FIITJEE PET – IX (1^{ST} YEAR_Champions 20S)
MAINS
DATE: 22.09.2018

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. In a parallelogram ABCD, $\left|\overrightarrow{AB}\right| = a, \left|\overrightarrow{AD}\right| = b$ and $\left|\overrightarrow{AC}\right|$ = c, then $\overrightarrow{DB} \cdot \overrightarrow{AB}$ has the value

(A) $\frac{3a^2 + b^2 - c^2}{2}$ (B) $\frac{a^2 + 3b^2 - c^2}{2}$ (C) $\frac{a^2 - b^2 + 3c^2}{2}$ (D) $\frac{a^2 + 3b^2 + c^2}{2}$

2. If $\vec{p}$ and $\vec{d}$ are two unit vectors and θ is the angle between them, then

(A) $\frac{1}{2}\left|\vec{p} - \vec{d}\right|^2 = \sin\frac{\theta}{2}$ (B) $\vec{p} \times \vec{d} = \sin\theta$

(C) $\frac{1}{2}\left|\vec{p} - \vec{d}\right|^2 = 1 - \cos\theta$ (D) $\frac{1}{2}\left|\vec{p} - \vec{d}\right|^2 = 1 - \cos 2\theta$

3. If the non-zero vectors $\vec{a}$ and $\vec{b}$ are perpendicular to each other, then the solution of the equation $\vec{r} \times \vec{a} = \vec{b}$ is

(A) $\vec{r} = x\vec{a} + \frac{1}{\vec{a}\cdot\vec{a}}\left(\vec{a} \times \vec{b}\right)$ (B) $\vec{r} = x\vec{b} - \frac{1}{\vec{b}\cdot\vec{b}}\left(\vec{a} \times \vec{b}\right)$ (C) $\vec{r} = x\left(\vec{a} \times \vec{b}\right)$ (D) none of these

4. If $\vec{A}, \vec{B}, \vec{C}$ are non-coplanar vectors then $\frac{\vec{A}\cdot\left(\vec{B} \times \vec{C}\right)}{\left(\vec{C} \times \vec{A}\right)\cdot\vec{B}} + \frac{\vec{B}\cdot\left(\vec{A} \times \vec{C}\right)}{\vec{C}\cdot\left(\vec{A} \times \vec{B}\right)}$ is equal to

(A) 3 (B) 0 (C) 1 (D) none of these

5. If $\vec{a}, \vec{b}, \vec{c}$ are three non-coplanar vectors and $\vec{p}, \vec{q}, \vec{r}$ are vectors defined by the relations $\vec{p} = \frac{\vec{b} \times \vec{c}}{\left[\vec{a}\vec{b}\vec{c}\right]}$, $\vec{q} = \frac{\vec{c} \times \vec{a}}{\left[\vec{a}\vec{b}\vec{c}\right]}$, $\vec{r} = \frac{\vec{a} \times \vec{b}}{\left[\vec{a}\vec{b}\vec{c}\right]}$, then the value of expression $\left(\vec{a} + \vec{b}\right)\cdot\vec{p} + \left(\vec{b} + \vec{c}\right)\cdot\vec{q} + \left(\vec{c} + \vec{a}\right)\cdot\vec{r}$ is equal to

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

6. If in a triangle ABC, $\overrightarrow{BC} = \frac{\vec{u}}{|\vec{u}|} - \frac{\vec{v}}{|\vec{v}|}$ and $\overrightarrow{AC} = \frac{2\vec{u}}{|\vec{u}|}$, where $|\vec{u}| \neq |\vec{v}|$, then

(A) 1 + cos 2A + cos 2B + cos 2C = 2 (B) sin A = cos B
(C) 1 + cos 2A + cos 2B + cos 2C = 0 (D) sin B = cos C

7. If $\vec{u}$ and $\vec{v}$ are two non collinear unit vector such that $\left|\vec{u} \times \vec{v}\right| = \left|\frac{\vec{u} - \vec{v}}{2}\right|$, then find the value of $\left|\vec{u} \times \left(\vec{u} \times \vec{v}\right)\right|^2$

(A) $\frac{1}{4}$ (B) $\frac{3}{4}$ (C) $\frac{1}{2}$ (D) $\frac{3}{8}$

Space for rough work

8. Let $\vec{u}$ and $\vec{v}$ are unit vectors and $\vec{w}$ is a vector such that $\vec{u}\times\vec{v}+\vec{u}=\vec{w}$ and $\vec{w}\times\vec{u}=\vec{v}$, then find the value $[\vec{u}\ \vec{v}\ \vec{w}]$

(A) 2 (B) 3 (C) 1 (D) 4

9. Two given points P and Q in the rectangular Cartesian coordinates lie on y = 2^{x+2} such that $\overrightarrow{OP}\cdot\hat{i}=-1$ and $\overrightarrow{OQ}\cdot\hat{i}=2$, where $\hat{i}$ is a unit vector along the x axis. Find the magnitude of $\overrightarrow{OQ}-4\overrightarrow{OP}$

