FIITJEE PET – VI (CHAMPIONS_2ND YEAR)
MAINS
DATE: 21.07.2018

Time: 3 hours **Maximum Marks: 360**
INSTRUCTIONS:

Instructions to the Candidates

1. This Test Booklet consists of **90 questions**.

   Use **Blue/Black ball Point Pen only** for writing particulars and bubbling of OMR.

2. For each correct answer **4 Marks** will awarded and for each wrong answer **1 Mark** will be deducted.

3. Attempt all questions.

4. In case you have not darkened any bubble you will be awarded 0 mark for that question.

5. Use of calculator/logarithmic table is not permitted.

Don't write / mark your answers in this question booklet.
If you mark the answers in question booklet, you will not be allowed to continue the exam.

NAME: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

ENROLLMENT NO.: ☐☐☐☐☐☐☐☐☐☐☐☐

1. The equation of the ellipse whose vertices are (2, –2), (2, 4) and eccentricity $\frac{1}{3}$ is

(A) $\frac{(x-1)^2}{25}+\frac{(y-1)^2}{16}=1$ (B) $\frac{(x-3)^2}{4}+\frac{(y-4)^2}{3}=1$

(C) $\frac{(x-1)^2}{25}+\frac{(y-1)^2}{16}=1$ (D) $\frac{(x-2)^2}{8}+\frac{(y-1)^2}{9}=1$

2. The equation of the ellipse with its focus at (6, 2), centre at (1, 2) and which passes through the point (4, 6) is

(A) $\frac{(x-1)^2}{25}+\frac{(y-2)^2}{16}=1$ (B) $\frac{(x-1)^2}{25}+\frac{(y-2)^2}{20}=1$

(C) $\frac{(x-1)^2}{45}+\frac{(y-2)^2}{16}=1$ (D) $\frac{(x-1)^2}{45}+\frac{(y-2)^2}{20}=1$

3. The ellipse $x^2 + 4y^2 = 4$ is inscribed in a rectangle aligned with the coordinate axes, which in turn is inscribed in another ellipse that passes through the point (4, 0). Then the equation of the ellipse is

(A) $x^2 + 12y^2 = 16$ (B) $4x^2 + 48y^2 = 48$ (C) $4x^2 + 64y^2 = 48$ (D) $x^2 + 16y^2 = 16$

4. The centre of the ellipse $\frac{(x+y-2)^2}{9}+\frac{(x-y)^2}{16}=1$ is

(A) (0, 0) (B) (1, 1) (C) (1, 0) (D) (0, 1)

5. The foci of the ellipse $9x^2 + 25y^2 – 36x + 50y – 164 = 0$ are

(A) (6, 1), (2, –1) (B) (6, –1), (–2, –1) (C) (–6, –1), (–2, –1) (D) (6, 1), (2, 1)

6. S and T are the foci of an ellipse and B is an end of the minor axis. If STB is an equilateral triangle then the eccentricity of the ellipse is

(A) $\frac{1}{4}$ (B) $\frac{1}{3}$ (C) $\frac{1}{2}$ (D) $\frac{2}{3}$

7. A circle is described with minor axis of an ellipse as a diameter. If the foci lie on the circle, the eccentricity of the ellipse is

(A) $\frac{1}{2}$ (B) $\frac{1}{\sqrt{2}}$ (C) $\frac{1}{3}$ (D) $\frac{1}{\sqrt{3}}$

Space for rough work

8. An ellipse passing through $\left(4\sqrt{2},2\sqrt{6}\right)$ has foci at (–4, 0) and (4, 0). Its eccentricity is

(A) $\frac{1}{2}$ (B) $\frac{1}{\sqrt{2}}$ (C) $\frac{1}{\sqrt{3}}$ (D) $\sqrt{2}$

9. The sides of the rectangle of greatest area that can be inscribed in the ellipse $x^2 + 4y^2 = 64$ are

(A) $\left(6\sqrt{2},4\sqrt{2}\right)$ (B) $\left(8\sqrt{2},4\sqrt{2}\right)$ (C) $\left(8\sqrt{2},8\sqrt{2}\right)$ (D) $\left(16\sqrt{2},4\sqrt{2}\right)$

10. Tangents are drawn through the point $\left(4,\sqrt{3}\right)$ to the ellipse $\frac{x^2}{16}+\frac{y^2}{9}=1$. The points in which these tangents touch the ellipse are

(A) $\left(2,\frac{3\sqrt{3}}{2}\right),(4,0)$ (B) $\left(2,\frac{\sqrt{3}}{\sqrt{2}}\right),\left(4,\frac{\sqrt{3}}{2}\right)$ (C) $\left(4,\frac{3\sqrt{3}}{\sqrt{3}}\right),(2,0)$ (D) (2, 0), (4, 0)

11. The tangent at any point on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ meets the tangents at A and A′ in L and M respectively. Then AL . A′M =

(A) a^2 (B) b^2 (C) ab (D) a^2b^2

12. C is the centre of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ and L is an end of a latus rectum. If the normal at L meets the major axis in G, then CG =

(A) ae (B) ae^2 (C) ae^3 (D) ae^4

13. If the tangent at α on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ meets the auxiliary circle at two points, which subtend a right angle at the centre, then e =

(A) $\sqrt{1+\sin^2\alpha}$ (B) $\sqrt{1+\cos^2\alpha}$ (C) $\frac{1}{\sqrt{1+\sin^2\alpha}}$ (D) $\frac{1}{\sqrt{1+\cos^2\alpha}}$

