FIITJEE RET – 11

(2018 – 2020)(1ST YEAR_REGULAR)

IIT-2015 (P1)_SET–A

DATE: 17.09.2018

Time: 3 hours **Maximum Marks: 264**

INSTRUCTIONS:

A. General

1. This booklet is your Question Paper containing 60 questions.
2. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed to be carried inside the examination hall.
3. Fill in the boxes provided for Name and Enrolment No.
4. The answer sheet, a machine-readable Objective Response (ORS), is provided separately.
5. DO NOT TAMPER WITH / MULTILATE THE ORS OR THE BOOKLET.

B. Filling in the OMR:

6. The instructions for the OMR sheet are given on the OMR itself.

C. Question paper format:

7. The question paper consists of **3 parts (Physics, Chemistry and Mathematics)**. Each part consists of **two sections**.
8. **Section I** contains **8 questions**. The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).
9. **Section II** contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.
10. **Section III** contains **2 Match the following** type questions and you will have to match entries in Column I with the entries in Column II

D. Marking Scheme

11. For each question in **Section I**, you will be awarded **4 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **No negative marks** will be awarded for incorrect answers in this section.
12. For each question in **Section II**, you will be awarded **4 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **–2 marks** will be awarded for incorrect answers in this section.
13. For each question in **Section III**, you will be awarded **2 marks** for each entry in Column I; if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **–1 marks** will be awarded for incorrect answers in this section.

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.

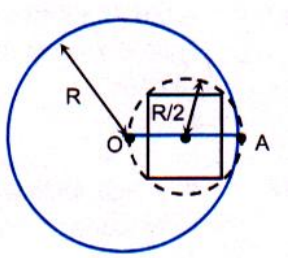
NAME: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

ENROLLMENT NO.: ☐☐☐☐☐☐☐☐☐☐

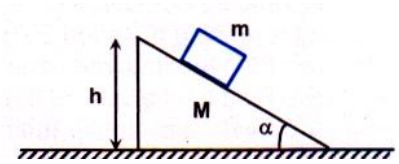
PAPER–I
PART I: PHYSICS
SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- Marking scheme:
  - **+4** If the bubble corresponding to the answer is darkened.
  - **0** In all other cases.

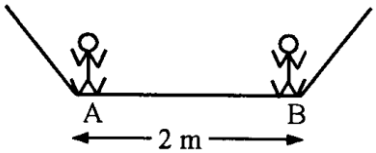
1. There is thin uniform disc of radius R and mass per unit area σ, in which a hole of radius R/2 has been cut out as shown in the figure. Inside the hole a square plate of same mass per unit area σ is inserted so that its corners touch the periphery of the hole. Centre of mass of the system is $\frac{R(2-\pi)}{(6\pi+N)}$. Find N.



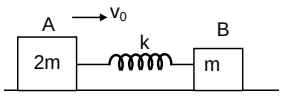
2. A cubical block of mass m is released from rest at a height h on a frictionless surface of a movable wedge of mass M, which is, in turn is placed on a horizontal frictionless surface as shown in the figure. The velocity of the triangular block when the smaller block reaches the bottom is $\frac{2\sqrt{N}}{3}$. Find N.



3. Two persons A and B of weight 80 kg and 50 kg respectively are standing at opposite ends of a boat of mass 70 kg and length 2 m, at rest. When they interchange their positions then displacement of the centre of mass of the boat will be (n x 10) cm. Find n.



4. Two blocks A & B of mass 2m and m respectively are placed on a smooth surface connected by a spring of constant k = 100 N/m. The spring is initially unstretched when the block A is given a velocity v_0 = 9 m/s. Find the velocity (in m/s) of block A at the instant when the spring has maximum compression (given m = 2 kg)

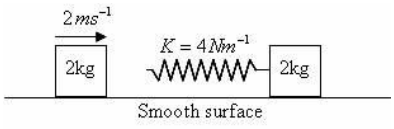


Space for rough work

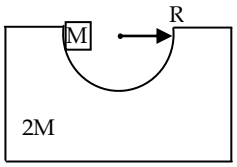
5. A body of mass m_1= 4kg moves at $5\hat{i}$ m/s and another body of mass m_2 = 2 kg moves at $10\hat{i}$ m/s. The kinetic energy of centre of mass is found to be $\frac{100n}{3}$ J. Find the value of n ?