(A) 5 (B) 10 (C) 20 (D) none of these

10. Let $\vec{a},\vec{b},\vec{c}$ be unit vectors such that $\vec{a}+\vec{b}+\vec{c}=\vec{x}, \vec{a}\cdot\vec{x}=1, \vec{b}\cdot\vec{x}=\frac{3}{2}, |\vec{x}|=2$, then angle between $\vec{c}$ and $\vec{x}$ is

(A) $\cos^{-1}\left(\frac{1}{4}\right)$ (B) $\cos^{-1}\frac{3}{4}$ (C) $\cos^{-1}\left(\frac{3}{8}\right)$ (D) $\cos^{-1}\left(\frac{5}{8}\right)$

11. Value of $\left[\vec{a}\times\vec{b}\quad \vec{a}\times\vec{c}\quad \vec{d}\right]$ is always equal to

(A) $(\vec{a}\cdot\vec{d})\left[\vec{a}\ \ \vec{b}\ \ \vec{c}\right]$ (B) $(\vec{a}\cdot\vec{c})\left[\vec{a}\ \ \vec{b}\ \ \vec{c}\right]$ (C) $(\vec{a}\cdot\vec{b})\left[\vec{a}\ \ \vec{b}\ \ \vec{c}\right]$ (D) none of these

12. If the vector $\hat{i}-3\hat{j}+5\hat{k}$ bisects the angle between $\vec{a}$ and $-\hat{i}+2\hat{j}+2\hat{k}$, where $\vec{a}$ is a unit vector, then

(A) $\vec{a}=\frac{1}{105}\left(41\hat{i}+88\hat{j}-40\hat{k}\right)$ (B) $\vec{a}=\frac{1}{105}\left(41\hat{i}+88\hat{j}+40\hat{k}\right)$

(C) $\vec{a}=\frac{1}{105}\left(-41\hat{i}+88\hat{j}-40\hat{k}\right)$ (D) $\vec{a}=\frac{1}{105}\left(41\hat{i}-88\hat{j}-40\hat{k}\right)$

13. If $\vec{a}=\vec{b}+\vec{c}, \vec{b}\times\vec{d}=\vec{0}, \vec{c}\cdot\vec{d}=0$, then the vector $\frac{\vec{d}\times(\vec{a}\times\vec{d})}{|\vec{d}|^2}$ is always equal to

(A) $\vec{a}$ (B) $\vec{d}$ (C) $\vec{b}$ (D) $\vec{c}$

14. If $\vec{a},\vec{b}$ and $\vec{c}$ are vectors such that $|\vec{a}|=3, |\vec{b}|=4$ and $|\vec{c}|=5$ and $(\vec{a}+\vec{b})$ is perpendicular to $\vec{c}$, $(\vec{b}+\vec{c})$ is perpendicular to $\vec{b}$, then to $\vec{a}$ and $(\vec{c}+\vec{a})$ is perpendicular to $\vec{b}$, then $|\vec{a}+\vec{b}+\vec{c}|$ is

(A) $4\sqrt{3}$ (B) $5\sqrt{2}$ (C) 2 (D) 12

Space for rough work

15. Centroid of the tetrahedron OABC, where A ≡ (a, 2, 3), B ≡ (1, b, 2), C ≡ (2, 1, c) and O is the origin is (1, 2, 3). The value of $a^2 + b^2 + c^2$ is equal to
(A) 75 (B) 80 (C) 121 (D) none of these

16. For any two vectors $\vec{a}$ and $\vec{b}$, the expression $(\vec{a}\times\hat{i})\cdot(\vec{b}\times\hat{i})+(\vec{a}\times\hat{j})\cdot(\vec{b}\times\hat{j})+(\vec{a}\times\hat{k})\cdot(\vec{b}\times\hat{k})$ is always equal to
(A) $\vec{a}\cdot\vec{b}$ (B) $2\vec{a}\cdot\vec{b}$ (C) zero (D) none of these

17. If $\vec{a}\times(\vec{b}\times\vec{c})$ is perpendicular to $(\vec{a}\times\vec{b})\times\vec{c}$, then we may have
(A) $\vec{b}\cdot\vec{c}=0$ (B) $\vec{a}\cdot\vec{b}=0$ (C) $\vec{a}\cdot\vec{c}=0$ (D) none of these

18. $\vec{a},\vec{b},\vec{c}$ are non-coplanar vectors and $\vec{a}_1,\vec{b}_1,\vec{c}_1$ constitute the corresponding reciprocal system of vectors, then we have $\vec{a}_1\times\vec{b}_1+\vec{b}_1\times\vec{c}_1+\vec{c}_1\times\vec{a}_1=\frac{\lambda}{[\vec{a}\ \vec{b}\ \vec{c}]}(\vec{a}+\vec{b}+\vec{c})$, where λ is equal to
(A) 2 (B) 3 (C) 1 (D) none of these

19. A, B, C and D are any four points in the space. If $|\overrightarrow{AB}\times\overrightarrow{CD}+\overrightarrow{BC}\times\overrightarrow{AD}+\overrightarrow{CA}\times\overrightarrow{BD}| = \lambda\Delta_{ABC}$, where Δ_{ABC} is the area of triangle ABC, then λ is equal to
(A) 2 (B) $\frac{1}{2}$ (C) 4 (D) $\frac{1}{4}$