14. If the line $\ell x + my = 1$ is a normal to the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, then $\frac{a^2}{\ell^2}-\frac{b^2}{m^2}=$

(A) $a^2 - b^2$ (B) $a^2 + b^2$ (C) $(a^2 + b^2)^2$ (D) $(a^2 - b^2)^2$

Space for rough work

15. Equation of the ellipse whose axes are the axes of coordinates and which passes through the point (–3, 1) and has eccentricity $\sqrt{\frac{2}{5}}$ is

(A) $3x^2 + 5y^2 - 15 = 0$ (B) $5x^2 + 3y^2 - 32 = 0$ (C) $3x^2 + 5y^2 - 32 = 0$ (D) $5x^2 + 3y^2 - 48 = 0$

16. The length of the latus rectum of the ellipse $9x^2 + 25y^2 - 18x - 100y - 116 = 0$ is

(A) $\frac{8}{3}$ (B) $\frac{18}{5}$ (C) $\frac{9}{2}$ (D) $\frac{8}{5}$

17. The eccentricity of the ellipse $9x^2 + 5y^2 - 30y = 0$ is

(A) $\frac{1}{3}$ (B) $\frac{2}{3}$ (C) $\frac{3}{4}$ (D) $\frac{1}{2}$

18. The major axis of an ellipse is three times the minor axis, then the eccentricity is

(A) $\frac{2\sqrt{2}}{3}$ (B) $\frac{2}{3}$ (C) $\frac{\sqrt{2}}{3}$ (D) $\frac{1}{3}$

19. The latusrectum LL′ subtends a right angle at the centre of the ellipse, then its eccentricity is

(A) $\frac{\sqrt{3}+1}{2}$ (B) $\frac{\sqrt{2}+1}{3}$ (C) $\frac{\sqrt{5}-1}{2}$ (D) $\frac{\sqrt{3}-\sqrt{2}}{2}$

20. The eccentricity of the ellipse which meets the straight line $\frac{x}{7}+\frac{y}{2} = 1$ on the axis of x the straight line $\frac{x}{3}-\frac{y}{5} = 1$ on the axis of y and whose axes lie along the axes of coordinates, is

(A) $\frac{3\sqrt{2}}{7}$ (B) $\frac{2\sqrt{6}}{7}$ (C) $\frac{\sqrt{3}}{7}$ (D) none of these

21. The equation of the hyperbola with its transverse axis is parallel to y-axis, and its centre is (4, –3), the lengths of the axes are 6, 4 is

(A) $\frac{(y+3)^2}{6}-\frac{(x+2)^2}{3}=1$ (B) $\frac{(y-3)^2}{36}+\frac{(x-2)^2}{13}=1$

(C) $\frac{(y+3)^2}{9}-\frac{(x-4)^2}{4}=1$ (D) $\frac{(y+3)^2}{36}-\frac{(x-2)^2}{13}=1$

Space for rough work

22. The equation of the hyperbola whose transverse axis is 14 and whose vertex bisects the distance between centre and the focus is

(A) $\frac{x^2}{14}-\frac{y^2}{49}=1$ (B) $\frac{x^2}{147}-\frac{y^2}{14}=1$ (C) $\frac{x^2}{49}-\frac{y^2}{147}=1$ (D) $\frac{x^2}{147}-\frac{y^2}{49}=1$

23. The foci of the hyperbola $9x^2 - 16y^2 + 18x + 32y - 151 = 0$ are

(A) (2, 1), (–6, 1) (B) (–2, 5), (–2, –3) (C) (4, 1), (–6, 1) (D) (–2, 4), (–2, –2)

24. If e and e′ are the eccentricities of the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ and its conjugate hyperbola, the value of $\frac{1}{e^2}+\frac{1}{e'^2}$ is

(A) 3 (B) 2 (C) 1 (D) 0

25. If e and e_1 are the eccentricities of the hyperbola $xy = c^2$, $x^2 - y^2 = c^2$, then $e^2 + e_1^2 =$

(A) 1 (B) 4 (C) 6 (D) 8

26. If the latus rectum of a hyperbola through one focus subtends 60° at the other focus, then its eccentricity e =

(A) $\sqrt{2}$ (B) $\sqrt{3}$ (C) $\sqrt{5}$ (D) $\sqrt{6}$

27. The equations of directrices of the hyperbola $5x^2 - 4y^2 - 30x - 8y - 39 = 0$ are

(A) $x = \pm\frac{9}{5}$ (B) $x = 3\pm\frac{8}{3}$ (C) $x = 2\pm\frac{8}{5}$ (D) $x = 3\pm\frac{16}{5}$

28. The foci of the ellipse $\frac{x^2}{16}+\frac{y^2}{b^2}=1$ and the hyperbola $\frac{x^2}{144}-\frac{y^2}{81}=\frac{1}{25}$ coincide. Then the value of b^2 is

(A) 5 (B) 7 (C) 9 (D) 1

29. The tangent at a point P on $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ cuts one of its directrices in Q. Then PQ subtends at the corresponding focus an angle of

(A) $\frac{\pi}{3}$ (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{4}$ (D) $\frac{\pi}{2}$

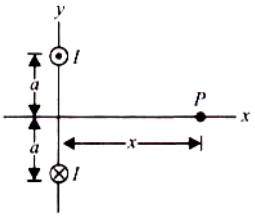
Space for rough work

30. The locus of the point of intersection of two tangents to the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ which make an angle 90° with one another is

