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Date: 11th December, 2013

Time: 100 Minutes

Instructions

- ❖ There are 20 questions. Answer all the questions or as many as you can.
- ❖ Each question carries equal marks.
- ❖ Circle only the right answer. If you do not know the answer, do not circle any answer.
- ❖ Circle with led pencil will be not acceptable.
- ❖ If you make a mistake, make your choice clear by writing out the correct answer in full or indicating it clearly. Marking two choices will be considered as a wrong answer.
- ❖ Any attempt to copy answers from another candidate will result in permanent disbarment from the university for all purposes.
- ❖ No books or lab tops are allowed.
- ❖ Use your own calculator. No permission for borrowing from others.

Rest mass of the electron	$m_e = 9.11 \times 10^{-31}$ kilogram $= 9.11 \times 10^{-28}$ gram
Magnitude of the electron charge	$e = 1.60 \times 10^{-19}$ coulomb $= 4.80 \times 10^{-10}$ statcoulomb (esu)
Avogadro's number	$N_0 = 6.02 \times 10^{23}$ per mole
Universal gas constant	$R = 8.31$ joules/(mole \cdot K)
Boltzmann's constant	$k = 1.38 \times 10^{-23}$ joule/K $= 1.38 \times 10^{-16}$ erg/K
Speed of light	$c = 3.00 \times 10^8$ m/s $= 3.00 \times 10^{10}$ cm/s
Planck's constant	$h = 6.63 \times 10^{-34}$ joule \cdot second $= 4.14 \times 10^{-15}$ eV \cdot second $\hbar = h/2\pi$
Vacuum permittivity	$\epsilon_0 = 8.85 \times 10^{-12}$ coulomb ² /(newton \cdot meter ²)
Vacuum permeability	$\mu_0 = 4\pi \times 10^{-7}$ weber/(ampere \cdot meter)
Universal gravitational constant	$G = 6.67 \times 10^{-11}$ meter ³ /(kilogram \cdot second ²)
Acceleration due to gravity	$g = 9.80$ m/s ² $= 980$ cm/s ²
1 atmosphere pressure	1 atm $= 1.0 \times 10^5$ newton/meter ² $= 1.0 \times 10^5$ pascals (Pa)
1 angstrom	1 Å $= 1 \times 10^{-10}$ meter

$$1 \text{ weber/m}^2 = 1 \text{ tesla} = 10^4 \text{ gauss}$$

Moments of inertia about center of mass

Rod	$\frac{1}{12} Ml^2$
Disc	$\frac{1}{2} MR^2$
Sphere	$\frac{2}{5} MR^2$

Candidate's Name:

Signature

Invigilator:

NIC No.:

Candidate's Signature:

Circle the Correct Answer

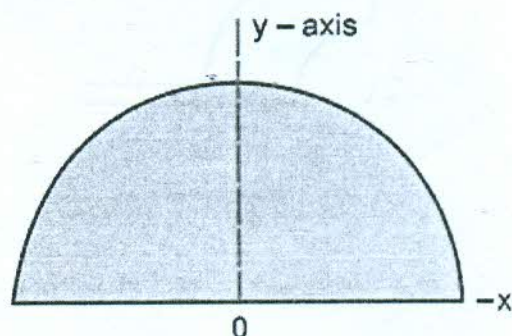
Q.1	A	B	C	D	E
Q.2	A	B	C	D	E
Q.3	A	B	C	D	E
Q.4	A	B	C	D	E
Q.5	A	B	C	D	E
Q.6	A	B	C	D	E
Q.7	A	B	C	D	E
Q.8	A	B	C	D	E
Q.9	A	B	C	D	E
Q.10	A	B	C	D	E
Q.11	A	B	C	D	E
Q.12	A	B	C	D	E
Q.13	A	B	C	D	E
Q.14	A	B	C	D	E
Q.15	A	B	C	D	E
Q.16	A	B	C	D	E
Q.17	A	B	C	D	E
Q.18	A	B	C	D	E
Q.19	A	B	C	D	E
Q.20	A	B	C	D	E

Signature Examiner:

Question No. 1

A semicircular disc of radius R has density ρ which varies as $\rho = cr^2$, where r is the distance from the center of the base and 'c' is a constant. The center of mass will lie along the y-axis for reasons of symmetry. The center of mass from O, the center of the base is given by

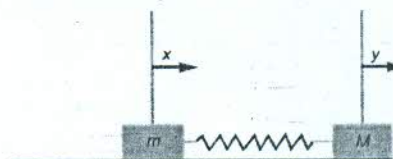
- A. $\frac{\pi R}{2}$
- B. $\frac{3\pi R}{4}$
- C. $\frac{5R}{8\pi}$
- D. $\frac{8R}{5\pi}$



Question No.2

Two blocks of mass m and M connected by a massless spring of spring constant k are placed on a smooth horizontal table. The equations of motion for the larger mass is

- A. $m\ddot{y} + k(y - x)$
- B. $m\ddot{y} - k(y + x)$
- C. $m\ddot{y} - k(y - x)$
- D. $m\ddot{y} + k(y + x)$



Question No. 3

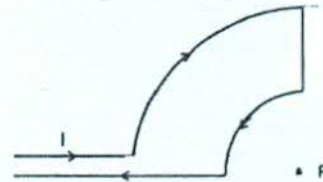
Current I flows in two concentric circular arcs of radii r and $2r$, in the following figure. Both arcs are quarter of a circle with P as the centre. B at P is

A. $\frac{\mu_0 I}{8r}$

B. $\frac{\mu_0 I}{16r}$

C. $\frac{\mu_0 I}{4r}$

D. $\frac{\mu_0 I}{2r}$



Question No. 4

A capacitor of $0.01 \mu\text{F}$ is charged to 100 V . The peak current that flows when the charged capacitor is connected across an inductance of 10 mH is

A. 0.1 A

B. 0.01 A

C. 10 A

D. 1 A

Question No. 5.

