TEST SERIES CSIR-UGC-NET/JRF June 2016

BOOKLET SERIES A

Paper Code 05

Test Type: TEST SERIES

PHYSICAL SCIENCES

Duration: 02:00 Hours

Date: 21-05-2016

Maximum Marks: 120

Read the following instructions carefully:

1. Attempt all the questions.
2. This booklet contain 60 Objective Type Questions, each Question carry **2 marks** each.
3. For rough work, blank sheet is attached at the end of test booklet.
4. There will be negative marking @25% for each wrong answer.
5. Darken the appropriate bubbles with HB pencil/Ball Pen to write your answer.
6. The candidates shall be allowed to carry the Question Paper Booklet after completion of the exam.

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1. A particle of unit mass moves in a potential $V(x)=\frac{a}{x^2}-\frac{b}{x}$, where a and b are positive constants. The angular frequency of small oscillation about the minimum of the potential is

(a) $\sqrt{\frac{2b^4}{a^3}}$ (b) $\sqrt{\frac{b^4}{a^3}}$ (c) $\sqrt{\frac{b^4}{8a^3}}$ (d) $\sqrt{\frac{b^4}{2a^3}}$

2. Acceleration due to gravity at a depth 'd' below the earth's surface is equal to acceleration due to gravity at a height 'd' above the earth's surface then (R = radius of earth)

(a) $d=\frac{\sqrt{5}-2}{2}R$ (b) $d=\frac{\sqrt{5}-1}{2}R$ (c) $d=\frac{\sqrt{3}-1}{2}R$ (d) $d=\frac{2-\sqrt{3}}{2}R$

3. A relativistic particle of mass m and charge 'e' moves with speed v in electromagnetic potentials $(\vec{A},\phi)$. Which of the following statements is correct?

(a) Lagrangian of particle is $L=-mc^2\sqrt{1-\text{v}^2/c^2}-e\phi$

(b) Hamiltonian of particle is $H=\sqrt{(\vec{p}-e\vec{A})^2+m^2c^4}+e\phi$

(c) Canonical momentum is $m\vec{\text{v}}$

(d) Canonical momentum is $m\vec{\text{v}}+e\vec{A}$

4. Which of the following is an example of spherical top

(a) cylinder (b) disc (c) square plate (d) cube

5. Hamiltonian of a system is $H=\frac{p_x}{x}-\frac{p_y}{y}+\frac{1}{2}(x^2-y^2)$ trajectory of system on x-y plane is

(a) circle (b) ellipse (c) parabola (d) hyperbola

6. A constant force F is applied to a relativistic particle of rest mass m. If the particle starts from rest, its speed after it has moved a distance x is

(a) $\frac{Fx}{m_0c}$ (b) $c\sqrt{1-\left(\frac{Fx}{m_0c^2}\right)^2}$ (c) $c\sqrt{1-\frac{1}{\left(1+\frac{Fx}{m_0c^2}\right)^2}}$ (d) $\sqrt{\frac{2Fx}{m_0}}$

7. A point particle of mass m carrying an electric charge q is attached to a spring of force constant K. A constant electric field E along the spring is applied due to which the block moves. Speed of the particle as a function of its displacement (x) is

(a) $\sqrt{\frac{2qEx-Kx^2}{m}}$ (b) $\sqrt{\frac{2qEx+Kx^2}{m}}$ (c) $\sqrt{\frac{qEx-Kx^2}{2m}}$ (d) $\sqrt{\frac{2qEx-Kx^2}{2m}}$

8. A bead embedded into a smooth wire is free to slide. Equation of the wire is $y=\alpha x^3$. y is vertical direction and x is horizontal. If the wire is rotated with uniform angular velocity ω, at what distance from y axis can the particle remain at rest?