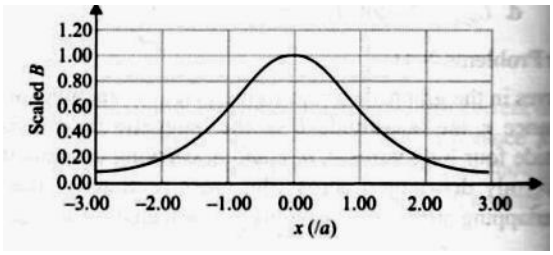
(A) $x^2 + y^2 = a^2 + b^2$ (B) $x^2 + y^2 = a^2 - b^2$ (C) $x^2 - y^2 = a^2 - b^2$ (D) $x^2 - y^2 = a^2 + b^2$

For question (31 – 32)

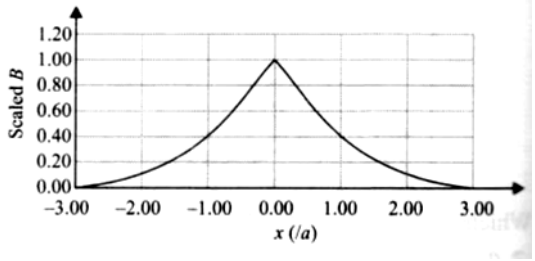
Figure shows an end view of two long, parallel wires perpendicular to the xy plane, each carrying a current I, but in opposite direction.



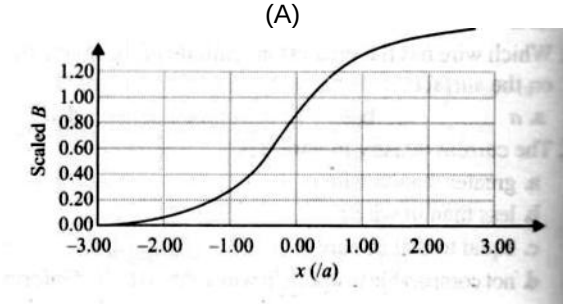
31. Figure shows an end view of two long, parallel wires perpendicular to the xy plane, each carrying a current I, but in opposite direction. Correct graph for $|\vec{B}|$ vs x is



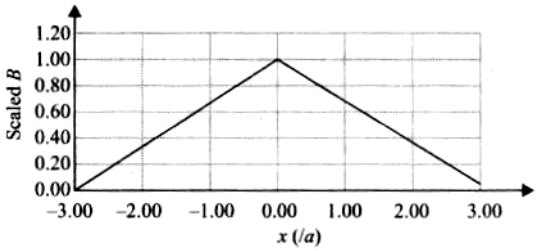
(A)



(B)



(C)



(D)

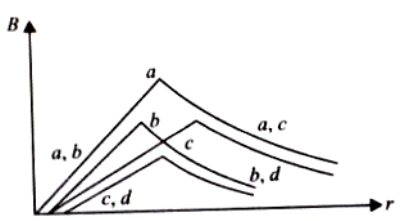
32. At what value of x is the magnitude of $\vec{B}$ a maximum ?

(A) x=0 (B) $x = \sqrt{2}a$ (C) $x = 1/\sqrt{2}a$ (D) x= a / 2

Space for rough work

For question (33 –35)

Curves in the graph shown in figure give, as functions of radius distance r, the magnitude B of the magnetic field inside and outside four long wires a,b,c and d, carrying currents that are uniformly distributed across the cross sections of the wires. Overlapping portions of the plots are indicated by double labels.

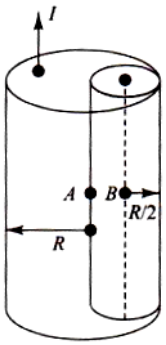


33. Which wire has the greatest radius ?
(A) a (B) b (C) c (D) d

34. Which wire has the greatest magnitude of the magnetic field on the surface?
(A) a (B) b (C) c (D) d

35. The current density in wire a is
(A) greater than in wire c
(B) less than in wire c
(C) equal to that in wire c
(D) not comparable to the that of in wire c due to lack of information

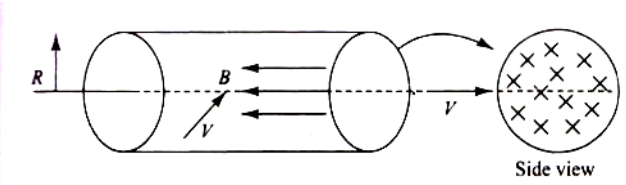
36. From a cylinder of radius R, a cylinder of radius R/2 is removed, as shown in figure. Current flowing in the remaining cylinder is I. Then, magnetic field strength is



(A) zero at point A
(B) zero at point B
(C) $\frac{\mu_0 I}{3\pi R}$ at point A
(D) None of these

Space for rough work

37. In a cylindrical region, uniform magnetic field is present as shown in figure. The cylinder is kept on a horizontal plane and its axis is horizontal. A charge particle of mass m and charge q is projected horizontally with velocity v through a hole normal to the axis of the cylinder as shown in the diagram. An observer states the particle moves first undeviated and subsequently.