6. The linear mass density of a ladder of length ℓ increases linearly from λ_0 to $2\lambda_0$ from one end A to the other end B. The position of the centre of mass from end A is $\frac{nL}{9}$, find n?

7. In the arrangement shown in figure the velocity of centre of mass after collision (in SI units)



8. A block of mass $2M$ with a semi circular track of radius R rests on a smooth horizontal floor. A sphere of mass M and radius $R/10$ is released from the top of track as shown. When sphere reaches the bottom of track then block has moved by a distance of $\frac{K_0R}{10}$. Then K_0 is ____

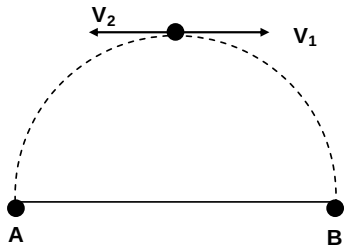


SECTION 2 (Maximum Marks: 40)

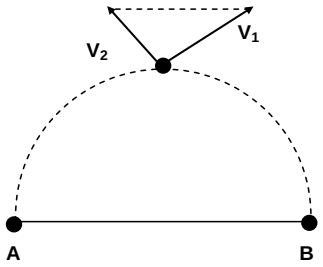
- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct.
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- Marking scheme:
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–2** In all other cases

Space for rough work

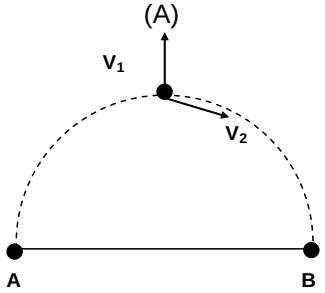
9. A bomb projected from A lands at B in absence of an explosion. At top most point , it explodes into two equal fragments. After explosion each fragment moves in a separate path and come to rest after hitting the ground. Find out in which of the following cases centre of mass of the system will finally(after landing of both fragments) be at ' B' (v_1,v_2 are velocities of fragments after explosion)



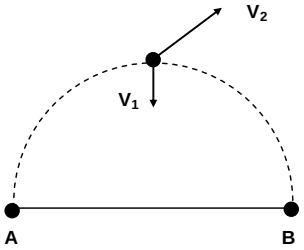
(A)



(B)



(C)

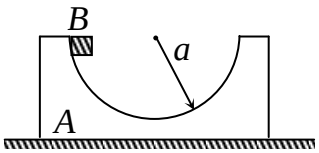


(D)

10. A bomb of mass 7 m explodes into two fragments of masses 4 m and 3m. If the momentum of the lighter fragment is 'P', then the energy released in the explosion is

(A) $\frac{7P^2}{24m}$ (B) $\frac{9P^2}{16m}$ (C) $\frac{11P^2}{24m}$ (D) $\frac{5P^2}{14m}$

11. Figure shows a block *A* of mass 6*m* having a smooth semi-circular groove of radius a placed on a smooth horizontal surface. A block *B* of mass *m* is released from a position in groove where its radius is horizontal. The speed of block *A* when block *B* reaches its bottom is



(A) $\sqrt{ga}$ (B) $\sqrt{\frac{2ga}{7}}$ (C) $\sqrt{\frac{ga}{21}}$ (D) zero

Space for rough work

12. A strip of wood of mass M and length ℓ is placed on a smooth horizontal surface. An insect of mass m starts at one end of the strip and walks to the other end in time t, moving with a constant speed.

(A) The speed of the insect as seen from the ground is $< \frac{\ell}{t}$

(B) The speed of the strip as seen from the ground is $\frac{\ell}{t}\left(\frac{M}{M+m}\right)$

(C) The speed of the strip as seen from the ground is $\frac{\ell}{t}\left(\frac{m}{M+m}\right)$

(D) The total kinetic energy of the system is $\frac{1}{2}(m+M)\left(\frac{\ell}{t}\right)^2$

13. A shell of mass 2 kg is fired with a velocity of 40 m/s at an angle of inclination of 30^o with horizontal. It explodes into two identical fragments at its highest point. One of the fragments retraces the path. Then