(a) $\frac{\omega^2}{3\alpha g}$ (b) $\frac{2\omega^2}{3\alpha g}$ (c) $\frac{\omega^2}{2\alpha g}$ (d) $\frac{\omega^2}{\alpha g}$

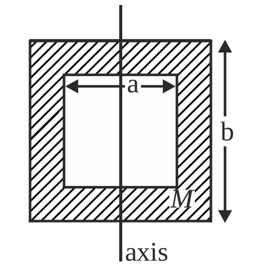
9. A planet (mass M) revolves around the Sun (mass M) in an elliptical orbit of major and minor axes a and b. If T be time of revolution then

(a) $T = 2\pi\sqrt{\dfrac{a^3}{G(m+M)}}$ (b) $T = 2\pi\sqrt{\dfrac{a^3}{Gm}}$ (c) $T = 2\pi\sqrt{\dfrac{a^3}{GM}}$ (d) $T = 4\pi\sqrt{\dfrac{a^3}{GM}}$

10. A square plate of mass m has a square cut as shown in the figure. Moment of inertia of the plate about the axis shown is

(a) $\dfrac{M(b^2+a^2)}{12}$ (b) $\dfrac{M(b^2-a^2)}{12}$

(c) $\dfrac{M(b^2-a^2)}{6}$ (d) $\dfrac{M(b^2+a^2)}{6}$



11. A particle of mass M initially at rest decays into two particles which move in opposite direction with speed $\dfrac{2c}{5}$ and $\dfrac{4c}{5}$. Rest masses of the two particles are

(a) $\dfrac{3}{5}$M, $\dfrac{4}{5}$M (b) $\dfrac{9}{25}$M, $\dfrac{16}{25}$M (c) $\dfrac{16}{35}$M, $\dfrac{9}{35}$M (d) $\dfrac{3}{25}$M, $\dfrac{4}{25}$M

12. Hamiltonian of a particle is $H = \dfrac{xp_x^2}{2} + x^2 p_x + V(x)$ corresponding Lagrangian is

(a) $\dfrac{(\dot{x}-x^2)^2}{2x} - V(x)$ (b) $\dfrac{(\dot{x}+x^2)^2}{2x} + V(x)$

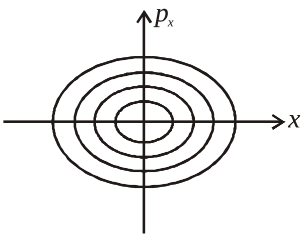
(c) $\dfrac{\dot{x}^2}{2x} - x^2\dot{x} - V(x)$ (d) $\dfrac{\dot{x}^2}{2x} + x^2\dot{x} - V(x)$

13. Value of Poisson bracket is $\{r^2, p^2\}$ is

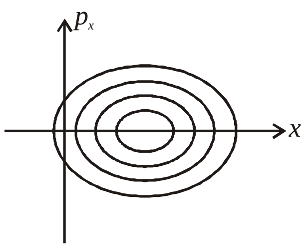
(a) $2rp$ (b) $4\vec{r}\cdot\vec{p}$ (c) 4 (d) $4rp$

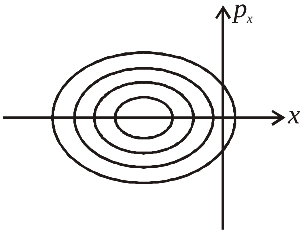
14. A particle of unit mass moves in a one dimensional potential $V(x) = \dfrac{x^2}{2} - x,$ which of the following is phase space trajectories for the particle.

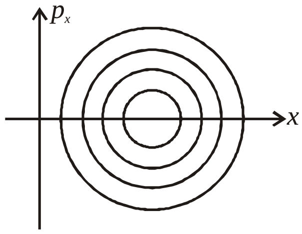
(a)



(b)



(c) 

(d) 

15. A particle of mass m moves under a central potential $V(r) = -\dfrac{K}{r^3}$. If total energy of the particle is E then root mean square speed of the particle is

(a) $\sqrt{\dfrac{E}{m}}$ (b) $\sqrt{\dfrac{2E}{m}}$ (c) $\sqrt{\dfrac{4E}{m}}$ (d) $\sqrt{\dfrac{6E}{m}}$