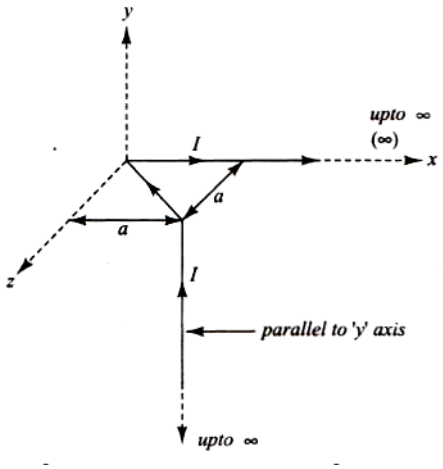
(A) Oscillates inside the cylinder along a horizontal diameter passing through axis of the cylinder with time period $\frac{4RqB}{mg}$

(B) Oscillates inside the cylinder along a horizontal diameter passing through axis of the cylinder with time period $\frac{2qRB}{mg}$

(C) Oscillates inside the cylinder along a horizontal diameter passing through axis of the cylinder with time period $\frac{mg}{qBR}$

(D) It is not possible for the particle to oscillate in this given situation

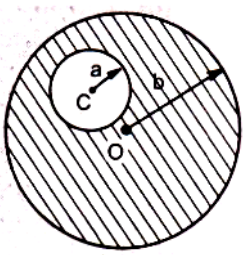
38. The magnetic field at the origin due to the current flowing in the wire is



(A) $-\frac{\mu_0 I}{8\pi a}\left(\hat{i}+\hat{k}\right)$ (B) $\frac{\mu_0 I}{2\pi a}\left(\hat{i}+\hat{k}\right)$ (C) $\frac{\mu_0 I}{8\pi a}\left(-\hat{i}+\hat{k}\right)$ (D) $\frac{\mu_0 I}{4\pi a\sqrt{2}}\left(\hat{i}-\hat{k}\right)$

Space for rough work

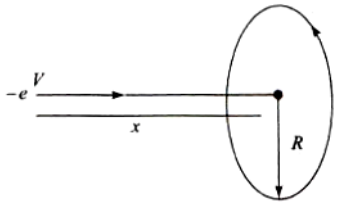
39. A long straight metal rod has a very long hole of radius 'a' drilled 'parallel to' the rod axis as shown in the figure. If the rod carries a current 'i' find the value of magnetic induction on the axis of the hole, where OC =c



(A) $\frac{\mu_0 ic}{\pi\left(b^2-a^2\right)}$ (B) $\frac{\mu_0 ic}{2\pi\left(b^2-a^2\right)}$

(C) $\frac{\mu_0\left(b^2-a^2\right)}{2\pi c}$ (D) $\frac{\mu_0 ic}{2\pi a^2 b^2}$

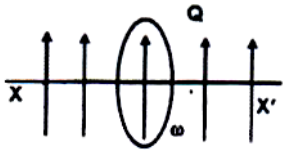
40. An electron moving with velocity v along the x–axis approaches a circular current carrying loop as shown in figure. The magnitude of magnetic force on the electron at this instant is



(A) $\frac{\mu_0}{2}\frac{eviR^2x}{\left(x^2+R^2\right)^{3/2}}$ (B) $\mu_0\frac{eviR^2x}{\left(x^2+R^2\right)^{3/2}}$

(C) $\frac{\mu_0}{4\pi}\frac{eviR^2x}{\left(x^2+R^2\right)^{3/2}}$ (D) 0

41. A disc of mass has a charge Q distributed on its surface. It is rotating about an XX' with angular velocity ω. The force acting on the disc is

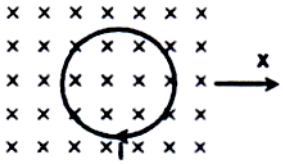


(A) zero (B) $\omega RN/\pi$

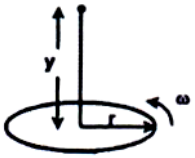
(C) $2Q\omega BR$ (D) None of these

Space for rough work

42. A circular loop of wire is carrying a current I (as shown in the figure). On applying a uniform magnetic field inward perpendicular to the plane of the loop, the loop
(A) move along the positive x–direction
(B) move along the negative x–direction
(C) contract
(D) expand



43. Calculate the magnetic field at distance y from the centre of the axis of a disc of radius r and uniform surface charge density σ, if the disc spins with angular velocity ω?



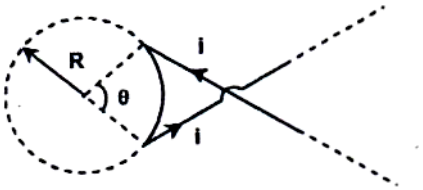
(A) $\frac{\mu_0\sigma\omega}{3}\left(\frac{r^2-2y^2}{\sqrt{r^2-y^2}}+2y\right)$

(B) $\frac{\mu_0\sigma\omega}{2}\left(\frac{r^2+y^2}{\sqrt{r^2+y^2}}\right)$

(C) $\frac{\mu_0\sigma\omega}{2}\left(\frac{r^2+2y^2}{\sqrt{r^2+y^2}}-2y\right)$

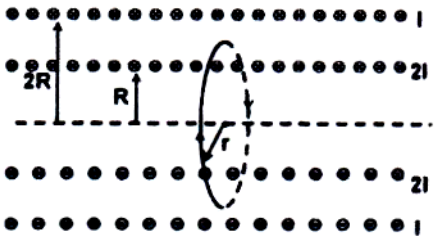
(C) $\frac{2\mu_0\sigma\omega}{3}\left(\frac{r^2+2y^2}{\sqrt{r^2+y^2}}-2y\right)$