(A) velocity of the other fragment just after the explosion is $60\sqrt{3}$ m/s

(B) distance between the two fragments when both have reached the ground [assuming they come to rest after hitting the ground] is $160\sqrt{3}$ m

(C) both the fragments reach the ground simultaneously

(D) the velocity of separation of the two fragments just after the explosion is $40\sqrt{3}$ m/s

14. Choose the incorrect statement

(A) if the linear momentum of a particle is known, we can find its kinetic energy

(B) if the kinetic energy of a particle is known, we can necessary find its linear momentum

(C) if the total mechanical energy of a particle is zero, its linear momentum is necessarily zero

(D) if the total mechanical energy of a particle is zero, its linear momentum is necessarily non–zero

15. The momentum of a particle is given by $\vec{P} = \left(4\sin t\vec{i} - 4\cos t\vec{j}\right)$ kg m/s. Select the correct alternative(s)

(A) momentum $\vec{P}$ of the particle is always parallel to $\vec{F}$

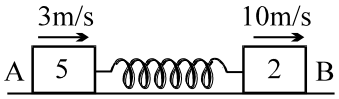
(B) momentum $\vec{P}$ of the particle is always perpendicular to $\vec{F}$

(C) magnitude of momentum $\vec{P}$ is always constant

(D) none of the above

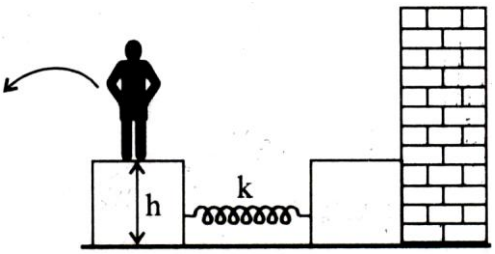
Space for rough work

16. Two blocks A (5kg) and B(2kg) attached to the ends of a spring constant 1120N/m are placed on a smooth horizontal plane with the spring undeformed. Simultaneously velocities of 3m/s and 10m/s along the line of the spring in the same direction are imparted to A and B then



(A) when the extension of the spring is maximum the velocities of A and B are zero.
(B) the maximum extension of the spring is 25cm.
(C) maximum extension and maximum compression occur alternately.
(D) none of these

17. Two identical blocks of mass 2M are joined by means of a light spring of spring constant k. A man of mass M is standing on one of the block as shown in the diagram. If man jumps horizontally with a velocity V relative to block and horizontal surface is smooth, then



(A) the maximum compression in the spring is $\sqrt{\frac{2M}{k}}\left(\frac{V}{3}\right)$

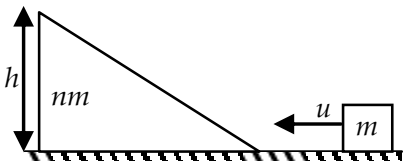
(B) man lands at horizontal distance $V\sqrt{\frac{2h}{g}}$ from initial position of the block

(C) right block loses contact with wall when the elongation in spring is maximum

(D) velocity of centre of mass of two blocks after 2M loses contact with wall is $\frac{V}{6}$

Space for rough work

18. A block of mass m is moving with velocity u as shown in the figure. The wedge has mass nm and height h. All surfaces are smooth.



(A) Velocity of centre of mass is zero when block reaches the highest point on the wedge

(B) horizontal component of velocity of centre of mass is $\frac{u}{1+n}$

(C) If the block has to reach the top of wedge then $u = \sqrt{2gh\ 1+{}^{1}\!/_{n}}$

(D) Block reaches top of the wedge when velocity $u = \sqrt{2gh}$

SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entries (A), (B), (C) and (D)
- **Column II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column I** with the entries in **Column II**
- One or more entries in **Column I** may match with one or more entries in **Column II**.
- The ORS contains a 4 × 5 matrix whose layout will be similar to the one shown below:

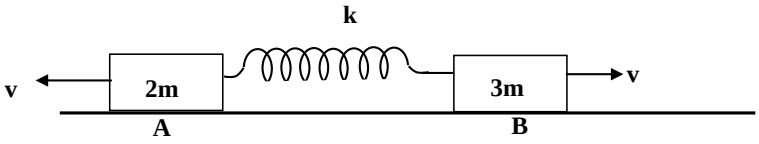
(A)	(P)	(Q)	(R)	(S)	(T)
(B)	(P)	(Q)	(R)	(S)	(T)
(C)	(P)	(Q)	(R)	(S)	(T)
(D)	(P)	(Q)	(R)	(S)	(T)

- For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in **Column I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (V), (C) and (D).
- Marking entry in Column I.