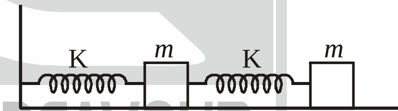
16. Lagrangian of a particle is $L = \dfrac{1}{2}m\dot{x}^2 - \dfrac{1}{2}Kx^2 + \alpha x$. If $\dot{x} = 0$ at $x = 0$ then $\dot{x}$ as a function of x can be written as

(a) $\sqrt{\dfrac{\alpha x - Kx^2}{m}}$ (b) $\sqrt{\dfrac{\alpha x - Kx^2}{2m}}$ (c) $\sqrt{\dfrac{2\alpha x - Kx^2}{2m}}$ (d) $\sqrt{\dfrac{2\alpha x - Kx^2}{m}}$

17. A solid cylinder of mass M and radius R rolls down an inclined plane from a height h. Speed of the cylinder at the bottom of inclined plane is

(a) $\sqrt{\dfrac{2gh}{3}}$ (b) $\sqrt{\dfrac{gh}{3}}$ (c) $\sqrt{\dfrac{4gh}{3}}$ (d) $\sqrt{\dfrac{5gh}{3}}$

18. Frequencies of normal modes of system shown in the figure are



(a) $\sqrt{\dfrac{3\pm\sqrt{2}}{2}\cdot\dfrac{K}{m}}$ (b) $\sqrt{\dfrac{3\pm\sqrt{5}}{2}\cdot\dfrac{K}{m}}$

(c) $\sqrt{\dfrac{2\pm\sqrt{3}}{2}\cdot\dfrac{K}{m}}$ (d) $\sqrt{\dfrac{2\pm\sqrt{2}}{2}\cdot\dfrac{K}{m}}$

19. Consider a canonical transformation $(q,\ p) \to (Q,\ P)$ such that $Q = \log(1 + q^{1/2}\cos p)$

$$P = 2(1 + q^{1/2}\cos p)q^{1/2}\sin p$$

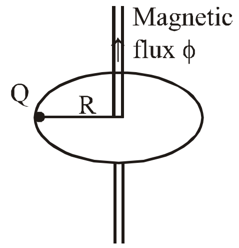
generating function is

(a) $(e^Q - 1)^2 \tan p$ (b) $-(e^Q - 1)^2 \tan p$ (c) $(e^Q - 1)\tan p$ (d) $-(e^Q - 1)\tan p$

20. Inertia tensor of a system is $\begin{pmatrix} \frac{5}{6} & -\frac{1}{4} & -\frac{1}{12} \\ -\frac{1}{4} & \frac{1}{2} & -\frac{1}{4} \\ -\frac{1}{12} & -\frac{1}{4} & \frac{5}{6} \end{pmatrix}$. Principal moment of inertia of system are

(a) $1, \dfrac{11}{12}, \dfrac{1}{4}$ (b) $1, \dfrac{7}{6}, \dfrac{3}{4}$ (c) 1, 2, 3 (d) $1, \dfrac{3}{4}, \dfrac{1}{4}$

21. A freely rotating disc is pierced through an infinite superconducting solenoid containing a magnetic flux ϕ. A charge Q is fixed to disc at a distance R from the centre of the solenoid. If the solenoid is heated and it loses it magnetic flux in time T, then the impulse acting on the charge is:



(a) $\frac{q\phi}{T}$ (b) $\frac{q\phi}{2\pi}$ (c) $q\phi$ (d) $\frac{q\phi}{2\pi R}$

22. The electric field components of a plane electromagnetic wave are

$$\vec{E}_1 = E_0 \sin\left(kz - \omega t - \frac{\pi}{6}\right)\hat{j}$$

$$\vec{E}_2 = -E_0 \cos\left(kz - \omega t + \frac{5\pi}{6}\right)\hat{i}$$

The state of polarization of wave is:

(a) Linearly poalrized (b) Elliptically polarized
(c) Left circularly polarized (d) Right circularly polarized.