44. A current carrying wire has the configuration shown in the figure. Two semi – infinite straight sections, each tangent to the same circle, are connected by a circular arc, of angle θ along the circumference of the circle with all section lying in the same plane. What must be θ in order for B (magnetic field) to be zero at the centre of the circle ?
(A) $\theta = 1$ rad (B) θ=2 rad
(C) $\theta = 3$ rad (D) None of the above



Space for rough work

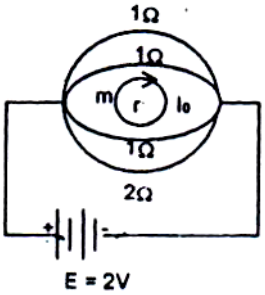
45. A long solenoid of radius 2R contains another coaxial solenoid of radius R. The coils have the same number of turns per unit length and initially both carry zero current. At time, t=0, current start increasing linearly with time in both solenoids. At any moment the current flowing in the inner coil is twice as large as that in the outer one and their directions are same . A charged particle initially at rest between the two solenoids, start moving along a circular trajectory due to increasing current in the solenoid as shown in the figure. What is the radius of the circle ? (Assume magnetic field due to each solenoid remains uniform over its cross section)



(A) $\sqrt{2}R$ (B) $\sqrt{3}R$

(C) $\frac{3}{2}R$ (D) None of these

46. Two circular rings each of radius a are joined together such that their planes are perpendicular to each other as shown in the figure. The resistance of each half part of the ring is indicated. A very small loop of mass m and radius r carrying a current I_0 is placed in the plane of the paper at the common centre of each ring. The loop can freely rotate about any of its diametric axes. If the loop is slightly displaced, find the time period of its oscillations (Given $ma = \frac{2\pi\mu_0 I_0}{\pi^2}$)



(A) 4 sec (B) 8 sec (C) 2 sec (D) None of these

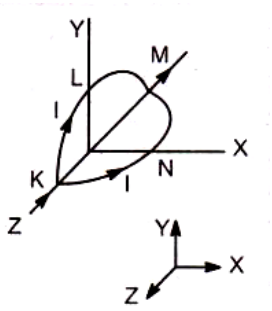
Space for rough work

47. A uniformly conducting wire is bent to form a ring of mass 'm' and radius 'r', and the ring is placed on a rough horizontal surface with its plane horizontal. There exists a uniform and constant horizontal magnetic field of induction B. Now a charge q is passed through the ring in a very small time interval Δt. As a result the ring ultimately just becomes vertical. Calculate the value of g (acceleration due to gravity) in terms of other given quantities. Assume that friction is sufficient to prevent slipping and ignore any loss in energy.

(A) $\frac{\pi}{3}\left(\frac{qB}{m}\right)r$ (B) $\frac{\pi^2}{3}\left(\frac{qB}{m}\right)r^2$ (C) $\frac{\pi}{3}\left(\frac{qB}{m}\right)r^2$ (D) $\frac{\pi^2}{3}\left(\frac{qB}{m}\right)^2 r$

For question (48 – 50)

A circular loop of radius R is bent along a diameter and given a shape as shown in fig (a). One of the semicircles (KNM) lies in the xz– plane and the other one (KLM) in the yz–plane with their centres at the origin. Current I is flowing through each of the semicircles as shown in fig (a)



48. A particle of charge q is released at the origin with a velocity $\vec{v} = \vec{v}_0\hat{i}$. Find the instantaneous force F on the particle. Assume that space is gravity free.

(A) $\frac{\mu_0 qI}{4R}\vec{v}_0\left(-\hat{k}\right)$ (B) $\frac{\mu_0 qI}{R}\vec{v}_0\left(-\hat{k}\right)$

(C) $\frac{\mu_0 qI}{4R}\vec{v}_0\left(\hat{k}\right)$ (D) $\frac{\mu_0 qI}{R}\vec{v}_0\left(\hat{k}\right)$

49. If an external uniform magnetic field $\vec{B}\hat{j}$ is applied, determine the force on the loop.

(A) $2IRB\hat{i}$ (B) $2IRB\hat{j}$ (C) $4IRB\hat{i}$ (D) $4IRB\hat{j}$

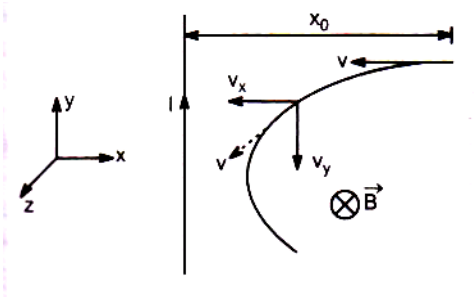
Space for rough work

50. A slightly divergent beam of charged particles accelerated by a P.D. V propagates from a point A along the axis of solenoid. The beam is brought into focus at a distance ℓ from the point A at two successive values of magnetic induction B_1 and B_2. Find the specific charge q/m of the particle

(A) $\frac{q}{m}=\frac{8\pi^2 v}{\ell^2\left(B_2+B_1\right)^2}$ (B) $\frac{q}{m}=\frac{4\pi^2 v}{\ell^2\left(B_2-B_1\right)^2}$

(C) $\frac{q}{m}=\frac{4\pi^2 v}{\ell^2\left(B_2+B_1\right)^2}$ (D) $\frac{q}{m}=\frac{8\pi^2 v}{\ell^2\left(B_2-B_1\right)^2}$

51. A long straight wire carries a current I. A particle having a positive charge q and mass m, kept at a distance x_0 from the wire is projected towards it with speed v. Find the closest distance of approach of charged particle to the wire.