20. $\vec{a}$ and $\vec{c}$ are unit vectors and $|\vec{b}|$ = 4. If angle between $\vec{b}$ and $\vec{c}$ is $\cos^{-1}\left(\frac{1}{4}\right)$ and $\vec{a}\times\vec{b}=2\vec{a}\times\vec{c}$, then $\vec{b}=\lambda\vec{a}+2\vec{c}$, where λ is equal to
(A) $\pm\frac{1}{4}$ (B) $\pm\frac{1}{2}$ (C) ±1 (D) ±4

21. Let $\vec{b}$ and $\vec{c}$ are unit vectors, then for any arbitrary vector $\vec{a}$, $\{[(\vec{a}\times\vec{b})+(\vec{a}\times\vec{c})]\times(\vec{b}\times\vec{c})\}\cdot(\vec{b}-\vec{c})$ is always equal to
(A) $|\vec{a}|$ (B) $\frac{1}{2}|\vec{a}|$ (C) $\frac{1}{3}|\vec{a}|$ (D) zero

Space for rough work

22. Resolved part of vector $\vec{a}$ along the vector $\vec{b}$ is $\vec{a}_1$ and that perpendicular to $\vec{b}$ is $\vec{a}_2$, then $\vec{a}_1 \times \vec{a}_2$ is equal to

(A) $\frac{(\vec{a}\times\vec{b})(\vec{b})}{|\vec{b}|^2}$ (B) $\frac{(\vec{a}\cdot\vec{b})\vec{a}}{|\vec{a}|^2}$ (C) $\frac{(\vec{a}\cdot\vec{b})(\vec{b}\times\vec{a})}{|\vec{b}|^2}$ (D) $\frac{(\vec{a}\cdot\vec{b})(\vec{b}\times\vec{a})}{|\vec{b}\times\vec{a}|}$

23. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three non-zero and non-coplanar vectors and $\vec{p}, \vec{q}$ and $\vec{r}$ be three vectors given by $\vec{p} = \vec{a} + \vec{b} - 2\vec{c}$, $\vec{q} = 3\vec{a} - 2\vec{b} + \vec{c}$ and $\vec{r} = \vec{a} - 4\vec{b} + 2\vec{c}$. If the volume of the parallelepiped determined by $\vec{a}, \vec{b}$ and $\vec{c}$ is V_1 and that of the parallelepiped determined by $\vec{p}, \vec{q}$ and $\vec{r}$ is V_2 and $V_2 : V_1$ is equal to

(A) 3 : 1 (B) 7 : 1 (C) 11 : 1 (D) 15 : 1

24. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors, then $\frac{1}{3}\left(|\vec{a}-\vec{b}|^2 + |\vec{b}-\vec{c}|^2 + |\vec{c}-\vec{d}|^2\right)$ does not exceed

(A) 9 (B) 3 (C) 6 (D) 8

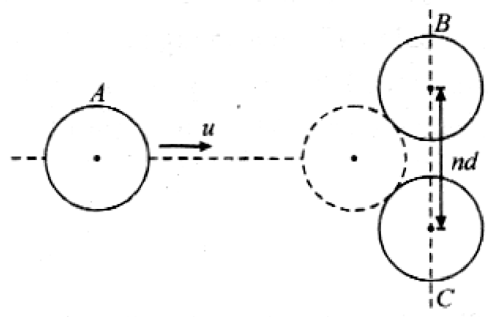
25. A, B, C and D are four points in a plane with position vectors $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ respectively such that $(\vec{a}-\vec{d})\cdot(\vec{b}-\vec{c}) = (\vec{b}-\vec{d})\cdot(\vec{c}-\vec{a}) = 0$. Then for ΔABC, D is its

(A) incentre (B) circumcentre (C) orthocentre (D) centroid

26. If $|\vec{a}| = 2$ and $|\vec{b}| = 3$ and $\vec{a}\cdot\vec{b} = 0$, then $\left(\vec{a}\times\left(\vec{a}\times\left(\vec{a}\times\left(\vec{a}\times\vec{b}\right)\right)\right)\right)$ is equal to

(A) $48\vec{b}$ (B) $-48\vec{b}$ (C) $48\vec{a}$ (D) $-48\vec{a}$

27. Three identical discs A,B and C having diameter 'd' each rest on a smooth horizontal plane as shown in figure. The disc A is set in motion with velocity v along the perpendicular bisector of the line BC joining the centres of the stationary discs. The distance between the centres of stationary discs B and C is n times the diameter of each disc. At what value of n will the disc A stop after elastic collision