23. A scientist designed an experiment to study the electromagnetic responce of silver at microwave frequency $\left(\sim 10^{10}\ \text{Hz}\right)$. Given that the resistivity of silver is $4\times10^{-7}\,\Omega - \text{m}$. The skin depth of the silver is (in μm) :

(a) 3.2 (b) 10 (c) 1.6 (d) 6.4

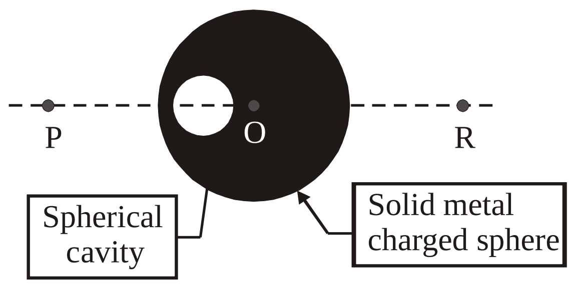
24. Assume that a lamp radiates power P uniformly in all the directions. The electric field strength at a distance 'r' from the lamp varies as :

(a) independent of 'r' (b) $\frac{1}{r}$ (c) $\frac{1}{r^2}$ (d) $\frac{1}{r^3}$

25. Two polarizing sheets have their polarizing directions parallel so that the intensity of the transmitted light is maximum. Through what angle must either be turned so that the transmitted light intensity drops by 75%?

(a) 30º (b) 45º (c) 60º (d) 90º

26. A solid metal sphere with a spherical cavity as shown below has a total charge +Q



O is the center of the sphere, and P and R are two points equidistant from it. If E_p and E_R represent the magnitude of the electric field at P and R respectively, which of the following statements is correct?

(a) $E_P = E_R$ (b) $E_P = 0$ and $E_R = 0$ (c) $E_P > E_R$ (d) $E_P < E_R$

27. A charge q is placed in front of an infinite metal plate at a distance d. If instead a charge 2q were to experience the same force, at what distance should it be placed from the plate?
(a) d (b) 2d (c) d/2 (d) 4d

28. The scalar and vector potentials are described as

$$\phi(\vec{r}, t) = 3xyz - 4t$$

$$\vec{A}(\vec{r}, t) = (2x - \omega t)\hat{i} + (y - 2z)\hat{j} + (z - 2e^{\omega t})\hat{k}$$

where 'ω' is a constant. The magnetic field associated with these potentials is:
(a) 0 (b) $2\hat{i}$ (c) $-3yz\hat{i}$ (d) $\hat{k}$

29. A beam of unpolarized light is incident on a glass plate at an angle of 60º from normal, the reflected light is completely plane polarized. If angle of incidence is 45º, the angle of refraction is:
(a) $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (b) $\cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (c) $\sin^{-1}\left(\frac{1}{\sqrt{6}}\right)$ (d) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

30. An electromagnetic wave is normally incident on an air-dielectric interface. The dielectric media is isotropic and non magnetic. The magnetic field of electromagentic wave in dielectric medium is given by

$$\vec{B} = 4\times10^{-8}\left(A\hat{i} + 3\hat{j}\right)e^{i\left(3x+4y-5\times10^{8}t\right)}\ \text{wb/m}^2$$

Where A is same constant. The fraction of energy reflected from the dielectric interface is:
(a) 1 (b) 0.25 (c) 0.33 (d) 0.5

31. The charge density inside a sphere of radius R is $\rho = k(R-r)$. The electric field on the surface of sphere is :
(a) $\frac{kR^2}{12\in_0}$ (b) $\frac{kR^2}{3\in_0}$ (c) $\frac{kR^2}{4\in_0}$ (d) $\frac{kR^2}{\in_0}$

32. A thin conducting rod of length ℓ is rotated with uniform angular velocity ω about a perpendicular axis through one end. There exists a uniform magnetic field $\vec{B}$ in space parallel to $\vec{\omega}$. The potential difference between two ends of rod is :
(a) 0 (b) $\omega B\ell$ (c) $\frac{\omega B\ell^2}{2}$ (d) $\omega B\ell^2$