(A) $X_{min}=X_0e^{2^{\pi rmv/\mu_0 ql}}$ (B) $X_{min}=X_0e^{-2^{\pi rmv/\mu_0 ql}}$

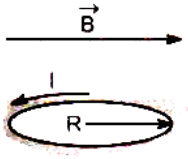
(C) $X_{min}=X_0e^{-2^{\mu_0 ql/\pi rmv}}$ (D) None of these

52. A conducting wire of length 'ℓ' is placed on a rough horizontal surface, where a uniform horizontal magnetic field B perpendicular to the length of the wire exists. Leaves values of the force required to move the rod when a current 'I' is established in the rod are observed to be F_1 and F_2 $(<F_1)$ for the two possible directions of the current through the rod respectively. Find coefficient of friction between the rod and the surface.

(A) $\mu=\frac{F_1+F_2}{2BIL}$ (B) $\mu=\frac{F_1-F_2}{BIL}$

(C) $\mu=\frac{F_1+F_2}{BIL}$ (D) $\mu=\frac{F_1-F_2}{2BIL}$

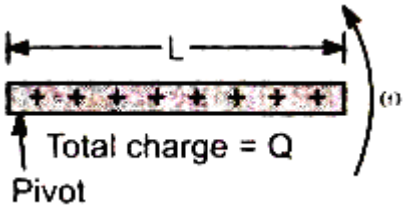
53. A circular wire loop of radius R, mass m and current I lies on a rough surface . There is a horizontal magnetic field $\vec{B}$. How large can the current I be before one edge of the loop will lift of the surface ?



(A) $I=\frac{mg}{\pi RB}$ (B) $I=\frac{2mg}{RB}$ (C) $I=\frac{2mg}{\pi RB}$ (D) $I=\frac{mg}{RB}$

Space for rough work

54. A rod has a total charge Q uniformly distributed along its length L. If the rod rotates with angular velocity ω about its end, compute its magnetic moment.



(A) $\frac{1}{2}Q\omega L^2$ (B) $Q\omega L^2$ (C) $\frac{Q\omega L^2}{6}$ (D) $\frac{Q\omega L^2}{3}$

55. A hollow cylinder has length L and inner and outer radii R_1 and R_2 respectively. The cylinder carries a uniform charge density ρ. Find the expression for the magnetic moment as a function of ω, the angular velocity of rotation of the cylinder about it axis.

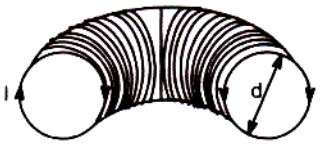
(A) $\mu = \frac{1}{4}\pi\rho L\omega\left(R_2^4 - R_1^4\right)$ (B) $\mu = \frac{1}{4}\pi\rho L\omega\left(R_2^3 - R_1^3\right)$

(C) $\mu = \frac{1}{4}\pi\rho L\omega\left(R_2^2 - R_1^2\right)$ (D) None of these

56. A solid cylinder of radius R and length L carries a uniform charge density $+\rho$ between r=0 and $r = R_s$ and an equal charge density of opposite sing $-\rho$ between $r = R_s$ and r=R. What must be the radius R_s so that on rotation of the cylinder about its axis the magnetic moment is zero ?

(A) $R_s = \sqrt{2}R$ (B) $R_s = 2^{-1/4}R$ (C) $R_s = 2^{-1/8}R$ (D) None

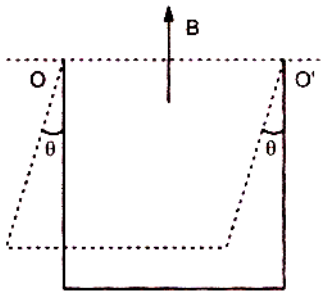
57. Calculate the magnetic moment of a this wire with a current I=0.8A, wound tightly on half a tore fir. The diameter of the cross –section of the tore is equal to d= 5.0 cm, the number of turns is N = 500.



(A) 0.2 $A-m^2$ (B) 0.4 $A-m^2$ (D) 0.8 $A-m^2$ (D) 0.5 $A-m^2$

Space for rough work

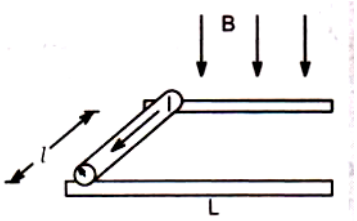
58. A wire of cross sectional area A forms three sides of a square and is free to rotate about axis OO'. If the structure is deflected by an angle θ from the vertical when current I is passed through it in a magnetic field B acting vertically upward and density of the wire is ρ, then the value of θ is given by.



(A) $\frac{2A\rho g}{IB} = \cot\theta$ (B) $\frac{2A\rho g}{IB} = \tan\theta$

(C) $\frac{A\rho g}{IB} = \sin\theta$ (D) $\frac{A\rho g}{IB} = \cos\theta$

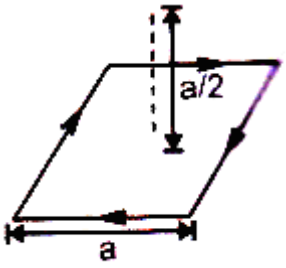
59. A rod of mass m and radius R rests on two parallel rails that are a distance ℓ apart and have a length L. The rod carries a current I (in the direction shown) and rolls along the rails without slipping . A uniform magnetic field B is directed perpendicular to the rod and the rails. If it starts from rest, what is the speed of the rod as it leaves the rails ?