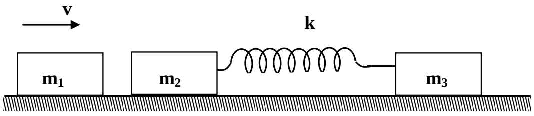


(A) $\sqrt{3}$ (B) $\frac{\sqrt{5}}{2}$

(C) $\sqrt{2}$ (D) $\frac{\sqrt{6}}{2}$

Space for rough work

28. Mass m_1 hits m_2 with inelastic impact (e = 0) while sliding horizontally with velocity v along the common line of centres of three equal mass as shown in figure. Initially, masses m_2 and m_3 are stationary and the spring is unstressed. After impact, find the maximum possible kinetic energy of m_3 during the motion. Take $m_1 = m_2 = m_3 = m$



(A) $\frac{mv^2}{18}$ (B) $\frac{2mv^2}{9}$

(C) $\frac{mv^2}{3}$ (D) $\frac{1}{2}mv^2$

29. Two billiard balls of equal mass move at right angles and meet at the origin of a coordinate system. First is moving up along the y – axis at 3 m/s and the other is moving to the right along the x- axis with speed 4.8 m/s. After the elastic collision, the second ball is moving along the positive y –axis. What is the final speed of the first ball.
(A) 4.8 m/s (B) 3.6 m/s (C) 2 m /s (D) 2.4 m/s

30. A ball moving with velocity 'v' collides elastically with another stationary ball of the same mass. At the moment of impact the angle between the straight line passing through the centres of the balls and the direction of the initial motion of the striking ball is equal to 45^0. Assuming the balls to be smooth, find the fraction of the kinetic energy of the striking ball that turned into potential energy at the moment of the maximum deformation.

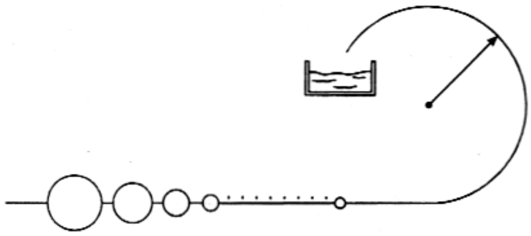
(A) $\frac{1}{8}$ (B) $\frac{1}{2}$ (C) $\frac{3}{8}$ (D) $\frac{1}{4}$

31. A block of mass 2 kg moving at 2 m/s collides head on with another block of equal mass kept at rest on smooth horizontal surface. What can be the maximum possible loss in kinetic energy due to the collision.
(A) 4 J (B) 2 J (C) 3 J (D) 1 J

32. A ball with a speed of 9 m/s strikes another identical ball such that after collision the direction of each ball makes an angle 30^0 with the original line of motion. Find the speeds of the two balls after the collision. There is no friction anywhere
(A) 3 m/s (B) $3\sqrt{3}\,m/s$ (C) 4.5 m /s (D) 6 m /s

Space for rough work

33. N beads are resting on a smooth horizontal fixed wire which is circular at the end with radius r as shown in figure . The masses of the beads are $m, m/2, m/4 \dots m/2^{n-1}$ respectively. Find the minimum velocity which should be imparted to the first bead of mass m such that the n^{th} bead will fall in the tank shown in figure.

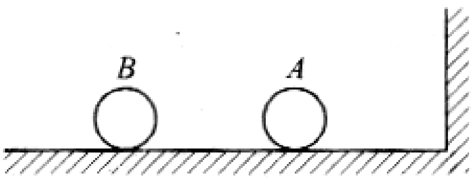


(A) $\left(\frac{3}{4}\right)^{n-1}.\sqrt{4gr}$ (B) $\left(\frac{3}{4}\right)^{n-1}.\sqrt{5gr}$ (C) $\left(\frac{1}{4}\right)^{n-1}.\sqrt{5gr}$ (D) None of these

34. Two small identical discs, each of mass m, lie on a smooth horizontal plane. The discs are interconnected by a light non- deformed spring of ℓ_0 and stiffness K. At a certain moment one of the discs is set in motion in a horizontal direction perpendicular to the spring length with velocity v_0. What will be the maximum elongation of the spring in the process of motion, if it is known to be considerably less than unity.

(A) $\frac{mv_0^2}{2K\ell_0}$ (B) $\frac{mv_0^2}{K\ell_0}$ (C) $\frac{\sqrt{2}mv_0^2}{K\ell_0}$ (D) None of these

35. A ball A of mass 10 kg and a ball B of unknown mass are placed on a horizontal frictionless table which rest against a rigid wall as shown in figure. The ball A moves towards the ball B with a velocity 'v'. What should be the mass of B such that both A and B move with the same speed after A has undergone a collision with ball B and the wall ? All collisions are assume to the elastic.



(A) 10 kg (B) 20 kg (C) 30 kg (D) 40 kg

36. A series of N identical balls are at rest on a smooth horizontal surface. Now the number 1 ball has been imparted velocity u towards the ball number 2 which in turn collides with the ball number 3 and so on. Find the speed of N^{th} ball if the coefficient of restitution for each impact is e.