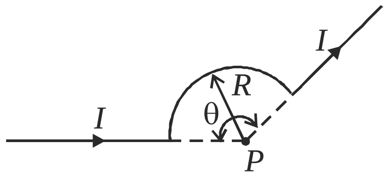
33. A large sheet having surface charge density σ is lying in *x*-*y* plane. It is moved with speed v in *y*-direction. Poynting vector above the sheet is
(a) $\frac{\sigma^2 v}{4\varepsilon_0}\hat{x}$ (b) $\frac{\sigma^2 v}{4\varepsilon_0}\hat{y}$ (c) $\frac{\sigma^2 v}{4\varepsilon_0}\hat{z}$ (d) $\frac{\sigma^2 v}{4\sqrt{2}\varepsilon_0}(\hat{x}+\hat{y})$

34. A long solenoide having *n* number of turns per unit length carries a current I. If axis of the solenoide lies along *z*-axis. The magnetic vector potential inside the solenoide can be expressed as
(a) $\frac{\mu_0 nI(-x\hat{j}+y\hat{i})}{2(x^2+y^2)}$ (b) $\frac{\mu_0 nI}{2}(-x\hat{j}+y\hat{i})$ (c) $\mu_0 nI(-x\hat{j}+y\hat{i})$ (d) $\mu_0 nI\left(\frac{-x\hat{j}+y\hat{i}}{x^2+y^2}\right)$

35. An electric dipole of dipole moment p is placed at d distance from a grounded infinite conducting sheet, with $\vec{p}$ being perpendicular to the sheet. The force on the dipole is

(a) $\frac{3p^2}{16\pi \epsilon_0 d^4}$ (b) $\frac{3p^2}{32\pi \epsilon_0 d^4}$ (c) $\frac{3p^2}{64\pi \epsilon_0 d^4}$ (d) $\frac{p^2}{64\pi \epsilon_0 d^4}$

36. A segment of wire is bent into an arc of radius *R* and subtended angle θ, as shown in the figure below. Point *P* is at the centre of the circular segment. The wire carries current *I*. What is the magnitude of the magnetic field at *P*?

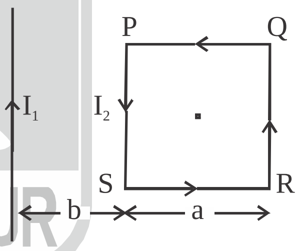


(a) 0 (b) $\frac{\mu_0 I\theta}{(2\pi)^2 R}$ (c) $\frac{\mu_0 I\theta}{4\pi R}$ (d) $\frac{\mu_0 I\theta}{4\pi R^2}$

37. The magnetic field in a region through which electromagnetic waves are propagating is given to be $\vec{B} = B_0 \cos kz \sin \omega t\ \hat{j}$. The average value of poynting vector is

(a) $\frac{B_0^2\omega}{2\mu_0 k}\hat{z}$ (b) $\frac{B_0^2\omega}{4\mu_0 k}\hat{z}$ (c) $\frac{B_0^2\omega}{8\mu_0 k}\hat{z}$ (d) zero

38. A current carrying square loop PQRS is placed near a current carrying long wire as shown in the figure. Which one of the following statements is NOT correct.



(a) Magnetic force on the loop is $\frac{\mu_0 I_1 I_2 a^2}{2\pi b(b+a)}$

(b) Magnetic force on side PQ is $\frac{\mu_0 I_1 I_2}{2\pi}\ln\left(\frac{a}{b}\right)$

(c) Magnetic flux through the loop due to I_1 is $\frac{\mu_0 I_1 a}{2\pi}\ln\left(1+\frac{a}{b}\right)$

(d) If a = b and $\frac{I_1}{I_2} = 6\sqrt{2}$ then net magnetic field at centre of loop is zero.