+2	If only the bubble(s) corresponding to all the correct match (s) is (are) darkened.
0	If none of the bubbles is darkened.
–1	In all other cases.

Space for rough work

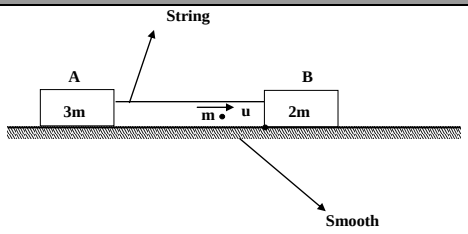
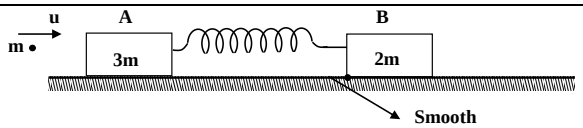
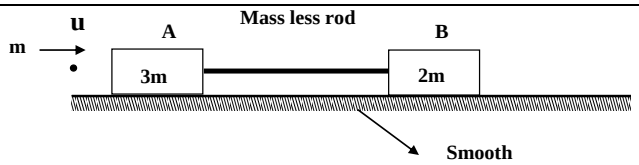
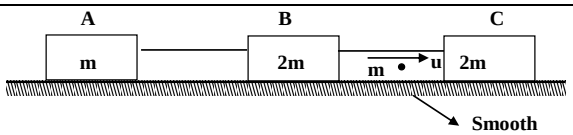
19. Two blocks A and B of masses 2m and 3m placed on smooth horizontal surface are connected with a light spring. The two blocks are given velocities as shown when spring is at natural length. Match the following



Column – I		Column – II	
(A)	Minimum magnitude of velocity of A $\left(v_{A_{min}}\right)$ during motion	(p)	v
(B)	Maximum magnitude of velocity of A $\left(v_{A_{max}}\right)$ during motion	(q)	$\frac{v}{5}$
(C)	Maximum magnitude of velocity of B $\left(v_{B_{max}}\right)$ during motion	(r)	0
(D)	Velocity of centre of mass $\left(v_{CM}\right)$ of the system comprised of blocks A, B and spring	(s)	$\frac{7v}{5}$

Space for rough work

20. In the column – I different situations are shown. In each case particle is moving with speed u and sticks to the blocks as shown in figure. Match the following.

Column – I		Column – II	
(A)	 Particle of mass 'm' sticks to block 'B'. Then magnitude of impulse of tension on block B during collision is ___	(p)	$\frac{mu}{3}$
(B)	 Particle of mass 'm' sticks to block 'A'. after colliding. Find the magnitude of normal on the particle during collision.	(q)	$\frac{3mu}{4}$
(C)	 Particle sticks to block A. Then impulse of rod force on block A during collision will be __	(r)	$\frac{mu}{2}$
(D)	 Particle sticks to block 'C'. Impulse of tension force (between block B and block C) on block B during collision is__	(s)	$\frac{2mu}{3}$
		(t)	None of these

Space for rough work

PART II: CHEMISTRY

SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- Marking scheme:
  - **+4** If the bubble corresponding to the answer is darkened.
  - **0** In all other cases.

21. An ideal gas on heating shows a rise in temperature by 8% at constant pressure. The % increase in volume of gas is.

22. A gas has a vapour density 11.2. The volume occupied by 1g of the gas at STP is x litre. What is x ?

23. Ammonium carbamate $\left(NH_2COONH_4\right)$ when heated to 200^0C gives a mixture of NH_3 and CO_2 vapour with a vapour density of 13. What is the degree of dissociation of ammonium carbamate ?