(A) $v = \sqrt{\frac{3BIL\ell}{4m}}$ (B) $v = \sqrt{\frac{4BIL\ell}{3m}}$

(C) $v = \sqrt{\frac{3BIL\ell}{2m}}$ (D) None of these

60. The magnetic field due to a current carrying square loop of side a at a point located symmetrically at a distance of a/2 from its centre as shown in figure is



(A) $\frac{\sqrt{2}\mu_0 i}{\sqrt{3}\pi a}$ (B) $\frac{\mu_0 i}{\sqrt{6}\pi a}$

(C) $\frac{2\mu_0 i}{\sqrt{3}\pi a}$ (D) zero

Space for rough work

61. C–14 activity of an archeological wood sample is found to be 0.4 times that of a recent sample. If $t_{1/2}$ of C–14 is 5700 yrs, the age of the ancient wooden piece is
(A) 7537 yrs (B) 6542 yrs (C) 8654 yrs (D) 9320 yrs

62. The disintegration constant of an unstable nuclide is 3.47×10^{-11} per year. The average life of it in years is
(A) 6.94×10^{11} (B) 1.735×10^{11} (C) 2×10^{-10} (D) 2.88×10^{10}

63. $^{238}_{92}U$ is in group 3 of the periodic table. It emits one α and 3 β particles. The final products belongs to the group
(A) 4 (B) 2 (C) 3 (D) 1

64. Isotope which is not likely to decay by β – emission is
(A) $^{14}_{6}C$ (B) $^{3}_{1}H$ (C) $^{22}_{11}Na$ (D) $^{24}_{11}Na$

65. If the sequence of reaction
$A \xrightarrow{k_1} B \xrightarrow{k_2} C \xrightarrow{k_3} D$, where $k_2 > k_3 > k_1$. The rate of the reaction depends on the concentration of
(A) A (B) B (C) C (D) D

66. A radioactive isotope $A^{\,p}_{z}$ decays to give $B^{\,p-12}_{z-6}$ stable nucleus by emitting the α - particles. If 2P gm of A are taken and kept in a sealed tube, how much He will accumulate in 20 days at 127^0C and 8.2 atmosphere
(A) 134.4 lit. (B) 6 lit (C) 24 lit (D) 12 lit

67. The rate law for a reaction between the substances A and B is given by : Rate = $K[A]^n[B]^m$. On doubling the concentration of A and halving the concentration of B, the ratio of the new rate to the earlier rate of the reaction will be as :
(A) (n – m) (B) 2^{n-m} (C) $2^{1/(m+n)}$ (D) 2^{m-n}

68. Uranium-234 radioactivity decays by alpha-particle emission. The neutron to proton ratio of the product nuclide is
(A) smaller than that for uranium-234 (B) greater than that for uranium-234
(C) the same as that for uranium-234 (D) equal to 1.0

Space for rough work

69. The incorrect product of different disintegration series is :
(A) $^{232}Th \rightarrow ^{208} Pb$ (B) $^{235}U \rightarrow ^{206}Pb$ (C) $^{238}U \rightarrow ^{206} Pb$ (D) $^{237}Np \rightarrow ^{209} Bi$

70. The half-life period of radioactive element is 140 days. After 560 days, one gram of the element will reduced to
(A) $\frac{1}{2}g$ (B) $\frac{1}{4}g$ (C) $\frac{1}{8}g$ (D) $\frac{1}{16}g$

71. $A \xrightarrow{-\alpha} B$ A and B are
(A) isomers (B) isotones (C) isobars (D) isodiaphers

72. In an old rock, the mole ratio of $_{92}U^{238}$ to $_{82}Pb^{206}$ is found to be 595:103. The age of the rock is (mean life of $_{92}U^{238}$ is T_o)
(A) $T_o \ln(1.2)$ (B) $T_o \ln\left(\frac{698}{595}\right)$ (C) $T_o \frac{\ln(1.2)}{\ln 2}$ (D) $\frac{T_o \ln\left(\frac{698}{595}\right)}{\ln 2}$

73. The half-life period of radioactive element is 140 days. After 560 days, one gram of the element will reduced to
(A) $\frac{1}{2}g$ (B) $\frac{1}{4}g$ (C) $\frac{1}{8}g$ (D) $\frac{1}{16}g$

74. Assuming radio active decay only through α, β and γ which of the following atoms could not possibly result from the natural decay of $^{235}_{92}U$ atoms
(A) $^{231}_{89}Ac$ (B) $^{227}_{89}Ac$ (C) $^{225}_{89}Ac$ (D) $^{207}_{82}Pb$

75. Uranium-235 decays via a sequence of seven alpha decays and four beta decays to produce a stable nuclide. Which of the following is the nuclide that is produced?
(A) Tungsten – 207 (B) Lead – 207 (C) Actinium – 235 (D) Uranium – 238

Space for rough work

76. Uranium-234 radioactivity decays by alpha-particle emission. The neutron to proton ratio of the product nuclide is
(A) smaller than that for uranium-234 (B) greater than that for uranium-234
(C) the same as that for uranium-234 (D) equal to 1.0