39. In an air filled square wave guide with a = 2 cm. Electric field $E_x = -10\sin(100\pi y)\sin(\omega t - 150z)\ \nu/m$. The mode of propagation of wave is:

(a) TE_{01} (b) TE_{10} (c) TM_{11} (d) TE_{02}

40. The vector $\vec{A} = \frac{1}{2}\alpha t\left(x\hat{j} - y\hat{i}\right)$, $\phi = \frac{1}{4}\alpha\left(x^2 + y^2\right)$, where '$\alpha$' is a constant and 't' is time. The electric field $(\vec{E})$ and magnetic fields $(\vec{B})$ corresponding to these potentials are, respectively

(a) $\frac{1}{4}\alpha\left[(x+y)\hat{i} + (x-y)\hat{j}\right], \frac{1}{2}\alpha t\,\hat{k}$ (b) $-\frac{1}{2}\alpha\left[(x-y)\hat{i} + (x+y)\hat{j}\right], \alpha t\,\hat{k}$

(c) $-\frac{1}{2}\alpha\left[x\hat{i} + y\hat{j}\right], \alpha t\,\hat{k}$ (d) $-\frac{1}{4}\alpha\left[(x+y)\hat{i} + (x-y)\hat{j}\right], \alpha t\,\hat{k}$

41. If the nuclear radius of certain nuclei is about 5×10^{-13} cm and the rest mass of a proton is about 940 MeV/c^2, then kinetic energy of the nucleon is given by (Given: $\hbar c = 197$ MeV-fm)
(a) 0.65 MeV (b) 0.72 MeV (c) 0.83 MeV (d) 0.90 MeV

42. $^{27}_{14}\text{Si}$ and $^{27}_{13}\text{Al}$ are mirror nuclei. The former is a positron emitter with $E_{max.}$ = 3.48 MeV. The value of radius constant (r_0) can be estimated as
(a) 1.20 fm (b) 1.50 fm (c) 1.30 fm (d) 1.66 fm

43. ^{14}O is a positron emitter decaying to an excited state of ^{14}N. The ^{14}N γ-rays have an energy of 2.313 MeV and the maximum energy of the positron is 1.835 MeV. The mass of ^{14}N is 14.003074 amu and that of electron is 0.000548 amu. The mass of ^{14}O is
(a) 13.980075 amu (b) 14.008623 amu (c) 13.752750 amu (d) 14.30275 amu

44. The expected value of shell-model quadrupole moment of ^{209}Bi, if the ground state spin-parity of ^{209}Bi is $\frac{9^-}{2}$.
(a) – 0.33 barn (b) – 0.22 barn (c) – 0.44 barn (d) – 0.11 barn

45. If the total binding energies of O^{15}, O^{16} and O^{17} are 111.9556 MeV, 127.6193 MeV and 131.7627 MeV respectively, find the gap between the $^1p_{1/2}$ and $^1d_{5/2}$ neutron shells for nuclei with mass number $A \approx 16$.
(a) 8.52 MeV (b) 11.52 MeV (c) 15.5 MeV (d) 20.0 MeV

46. The empirical mass formula (neglecting a term representing the odd-even effect) is

$$M(A,Z) = Z(m_p + m_e) + (A - Z)\,m_n - \alpha A + \beta A^{2/3} + \gamma \frac{(A-2Z)^2}{A} + \varepsilon \frac{Z^2}{A^{1/3}}$$

where α, β, γ and ε are constants. The expression for the value of Z which corresponds to the most stable nucleus for a set of isobars of mass number A is

(a) $Z_{\min} = \dfrac{0.5\,A}{\left[1 + 0.015\left(\dfrac{\varepsilon}{\gamma}\right)A^{2/3}\right]}$ (b) $Z_{\min} = \dfrac{0.5\,A}{\left[1 + 0.15\left(\dfrac{\varepsilon}{\gamma}\right)A^{2/3}\right]}$

(c) $Z_{\min} = \dfrac{0.5\,A}{\left[1 + 0.25\left(\dfrac{\varepsilon}{\gamma}\right)A^{2/3}\right]}$ (d) $Z_{\min} = 0.5\,A$