(A) $\frac{u(1+e)^{N-1}}{2^{N-1}}$ (B) $\frac{u(1-e)^{N-1}}{2^{N-1}}$ (C) $\frac{u(1+e)^{N}}{2^{N}}$ (D) $\frac{u(1-e)^{N}}{2^{N}}$

Space for rough work

37. A 42 kg girl walks along a stationary uniform platform of mass 21 kg. She walks with a speed of 0.75 m/s. What is the speed of the centre of mass of the system of girl plus platform ? Assume that platform is placed on a smooth horizontal surface.
(A) 0.50 m/s (B) 0.25 m/s (C) 0.75 m/s (D) Non of these

38. A ball of mass m moving at a speed v makes a head on collision with an identical ball at rest. The kinetic energy of the balls after the collision is three fourths of the original. Find the coefficient of restitution.
(A) $\frac{1}{2}$ (B) $\frac{1}{4}$ (C) $\frac{3}{4}$ (D) $\frac{1}{\sqrt{2}}$

39. After perfectly inelastic collision between two identical particles moving with same speed in different directions, the speed of the particles become half the initial speed. The angle between the velocities of the two before collision is
(A) 60° (B) 45° (C) 120° (D) 30°

40. A ball strikes a horizontal floor at angle $\theta = 45°$. The coefficient of restitution between the ball and the floor is $e = \frac{1}{2}$. The fraction of its kinetic energy lost in collision is
(A) $\frac{5}{8}$ (B) $\frac{3}{8}$ (C) $\frac{3}{4}$ (D) $\frac{1}{4}$

41. A particle strikes a smooth horizontal surface at an angle of 45° with a velocity of 100 m/s and rebounds. If the coefficient of restitution between the floor and the particle is $\frac{1}{\sqrt{3}}$ then the angle made by the velocity of the particle with the floor after it rebounds is (approximately)
(A) 30° (B) 45° (C) 60° (D) 90°

42. A tennis ball bounces down a flight of stairs striking each step in turn and rebounding to the height of the step above. The coefficient of restitution is
(A) $\frac{1}{2}$ (B) $\frac{1}{\sqrt{2}}$ (C) $\frac{1}{4}$ (D) 1

Space for rough work

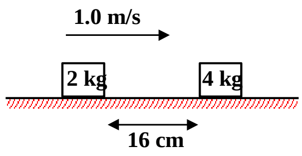
43. In a head on collision between two identical particles A and B moving on a horizontal surface, B is stationary and A has momentum P_0 before impact. Due to the impact A receives an impulse of magnitude I. Then coefficient of restitution between the two is

(A) $\frac{2I}{P_0}-1$ (B) $\frac{2I}{P_0}+1$ (C) $\frac{I}{P_0}+1$ (D) $\frac{1}{P_0}-1$

44. A particle of mass m_1 moves with speed v and collides head on with a stationary particle of mass m_2. The first particle continue to move in the same director if $\frac{m_1}{m_2}$ is (e = coefficient of restitution)

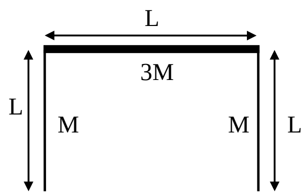
(A) = e (B) > e (C) < e (D) > e^2

45. The friction coefficient between the horizontal surface and each of the blocks shown in the figure is 0.2. The collision between the blocks is perfectly elastic. The velocity of 2 kg block in the position shown is 1 m/s and the 4 kg block is initially at rest. Which of the following statement is **correct.** Take g = 10m/s^2.



(A) The velocity of 4 kg mass just after collision is 0.2 m/s
(B) The velocity of 2 kg mass just after collision is 0.3 m/s
(C) The velocity of 4 kg mass just after collision is 0.4 m/s
(D) the separation between them when they finally come to rest is 9 cm

46. Three thin rods of each of length L are arranged in an inverted U, as shown in the figure. The two rods on the arms of the U each have mass M, the third rod has mass 3M. Which of the following statement is **incorrect.**



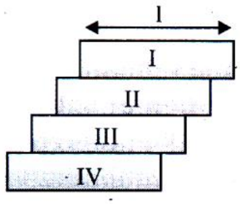
(A) the center of mass is located at a distance of $\frac{2L}{5}$ from the 3M rod
(B) the center of mass is located at a distance of $\frac{L}{5}$ from the 3M rod
(C) the center of mass is equidistant from both the rods of mass M
(D) if another rod of length L and mass 3M is introduced to complete the square, the centre of mass will shift downwards

Space for rough work

47. A ball P of mass 10 kg moving with a speed of 8 m s^{-1} collides with another ball Q of mass 20 kg initially at rest. After the collision, P and Q move in directions making angles of 30^o and 45^o respectively with the initial direction of motion of P.
(A) velocity of P after collision is $4(\sqrt{3}-1)$ m/s (B) velocity of P after collision is $8(\sqrt{3}-1)$ m/s
(C) velocity of P after collision is $2\sqrt{2}(\sqrt{3}-1)$ m/s (D) velocity of P after collision is $2(\sqrt{3}-1)$ m/s

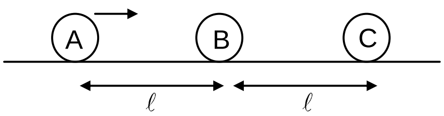
48. A particle of mass m = 2 kg collides head on with another stationary particle of mass M = 3 kg with an initial velocity of 6 m/s. If the particle m stops just after the collision, which of the following statement is **incorrect.**
(A) the velocity of block M after the collision is 4 m/s
(B) kinetic energy of system before collision is equal to kinetic energy after the collision
(C) the coefficient of restitution for the collision is 2/3
(D) fractional loss of kinetic energy due to the collision is 1/3