77. ^{32}P has a half-life of 14.3 days. How many mCi will be left after 3 days in a sample that was originally 200 mCi?
(A) 173 mCi (B) 175 mCi (C) 179 mCi (D) 184 mCi

78. The probability for survival of a radioactive nucleus for one mean life is
(A) $\frac{1}{e}$ (B) $\left(1-\frac{1}{e}\right)$ (C) $\ln\frac{(2)}{e}$ (D) $\left(1-\frac{\ln 2}{e}\right)$

79. Half life of a radioactive substance A is 2 times the half life of another radioactive substance B. Initially the number of nuclei of A and B are N_A and N_B respectively. After three half lives of A, number of nuclei of both become equal, the ratio $\frac{N_A}{N_B}$ is
(A) 1/4 (B) 1/8 (C) 1/3 (D) 1/6

80. The activity of the hair of Egyptian mummy is 1.75 dpm. $t_{1/2}$ of $_6C^{14}$ is 5770 year and disintegration rate of fresh sample of C^{14} is 14 dpm. Find out age of mummy. [log8 = 0.90]
(A) 23080 year (B) 138480 year (C) 11998.3 year (D) 17313.6 year

81. The pH of a 0.005 M H_2SO_4 solution is
(A) 5.0 (B) 2.0 (C) 2.3 (D) 3.3

82. The dissociation constant K_a of a weak monobasic acid is 1×10^{-5}. The pH of a 0.1 M solution of that acid is
(A) 5 (B) 1 (C) 2 (D) 3

83. 100 mL of 0.1 M NaOH is added to 100 mL of a 0.2 M CH_3COOH solution. The pH of the resulting solution will be (K_a for $CH_3COOH = 1.8 \times 10^{-5}$)

Space for rough work

(A) 4.74 (B) 5.74 (C) 3.74 (D) 7.00

84. Which of the following conditions will make the buffer most efficient ?
(A) $pH = pK_a + 1$ (B) $pH = pK_a - 1$ (C) $pH = pK_a$ (D) $pH = pK_a \pm 2$

85. Which of the following combinations will make a basic buffer ?
(A) NH_3 (1 M) and NH_4Cl (1M) (B) HCN (2M) and NaOH (1M)
(C) NaCN (2M) and HCl (1M) (D) All of these

86. At 90°C, pure water has $\left[H_3O^+\right] = 10^{-6}$ mol litre^{-1}. The value of K_w at 90°C is :
(A) 10^{-6} (B) 10^{-12} (C) 10^{-14} (D) 10^{-8}

87. Conjugate acid of OH^- is ?
(A) H_2O (B) O^{-2} (C) H_3O^+ (D) $(OH)_2$

88. Which of the following mixture solutions has pH = 1 ?
(A) $100\ ml\frac{M}{10}HCl + 100ml\frac{M}{10}NaOH$ (B) $55ml\frac{M}{10}HCl + 45ml\frac{M}{10}NaOH$
(C) $10ml\frac{M}{10}HCl + 90ml\frac{M}{10}NaOH$ (D) $75ml\frac{M}{5}HCl + 25ml\frac{M}{5}NaOH$

89. Which among the following is a wrong statement ?
(A) Larger the value of Ka, stronger is an acid (B) K_w increase with temperature
(C) Lower the pK_b, stronger the base
(D) pH of water decreases while pOH increases with increase in temperature

90. Ammonium chloride is added to ammonium hydroxide. Then
(A) concentration of OH^- increases (B) concentration of H^+ decreases
(C) concentration of OH^- decreases (D) concentration of NH_4^+ and OH^- decreases

Space for rough work

FIITJEE PET – VI (CHAMPIONS_2ND YEAR)

MAINS_ANSWERS

DATE: 21.07.2018

MATHEMATICS

1.	**D**	2.	**D**	3.	**A**	4.	**B**
5.	**B**	6.	**C**	7.	**B**	8.	**A**
9.	**B**	10.	**A**	11.	**Bonus**	12.	**C**
13.	**C**	14.	**Bonus**	15.	**C**	16.	**B**
17.	**B**	18.	**A**	19.	**C**	20.	**B**
21.	**C**	22.	**C**	23.	**C**	24.	**C**
25.	**B**	26.	**B**	27.	**B**	28.	**B**
29.	**D**	30.	**B**				

PHYSICS

31.	**A**	32.	**A**	33.	**C**	34.	**A**
35.	**A**	36.	**C**	37.	**D**	38.	**C**
39.	**B**	40.	**D**	41.	**A**	42.	**D**
43.	**C**	44.	**B**	45.	**Bonus**	46.	**A**
47.	**D**	48.	**C**	49.	**C**	50.	**D**
51.	**B**	52.	**D**	53.	**A**	54.	**C**
55.	**A**	56.	**B**	57.	**D**	58.	**A**
59.	**B**	60.	**C**				

CHEMISTRY

61.	**A**	62.	**D**	63.	**C**	64.	**C**
65.	**A**	66.	**Bonus**	67.	**B**	68.	**B**
69.	**B or D**	70.	**D**	71.	**D**	72.	**B**
73.	**D**	74.	**C**	75.	**B**	76.	**B**
77.	**A**	78.	**A**	79.	**B**	80.	**D**
81.	**B**	82.	**D**	83.	**A**	84.	**C**
85.	**A**	86.	**B**	87.	**A**	88.	**D**
89.	**D**	90.	**C**				