47. From the shell model prediction find the ground state spin and parity of the following nuclides:
$^{3}_{2}\text{He}$; $^{20}_{10}\text{Ne}$; $^{27}_{13}\text{Al}$; $^{41}_{21}\text{Si}$;

(a) $\frac{1^+}{2}; 0^+; \frac{5^+}{2}; \frac{7^-}{2}$ (b) $\frac{3^+}{2}; 0^+; \frac{3^-}{2}; \frac{5^+}{2}$ (c) $\frac{3^-}{2}; 0^+; \frac{5^-}{2}; \frac{7^-}{2}$ (d) $\frac{1^+}{2}; 0^+; \frac{7^-}{2}, \frac{5^+}{2}$

48. Consider the decay of K° meson of momentum p_0 into π^+ and π^- of momenta p_+ and p_- in the opposite direction such that $p_+ = 2p_-$. The value of p_0 is given by

(a) $\frac{m_K}{2}\left[\frac{m_K^2 - m_\pi^2}{m_K^2 + m_\pi^2}\right]$ (b) $\frac{m_K}{2}\left[\frac{m_K^2 - 4m_\pi^2}{2m_K^2 + m_\pi^2}\right]^{1/2}$ (c) $\frac{m_K}{2}\left[\frac{m_K^2 - 2m_\pi^2}{2m_K^2 + m_\pi^2}\right]$ (d) $\frac{m_K}{2}\left[\frac{m_K^2 + m_\pi^2}{m_K^2 - m_\pi^2}\right]$

49. If the binding energies of the mirror nuclei $_{21}Sc^{41}$ and $_{20}Ca^{41}$ are 343.143 MeV and 350.420 MeV, respectivley. The radii of the two nuclei by using the semi-empirical mass formula is $\left(\frac{e^2}{4\pi\varepsilon_0}=1.44\text{ MeV-fm}\right)$

(a) 3.7 fm (b) 2.5 fm (c) 7.0 fm (d) 4.7 fm

50. Consider the alpha particle decay $_{90}Th^{230} \rightarrow {}_{88}Ra^{226} + \alpha$ and use the following expression to calculate the values of the binding energy B for two heavy nuclei involved in this process.

$$B = a_v A - a_s A^{2/3} - a_c\left(\frac{Z(Z-1)}{A^{1/3}}\right) - a_a\left(\frac{(N-Z)^2}{A}\right) - a_p A^{-3/4}$$

where values for the constants a_v, a_s, a_c, a_a and a_s are respectively 15.5, 16.8, 0.72, 23.0 and -34.5 MeV. If the total binding energy of the alpha particle is 28.3 MeV, the energy released in the decay is given by

a) 22.0 MeV (b) 16.0 MeV (c) 25.5 MeV (d) 30.0 MeV

51. The masses (amu) of the mirror nuclei $_{13}Al^{27}$ and $_{14}Si^{27}$ are 26.981539 and 26.986704 respectively. The Coulomb's coefficient (a_c) in the semi-empirical mass formula can be given as

(a) 0.6 MeV (b) 0.7 MeV (c) 0.5 MeV (d) 0.8 MeV

52. The maximum kinetic energy of the electron emitted in the beta decay of the free neutron (the neutron proton mass difference is 1.3 MeV) is

(a) 0.51 MeV (b) 1.3 MeV (c) 0.79 MeV (d) 1.81 MeV

53. If a pion decays from rest to give a muon of 4 MeV energy. What is the kinetic energy of the accompanying neutrino ? (Given : mass of pion = 273 m_e, mass of muon = 207 m_e)

(a) 33.7 MeV (b) 4 MeV (c) 0.51 MeV (d) 29.7 MeV

54. Which one of the following reaction is forbidden ?

(a) $\pi^+ \rightarrow \pi^0 + e^+ + \nu_e$ (b) $p + p \rightarrow p + p + \pi^+$

(c) $\Sigma^- \rightarrow \Lambda^0 + e^- + \bar{\nu}_e$ (d) $\pi^+ \rightarrow \mu^+ + \nu_\mu$