49. Four bricks, each of length ℓ, are put on the top of one another in such a way that part of each extends beyond the one beneath. The bricks are kept such that largest equilibrium extensions(off-set) are achieved w.r.t bottom (brick- IV). Which of the following statement is **incorrect.**



(A) top brick over hanging the one below by $\frac{\ell}{2}$
(B) second brick from top over hanging the one below $\frac{\ell}{6}$
(C) third brick from top overhanging by bottom one by $\frac{\ell}{6}$
(D) the total overhanging length on the edge of the bottom brick is $\frac{11}{12}\ell$

50. Three small spheres A, B and C of same size and each of mass m, 3m and 9m respectively are placed along a straight line. The sphere A is given a velocity u towards sphere B is shown in figure. All the collisions between the spheres are elastic. [Assume the horizontal surface on which the spheres are placed to be friction less]. Find the final velocity of sphere C after all collisions

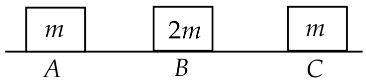


(A) $\frac{u}{2}$ (B) $\frac{u}{4}$ (C) $\frac{2u}{3}$ (D) $\frac{3u}{4}$

Space for rough work

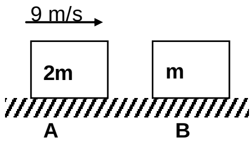
51. A ball is thrown downwards with a initial velocity u from a height h = 0.6 m. The ball collides inelastically with the ground and rebounds back to the same height. Find u (in m/s). [coefficient of restitution, e = 1/2)
(A) 4 m/s (B) 3 m/s (C) 6 m/s (D) 2 m/s

52. Three objects A, B and C are kept in a straight line on a frictionless horizontal surface. These have masses $m, 2m$ and m respectively. The object A moves towards B with a speed $9ms^{-1}$ and makes an elastic collision with it. Thereafter, B makes completely inelastic collision with C. All motions occur on the same straight line. Find the final speed of C (in ms^{-1})



(A) 4 m/s (B) 3 m/s (C) 6 m/s (D) 2 m/s

53. A block of mass 2 m collides elastically with a mass m kept at rest. Friction exists between the block B and surface with coefficient μ=0.3, where as no friction exists between block A and the surface . The block will again collide after time _____



(A) 6 sec (B) 4 sec (C) 8 sec (D) ∞

54. A weather balloon is inflated with helium. The balloon has a volume of 100 m^3 and it must be inflated to a pressure of 0.10 atm. If 50 L gas cylinders of helium at a pressure of 100 atm are used, how many cylinders are needed ? Assume that the temperature is constant.
(A) 2 (B) 3 (C) 4 (D) 1

55. The pressure of sodium vapour in a 1.0 L container is 10 torr at 1000°C. How many atoms are in the container ?
(A) 9.7×10^{17} (B) 7.6×10^{19} (C) 4.2×10^{17} (D) 9.7×10^{19}

56. An open flask containing air is heated from 300 K to 500 K. What percentage of air will be escaped to the atmosphere, if pressure is keeping constant ?
(A) 80 (B) 40 (C) 60 (D) 20

57. O_2 and SO_2 gases are filled in ratio of 1 : 3 by moles in a closed container of 3 L at temperature of 27°C. The partial pressure of O_2 is 0.60 atm, the concentration of SO_2 would be
(A) 0.36 (B) 0.036 (C) 3.6 (D) 36

58. Two flasks A and B have equal volumes. A is maintained at 300 K and B at 600 K, while A contains H_2 gas, B has an equal mass of CO_2 gas. Find the ratio of total K.E. of gases in flask A to that of B.
(A) 1 : 2 (B) 11 : 1 (C) 33 : 2 (D) 55 : 7

Space for rough work

59. 6×10^{22} gas molecules each of mass 10^{-24} kg are taken in a vessel of 10 litre. What is the pressure exerted by gas molecules ? The root mean square speed of gas molecules is 100 m/s.
(A) 20 Pa (B) 2×10^4Pa (C) 2×10^5 Pa (D) 2×10^7 Pa

60. The density of gas A is twice that to B at the same temperature the molecular weight of gas B is twice that of A. The ratio of pressure of gas A and B will be :
(A) 1 : 6 (B) 1 : 1 (C) 4 : 1 (D) 1 : 4

61. Dimethyl ether decomposes as
$CH_3OCH_3(g) \rightarrow CH_4(g) + CO(g) + H_2(g)$
When CH_3OCH_3decomposes to 20% extent at certain fixed conditions, what is the ratio of diffusion of pure CH_3OCH_3 with methane ?
(A) 0.59 : 1 (B) 1.18 : 1 (C) 2.36 : 1 (D) 1.77 : 1

62. The root mean square speed of 8g of He is 300 ms^{-1}. Total kinetic energy of He gas is :
(A) 120 J (B) 240 J (C) 360 J (D) None of these