The wavefunction of an electron in a hydrogen like atom is $Ce^{-r/a}$, the value of C is

- A. $\frac{1}{\sqrt{2\pi a^3}}$
- B. $\frac{1}{\sqrt{\pi a^3}}$
- C. $\frac{1}{\sqrt{\pi a^4}}$
- D. $\frac{1}{\sqrt{2a^3}}$

Question No. 6

For $S^2 = S_X^2 + S_Y^2 + S_Z^2$, $[S^2, S_Z]$ is given by

- A. Zero
- B. $\frac{1}{2}\sigma_{\sigma_x}$
- C. $\frac{1}{2}\sigma_x$
- D. $\frac{1}{2}i\sigma_x$

Question No. 7

In a grand canonical ensemble, a system A of fixed volume is in contact with a large reservoir B. Then

- A. A can exchange only energy with B
- B. A can exchange only particles with B
- C. A can exchange neither energy nor particles with B
- D. A can exchange both energy and particles with B

Question No. 8

According to Maxwell's law of distribution of velocities of molecules, the most probable velocity is

- A. Greater than the mean velocity
- B. Equal to the mean velocity
- C. Equal to root mean square velocity
- D. Less than the root mean square velocity

Question No.9

The magnitude of force between total +ve and -ve charges in a one rupee coin having the mass of 3.11 g made up of copper ($^{29}\text{Cu}_{63.5}$) separated at a distance of 100m apart will be

- A. $1.6 \times 10^{-19} \text{ N}$
- B. $1.6 \times 10^{19} \text{ N}$
- C. $1.69 \times 10^{-16} \text{ N}$
- D. $1.69 \times 10^{16} \text{ N}$

Question No. 10

A 60W, 120V bulb is connected in series with a resistance across a 277V line. The minimum power rating of the resistance should be.

- A. 78.5W
- B. 67W
- C. 94.5W
- D. 120W

Question No. 11

A particle moves according to the law $x = A \sin \pi t$, where x is the displacement and t is time. Find the distance traversed by the particle in 3.0 s.

- A. $2A$
- B. $5A$
- C. $6A$
- D. $8A$

Question No. 12

Number of atoms in 6.5g of $^{30}\text{X}_{65}$ is

- A. 6.02×10^{22}
- B. 6.02×10^{23}
- C. 1.3×10^{23}
- D. 1.3×10^{22}

Question No. 13

The nucleus of an iron atom has a radius of about $4 \times 10^{-15} \text{m}$ and contains 26 protons. The repulsive electrostatic force acts between two protons in such a nucleus if they are separated by a distance of one radius is

- A. 14N
- B. 16N
- C. $14 \times 10^{-6} \text{N}$
- D. $16 \times 10^{-6} \text{N}$

Question No. 14

Electric field due to a dipole at a point P at a distance x normal to the centre of line constituting the dipole body is proportional to

- A. p/x^2
- B. q/x^2
- C. p/x^3
- D. zero

Question No. 15.

For the problem in Question No. 14 the potential at the point will be

- A. p/x^2
- B. q/x^2
- C. p/x^3
- D. zero

Question No. 16

Which of the following properties of the hydrogen atom can be predicted most accurately from the simple Bohr model?

- A. Energy differences between states
- B. Angular momentum of the ground state
- C. Degeneracy of states
- D. Transition probabilities

Question No. 17

The ratio of the nuclear radius to the atomic radius of an element near the middle of the periodic table is most nearly

- A. 10^{-2}
- B. 10^{-5}
- C. 10^{-8}
- D. 10^{-14}

Question No. 18

Materials that are good electrical conductors also tend to be good thermal conductors because

- A. they have highly elastic lattice structures
- B. they have energy gaps between the allowed electron energy bands
- C. impurities aid both processes
- D. conduction electrons contribute to both processes

Question No. 19

At time $t=0$ the switch in Fig i. is thrown from 'a' to 'b' which of the graph describe the behavior of current in resistor 'R'

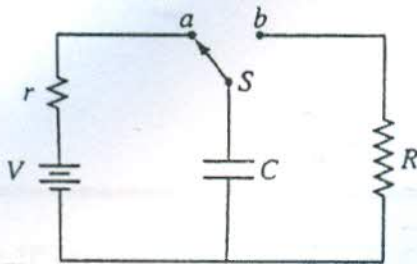


Fig. i.

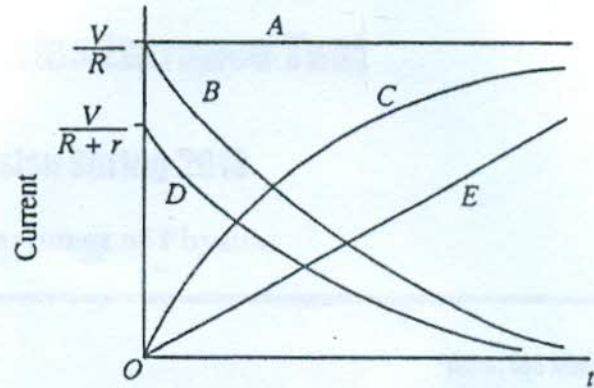


Fig ii.

Question No. 20

Two identical copper blocks of mass 1kg, having initial temperature 0°C and 100°C respectively, are in contact with each other. The blocks come to thermal equilibrium. The amount of heat exchange in this process is (the specific heat of copper is $0.1\text{kcal/kg}^\circ\text{K}$)

- A. 50 kcal
- B. 25 kcal
- C. 150 kcal
- D. 5 kcal