55. The radius of Ge is measured to be twice the radius of $_4Be^9$. The number of nucleons in Ge is

(a) 75 (b) 71 (c) 72 (d) 73

56. If nuclear mass of $_{32}Ge^{73}$, mass of proton (m_p) and mass of neutron (m_n) is 72.90591 a.m.u., 1.007275 a.m.u, 1.008665 a.m.u., respectively. The binding and Coulomb energy of the nuclei $_{32}Ge^{73}$ are given by (Given : $\frac{e^2}{4\pi \in_0} = 1.44\text{ MeV-fm}$ and 1 a.m.u = 931 MeV)

(a) 630 MeV, 165 MeV (b) 635 MeV, 170 MeV

(c) 640 MeV, 160 MeV (d) 635 MeV, 165 MeV

57. Consider the decay process $\pi^+ \rightarrow \mu^+ + \nu_\mu$ in the rest frame of π^+. If the rest masses of π^+, μ^+ and ν_μ are m_π, m_μ and zero respectively, the energy of neutrino is given by

(a) $\frac{\left(m_\pi^2 - m_\mu^2\right)c^2}{2m_\nu}$ (b) $\frac{\left(m_\pi^2 - m_\mu^2\right)c^2}{2m_\mu}$ (c) $\frac{\left(m_\pi^2 - m_\mu^2\right)c^2}{2m_\pi}$ (d) $\frac{\left(m_\pi^2 + m_\mu^2\right)c^2}{2m_\mu}$

58. Indicate, whether the following interactions proceed through the strong, electromagnetic (EM) or weak interactions or whether they do not occur

(1) $\pi^- \to \mu^- + \bar{v}_e$ (2) $\bar{\tau} \to \mu^- + \bar{v}_\tau$ (3) $\Sigma^0 \to \Lambda + \gamma$ (4) $p \to n + e^+ + v_e$

The correct order of interactions is

(a) (1) strong, (2) weak, (3) does not occur, (4) weak

(b) (1) weak, (2) does not occur, (3) EM, (4) weak

(c) (1) strong, (2) weak, (3) does not occur, (4) weak

(d) (1) strong, (2) does not occur, (3) weak, (4) EM

59. Consider the decay process

$$K^+ \to \pi^+ \pi^0$$

with the K^+ at rest. The total energy of the π^0 meson is

(The rest mass energy is 494 MeV for K^+, 140 MeV for π^+, 135 MeV for π^0)

(a) 250.6 MeV (b) 245.6 MeV (c) 345.6 MeV (d) 350.6 MeV

60. One of the decay modes of K^+ mesons is $K^+ \to \pi^+ + \pi^+ + \pi^-$. The maximum kinetic energy that any of the pions can have , if the K^+ decays at rest, (Given : $m_K = 966.7\, m_e$ and $m_\pi = 273.2\, m_e$)

(a) 100 MeV (b) 50 MeV (c) 25 MeV (d) 75 MeV

Space for rough work

PHYSICAL SCIENCES
TEST SERIES-I

Date : 21-05-2016

ANSWER KEY

1. (c)	2. (b)	3. (b)	4. (d)	5. (a)	6. (c)	7. (a)
8. (a)	9. (c)	10. (a)	11. (c)	12. (a)	13. (b)	14. (d)
15. (d)	16. (d)	17. (c)	18. (b)	19. (b)	20. (a)	21. (d)
22. (d)	23. (a)	24. (b)	25. (c)	26. (a)	27. (b)	28. (b)
29. (c)	30. (b)	31. (a)	32. (c)	33. (a)	34. (b)	35. (a)
36. (c)	37. (d)	38. (b)	39. (d)	40. (b)	41. (c)	42. (d)
43. (b)	44. (b)	45. (b)	46. (c)	47. (a)	48. (b)	49. (d)
50. (c)	51. (b)	52. (c)	53. (d)	54. (b)	55. (c)	56. (b)
57. (c)	58. (b)	59. (b)	60. (b)			