63. –CN(I) –COOH (II) –F(III)
Among these groups, which of the following orders is correct for the magnitude of their– I effect ?
(A) I > II > III (B) III > I > II (C) II > I > III (D) III > II > I

64. Two closed vessel A and B of equal volume of 8.21 L are connected by a narrow tube of negligible volume with open valve. The left hand side container is found to contain 3 mole CO_2 and 2 mole of He at 400 K, what is the partial pressure of He in vessel B at 500 K ?
(A) 2.4 atm (B) 8 atm (C) 12 atm (D) None of these

65. A mixture of Ne and Ar at 250 K has a total K. E. = 3 KJ in a closed vessel, the total mass of Ne and Ar is 30 g. Find mass % of Ne in gaseous mixture at 250 K.
(A) 61.63 (B) 38.37 (C) 50 (D) 28.3

66. The average speed at temperature T°C of CH_4 (g) is $\sqrt{\frac{28}{88}} \times 10^3 ms^{-1}$. What is the value of T ?
(A) 240.55°C (B) –32.45°C (C) 3000°C (D) –24.055°C

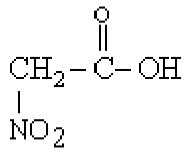
67. Consider the given compounds
1) $CH_3-CH_2-NH_2$ 2) $CH_3-CH(CN)-NH_2$
3) $CH_3-CH(Cl)-NH_2$ 4) $C_2H_5-NH-C_2H_5$
Arrange basic strength of these compounds in decreasing order in gaseous phase:
(A) 4 > 1 > 2 > 3 (B) 4 > 1 > 3 > 2 (C) 1 > 4 > 2 > 3 (D) 2 > 1 > 4 > 3

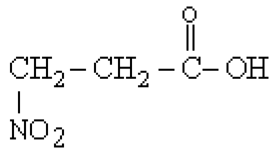
Space for rough work

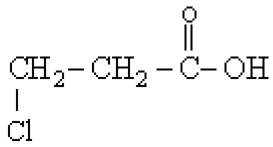
68. The root mean square speed of molecules of nitrogen gas is v, at a certain temperature. When the temperature is doubled, the molecules dissociate into individual atoms. The new rms speed of the atom is :

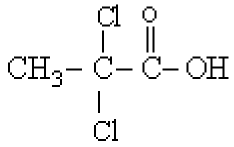
(A) $\sqrt{2}v$ (B) $2v$ (C) v (D) $4v$

69. Which of the following acids has highest Ka value (strongest acid) ?

(A) 

(B) 

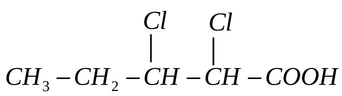
(C) 

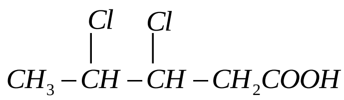
(D) 

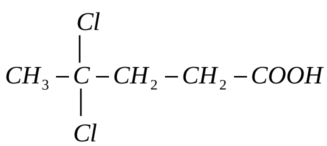
70. Of the two flasks, A and B which are of equal volumes, A contains H_2 at 27°C but B contains equal mass of C_2H_6 at 627°C. Assuming ideal behavior of gases, which of the following statements is correct?

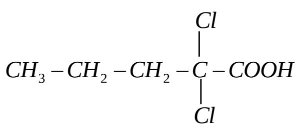
(A) H_2 molecules in a A will move 4.8 times faster than C_2H_6 molecules in B
(B) C_2H_6 molecules in B will move 2.24 times faster than H_2 molecules in A.
(C) Both the molecules will move in the same speed, since the containers are of equal volumes.
(D) H_2 molecules in 'A' will move 2.24 time faster than C_2H_6 molecules in 'B'

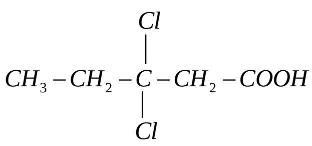
71. Which is the order of decreasing acidic character of the following compounds?


(I)


(II)


(III)


(IV)


(V)

(A) IV > V > III > I > II (B) IV > I > V > II > III
(C) I > II > III > V > IV (D) III > V > IV > II > I

72. The correct arrangement of acid strength in decreasing order is

(A) $(CH_3)_3CCOOH$ > CH_3COOH > CCl_3COOH > O_2NCH_2COOH
(B) CH_3COOH > $(CH_3)_3C\ COOH$ > O_2NCH_2COOH > CCl_3COOH
(C) O_2NCH_2COOH > $(CH_3)_3CCOOH$ > CH_3COOH > CCl_3COOH
(D) CCl_3COOH > O_2NCH_2COOH > CH_3COOH > $(CH_3)_3CCOOH$

73. In which of following pairs the first one is the weaker base than second?

(A) $CH_3COO^{\ominus}, HCOO^{\ominus}$ (B) $\overset{\ominus}{O}H, \overset{\ominus}{N}H_2$
(C) $CH_2=\overset{\ominus}{C}H, HC\equiv\overset{\ominus}{C}$ (D) CH_3NH_2, CH_3OH