24. Two solid compounds X and Y dissociate at a certain temperature as follows :
$X(s) \rightleftharpoons A(g) + 2B(g)$; $K_{P_1} = 7.2 \times 10^{-2}$ atm^3 ; $Y(S) \rightleftharpoons 2B(g) + C(g)$; $K_{P_2} = 3.6 \times 10^{-2}$ atm^3
The total pressure of gases over the mixture of X and Y is P x 10^{-1} atm. Find the value of P

25. For a reversible system $X_{(g)} \rightleftharpoons Y_{(g)} + Z_{(g)}$ a quantity of X was heated at constant pressure P at a certain temperature. The equilibrium partial pressure of X was found to be $\frac{P}{7}$. The value of K_P at given temperature is $P.\frac{X}{7}$. Then $\frac{x}{4}$ is _____

26. If in an equilibrium reaction if $\Delta G^0 = 0$, then the equilibrium constant , K should be equal to

27. If concentration of SO_2 and O_2 in the equilibrium reaction, $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ are quadrupled, the concentration of SO_3 now will be …. Times.

28. For the reaction involving oxidation of ammonia by oxygen to form nitric oxide and water vapour, the equilibrium constant has the units (bar)^n. Then n is

Space for rough work

SECTION 2 (Maximum Marks: 40)

- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct.
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- Marking scheme:
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–2** In all other cases

29. In the equation PV = RT, the value of R will not depend on (one or more)
(A) the nature of the gas (B) the temperature of the gas
(C) the pressure of the gas (D) units of measurement.

30. Which of the following represents the molar volume of the gas correctly
(A) 22.4 L at 0°c and 1 atm pressure (B) 22.7 L at 0°c and 1 bar pressure
(C) 24.8 L at SATP conditions (D) 22.5 L at 25°C and 1 bar pressure.

31. Unit of equilibrium constant is
(A) $(\text{mol/L})^{1-n}$ (B) $(\text{mol/L})^{\Delta n}$
(C) $(\text{atm})^{\Delta n}$ (D) all of these

32. Degree of dissociation of reaction A $\rightleftharpoons$ nB. (initial no. of moles of A = 1)
(A) $\frac{D-d}{(n-1)d}$ (B) $\frac{M-m}{(n-1)m}$ (C) $\frac{x}{1}$ (D) none of the above

33. According to Charles' law :
(A) $V \propto \frac{1}{T}$ (B) $\left(\frac{dV}{dT}\right)_P = K$ (C) $\left(\frac{dT}{dV}\right)_P = K$ (D) $\left(\frac{1}{T} - \frac{V}{T^2}\right)_P = 0$

34. The equilibrium, $SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$ is attained at 25^0C in a closed container and an inert gas, helium is introduced. Which of the following statements is not correct?
(A) Concentration of SO_2, Cl_2 and SO_2Cl_2 change
(B) More chlorine is formed
(C) Concentration of SO_2 is reduced (D) more SO_2Cl_2 is formed.

Space for rough work

35. An example of irreversible reaction is
(A) $AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$
(B) $2Na + 2H_2O \rightarrow 2NaOH + H_2\uparrow$
(C) $NaOH + CH_3COOH \rightarrow CH_3COONa + H_2O$ (D) $Pb(NO_3)_2 + 2NaI \rightarrow PbI_2(S) + 2NaNO_3$

36. Steam is passed over hot carbon to attain the equilibrium at 400 K,

$C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$

The equilibrium constant K = 1.34 (dimension less) and the total pressure of the equilibrium mixture is 200 kPa. Which one is correct when equilibrium is attained ?
(A) Mole fraction of CO = mole fraction of H_2 = 0.388
(B) Mole fraction of CO = mole fraction of H_2 = 0.075
(C) Mole fraction of H_2O = 0.224
(D) Mole fraction of H_2O = 0.85

37. The following statement(s) is/are correct
(A) A plot of log K_p vs. 1/T is linear
(B) A plot of log [X] vs. time is linear for a first order reaction, $X \rightarrow P$
(C) A plot of log Pvs. 1/T is linear at constant volume
(D) A plot of P vs. 1/V is linear at constant temperature.

