Kafr Elshiekh University
Faculty of Engineering
Department of
Physical and Mathematical Engineering
Preparatory Year   **Engineering physics (1) (PHM0002)**

08- 06- 2019
3 hours
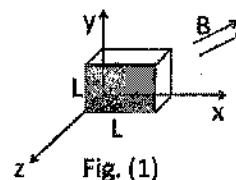90 Marks
Final exam: 3 pages

Answer the following questions:

Question(1) : (ILOs: a1)   (15 Marks)

(a) An electron ($q = -1.6 \times 10^{-19}$C) is moving at 3×10^5 m/s in the +x direction. A magnetic field of 0.8 T is in the +z direction. Calculate the magnetic force on the electron.

(b) A cube of edge length L=2.5 cm is positioned as shown in fig.(1). A uniform magnetic field given by B=5i+4j+3k   T exists through the region. Calculate the magnetic flux through the shaded face.

Fig. (1)

(c) A conductor in the shape as shown in Fig.(2) of edge length L=0.4m carries a current I=10 A. Calculate the magnetic field at point O. ($\mu_o = 4\pi \times 10^{-7}$ T.m/A)

Fig. (2)
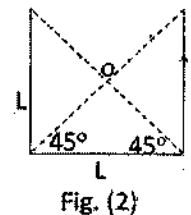
Question(2) : (ILOs: b1)   (30 Marks)

(a) A circular wire loop of radius 20cm consists of 25 turns of wire and carries a current of 2A. A 0.35 T magnetic field is applied parallel to the plane of the loop. Calculate :
- The magnetic dipole moment of the loop.
- The torque acting on the loop.

(b) A coil of area 0.1 m^2 is rotating at 60 Hz with the axis of rotation perpendicular to 0.2 T magnetic field.
- If the coil has 1000 turns, what is the maximum emf generated in it?
- If the total resistance of the wire is 12Ω , what is the maximum induced current in the coil?

(c) Consider a uniformly wound solenoid having N turns and length L. Assume L is much longer than the radius of the windings and the core of the solenoid is air.
- Find the inductance of the solenoid.
- Calculate the inductance of the solenoid if it contains 300 turns, its length is 25cm and its cross section area is 4cm^2. ($\mu_o = 4\pi \times 10^{-7}$ T.m/A)

<u>*Question(3) : (ILOs: a1)*</u>   *(15 Marks)*

(a)Choose the best answer:

1- In constructing a thermometer it is necessary to use a substance that:

A. expands with rising temperature   B. expands linearly with rising temperature

C. will not freeze   D. will not boil   E. undergoes some change when heated or cooled

2- The "triple point" of a substance is that point for which the temperature and pressure are such that:

A. only solid and liquid are in equilibrium   B. only liquid and vapor are in equilibrium

C. only solid and vapor are in equilibrium   D. solid, liquid, and vapor are all in equilibrium

E. the temperature, pressure and density are all numerically equal

3- When the temperature of a copper penny is increased by 100° C, its diameter increases by 0.17%. The area of one of its faces increases by:

A. 0.17%   B. 0.34%   C. 0.51%   D. 0.13%   E. 0.27%

4- Possible units for the coefficient of volume expansion are:

A. mm/C°   B. mm3/C°   C. (C°)3   D. 1/(C°)3   E. 1/C°

5- Heat has the same units as:

A. temperature   B. work   C. energy/time   D. heat capacity   E. energy/volume

6- The internal energy of an ideal gas depends on:

A. the temperature only   B. the pressure only   C. the volume only   D. the temperature and pressure only

E. temperature, pressure, and volume

(b) Discuss the fundamental ways for heat transfer.

(c) A segment of steel railroad track has a length of 30 m when the temperature is 0°C.

(1)What is its length when the temperature is 40°C?

(2) Suppose that the ends of the rail are rigidly clamped at 0°C so that expansion is prevented. What is the thermal stress set up in the rail if its temperature is raised to 40°C? (Young's modulus for steel is $20 * 10^{10}$ Pa)

<u>*Question(4) : (ILOs: b1)*</u>   *(15 Marks)*

(a) Check the errors for the following statements and correct it if exist.

1- A heat engine: takes heat in, does work, and loses energy as heat

2- A Carnot cycle: is bounded by two isotherms and two isobaric on a p-V graph

3- A heat engine in each cycle absorbs energy from a reservoir as heat and does an equivalent amount of work, with no other changes. This engine violates: the second law of thermodynamics

4- A heat engine in each cycle absorbs energy of magnitude |QH| as heat from a high temperature reservoir, does work of magnitude |W|, and then absorbs energy of magnitude |QL| as heat from a low temperature reservoir. If |W| = |QH| + |QL| this engine violates: the third law of thermodynamics

5- On a warm day a pool of water transfers energy to the air as heat and freezes. This is a direct violation of: the second law of thermodynamics

6- A heat engine that in each cycle does positive work and loses energy as heat, with no heat energy input, would violate: the third law of thermodynamics

(b) Mention three statements for the second law of thermodynamics.

(c) A multicylinder gasoline engine in an airplane, operating at 2500 rev/min, takes in energy 7.89 K J and exhausts 4.58 KJ for each revolution of the crankshaft.

(i) How many liters of fuel does it consume in 1h of operation if the heat of combustion is $4.03 * 10^4$ KJ/L? (ii) What is the mechanical power output of the engine? Ignore friction and express the answer in horsepower. (iii) What is the torque exerted by the crankshaft on the load? (iv) What power must the exhaust and cooling system transfer out of the engine?

Question(5) : (ILOs: c2)   (15 Marks)

(a)Choose the best answer:

1- A certain heat engine draws 500cal/s from a water bath at 27° C and transfers 400cal/s to a reservoir at a lower temperature. The efficiency of this engine is:

A. 80%   B. 75% C. 55% D. 25% E. 20%

2- The change in entropy is zero for:

A. reversible adiabatic processes   B. reversible isothermal processes

C. reversible processes during which no work is done

D. reversible isobaric processes   E. all adiabatic processes

3- Possible units of entropy are:

A. J   B. J/K   C. J^{-1} D. liter·atm   E. cal/mol

4- A concave mirror forms a real image that is twice the size of the object. If the object is 20 cm from the mirror, the radius of curvature of the mirror must be about:

A. 13 cm   B. 20 cm   C. 27 cm   D. 40 cm   E. 80 cm

5- A concave spherical mirror has a focal length of 12 cm. If an object is placed 6 cm in front of it the image position is:

A. 4 cm behind the mirror   B. 4 cm in front of the mirror   C. 12 cm behind the mirror

D. 12 cm in front of the mirror   E. at infinity

6- An erect object placed outside the focal point of a converging lens will produce an image that is:

A. erect and virtual   B. inverted and virtual   C. erect and real

D. inverted and real   E. impossible to locate

(b) State the general law of mirrors and prove it.

(c) Two thin converging lenses of focal lengths $f_1 = 10$ cm and $f_2 = 20$ cm are separated by 10 cm. An object is placed 30 cm to the left of lens 1. Find the position and the magnification of the final image.

(d) Discuss three different types of thermometers.

Assume any missing data.

Best Wishes

Dr. Ahmed Saeed   **Dr. Demyana Adel Abdel Masieh**

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