74. Which among following statements is correct?
(A) Energy needed for homolytic bond fission is less than that required for the heterolytic bond fission
(B) Homolytic bond fission gives neutral species which is paramagnetic in nature
(C) Homolytic bond fission doesn't necessarily require non polar solvents
(D) Cation and anion is produced by heterolytic bond fission

Space for rough work

75. Which of the following gas has more kinetic energy
(A) 1 mole N_2 (B) 1 mole of O_2
(C) 1 mole of He (D) All have same kinetic energy

76. If T_1, T_2 and T_3 are the temperature at which the U_{RMS}, $U_{average}$, U_{MP} of oxygen gas are all equal to 1500 m/s then the correct statement is :
(A) $T_1 > T_2 > T_3$ (B) $T_1 < T_2 < T_3$ (C) $T_1 = T_2 = T_3$ (D) None of these

77. A bottle of cold drink contains 200 ml of liquid in which CO_2 is 0.1 molar. Suppose that CO_2 behaves as an ideal gas, the volume of dissolved CO_2 at STP is
(A) 0.224 L (B) 0.448 L (C) 22.4 L (D) 2.24 L

78. The r.m.s. velocity of CO_2 at a temperature T(in Kelvin) is $x\ cms^{-1}$. At what temperature the r.m.s. velocity of nitrous oxide would be $4x\ cms^{-1}$?
(A) 16T (B) 2T (C) 4T (D) 32T

79. At STP, the order of mean square velocity of molecules of H_2, N_2, O_2 and HBr is
(A) $H_2 > N_2 > O_2 > HBr$ (B) $HBr > O_2 > N_2 > H_2$ (C) $HBr > H_2 > O_2 > N_2$ (D) $N_2 > O_2 > H_2 > HBr$

80. A sample of pure gas has a density of 1.60 g/lit at 26.5°C and 680.2 mm Hg. Which of the following is present in the sample?
(A) CH_4 (B) C_2H_6 (C) CO_2 (D) Xe

81. Good example for multiple allelism is
(A) blood groups (B) skin colour in man (C) haemophilia (D) colour blindness

82. For evolutionary success, a mutation must occur in
(A) germplasm DNA (B) somatic RNA (C) germplasm (D) somatic DNA

83. Speciation is due to
(A) Inbreeding (B) Natural selections (C) Genetic drift (D) All of these

84. The universal donor
(B) AB^+ (B) AB^- (C) O^+ (C) O^-

85. The female children of a haemophilic man and carrier woman are likely to be
(A) all carriers (B) all haemophilic
(C) half normal and half carriers (D) half haemophilic and half carriers

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Space for rough work

86. The Phenotypic ratio in F_2 generation in a Dihybrid Cross is
(A) 9:3:3:1 (B) 1:2:1 (C) 3:1 (D) None of these

87. Application of the principle of heredity for the improvement of man kind
(A) euthenics (B) eugenics (C) biotechnology (D) euphenics

88. Which one of the examples is analogous derived from different origin?
(A) Thorn of Bougainvillea and Tendrils of Cucurbita
(B) Eyes of octopus and eyes of mammal
(C) Wings of bat and forelimbs of frog
(D) The **leaves** of opuntia and peepal are analogous organs in plants

89. In 1920, Oparin and Haldane suggested that life is originated in the sea from a primeval soup through
(A) Inorganic and Organic evolution (B) Living organisms are formed from non-living
(C) Radiation resistant spores (D) Process of Coacervation

90. Swan-neck Flask experiment disproves
(A) Abiogenesis theory (B) Special creation theory
(C) Cosmozoic theory (D) Chemical evolution theory

Space for rough work

FIITJEE PET – IX (1ST YEAR_Champions 20S)
MAINS_ANSWERS
DATE: 22.09.2018

MATHEMATICS

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

PHYSICS

27.	**Bonus**	28.	**B**	29.	**Bonus**	30.	**Bonus**
31.	**B**	32.	**Bonus**	33.	**A,D**	34.	**Bonus**
35.	**C**	36.	**A**	37.	**D**	38.	**D**
39.	**Bonus**	40.	**B**	41.	**A**	42.	**B**
43.	**A**	44.	**B**	45.	**C**	46.	**A**
47.	**Bonus**	48.	**B**	49.	**B**	50.	**B**
51.	**C**	52.	**A**	53.	**C**		

CHEMISTRY

54.	**Bonus**						
55.	**B**	56.	**B**	57.	**B**	58.	**B**
59.	**B**	60.	**C**	61.	**C**	62.	**C**
63.	**A**	64.	**B**	65.	**D**	66.	**B**
67.	**B**	68.	**B**	69.	**A**	70.	**D**
71.	**B**	72.	**D**	73.	**B**	74.	**C**
75.	**D**	76.	**B**	77.	**B**	78.	**A**
79.	**A**	80.	**C**				

Biology

81.	**A**	82.	**A**	83.	**D**	84.	**D**
85.	**D**	86.	**A**	87.	**B**	88.	**B**
89.	**A**	90.	**A**				