$ flows through it. 3+2=5

(b) (i) Derive an expression for force and torque acting on an electric dipole placed in a uniform electric field. 4

(ii) Mention the analogy between electric dipole moment and magnetic dipole moment. Apply Biot-Savast law to derive an expression for magnetic field due to a straight wire carrying current. 2+4=6