38. For the equilibrium

LiCl. $3NH_3(s) \rightleftharpoons LiCl.NH_3(s) + 2NH_3(g)$;

$K_p = 9atm^2$ at 37°C. A 5 litre vessel contains 0.1 mole of LiCl. NH_3. How many moles of NH_3 should be added to the flask at this temperature to derive the backward reaction for completion ?
Use : R = 0.082 atm –L/mol K
(A) 0.2 (B) 0.59 (C) 0.69 (D) 0.79

Space for rough work

SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entries (A), (B), (C) and (D)
- **Column II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column I** with the entries in **Column II**
- One or more entries in **Column I** may match with one or more entries in **Column II**.
- The ORS contains a 4 × 5 matrix whose layout will be similar to the one shown below:

(A)	(P)	(Q)	(R)	(S)	(T)
(B)	(P)	(Q)	(R)	(S)	(T)
(C)	(P)	(Q)	(R)	(S)	(T)
(D)	(P)	(Q)	(R)	(S)	(T)

- For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in **Column I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (V), (C) and (D).
- Marking entry in Column I.
  - **+2** If only the bubble(s) corresponding to all the correct match (s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–1** In all other cases.

39.

Column – I		Column - II	
(A)	$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$	(p)	Kp = Kc
(B)	$N_2O_4(g) \rightleftharpoons 2NO_2(g)$	(q)	$Kp = \frac{27\alpha^4 p^2}{16(1-\alpha^2)^2}$
(C)	$2ClF_3(g) \rightleftharpoons Cl_2(g) + 3F_2(g)$	(r)	$Kp = \frac{\alpha^2 p}{1-\alpha^2}$
(D)	$NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$	(s)	$Kp = \frac{4\alpha^2 p}{1-\alpha^2}$

Space for rough work

40.

Column – I		Column - II	
(A)	Boyle's Law	(p)	$V \propto n$ at const T & P
(B)	Charle's Law	(q)	$V \propto T$ at const n and P
(C)	Gay Lussac's Law	(r)	$P \propto \frac{1}{V}$ at const n and T
(D)	Avogadro's Law	(s)	$P \propto T$ at const n and V

PART III: MATHEMATICS

SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- Marking scheme:
  - **+4** If the bubble corresponding to the answer is darkened.
  - **0** In all other cases.

41. 'P' is any arbitrary point on the circumcircle of the equilateral triangle of side length 2 unit, then the value of $\left|\overrightarrow{PA}\right|^2 + \left|\overrightarrow{PB}\right|^2 + \left|\overrightarrow{PC}\right|^2$ must be

42. Let $\vec{a}$ and $\vec{b}$ be unit vectors such that $\left|\vec{a}+\vec{b}\right| = \sqrt{3}$, then the value of $\frac{10}{39}\left(2\vec{a}+5\vec{b}\right)\cdot\left(3\vec{a}+\vec{b}+\vec{a}\times\vec{b}\right)$ must be

43. ABCD is a parallelogram. A_1 and B_1 are the midpoints of sides BC and CD respectively. If $\overrightarrow{AA_1} + \overrightarrow{AB_1} = \lambda\overrightarrow{AC}$, then the value of 4λ must be

44. If the distance of the point $B\left(\hat{i}+2\hat{j}+3\hat{k}\right)$ from the line which is passing through $A\left(4\hat{i}+2\hat{j}+2\hat{k}\right)$ and which is parallel to the vector $\vec{c} = 2\hat{i}+3\hat{j}+6\hat{k}$ is λ, then the value of $\frac{2}{11}\left(\lambda^2+1\right)$ must be

Space for rough work

45. Let $\vec{a} = 2\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{b}$ be another vector such that $\vec{a} \cdot \vec{b} = 14$ and $\vec{a} \times \vec{b} = 3\hat{i} + \hat{j} - 8\hat{k}$, then the value of $\frac{|\vec{b}|^2}{6}$ is

46. Given the vectors $\vec{a}$ and $\vec{b}$, the angle between which equals 120°. If $|\vec{a}| = 3, |\vec{b}| = 4$ and the length of the vector $2\vec{a} - \frac{3\vec{b}}{2}$ is k, then the value of $\frac{1}{3\sqrt{3}}k$ is

47. If I be the incentre of the triangle ABC and a, b, c be the lengths of the sides then the vector $a\vec{IA} + b\vec{IB} + c\vec{IC}$ is equal to

48. Let $\vec{A}, \vec{B}$ and $\vec{C}$ be unit vectors. Suppose that $\vec{A} \cdot \vec{B} = \vec{A} \cdot \vec{C} = 0$ and that the angle between $\vec{B}$ and $\vec{C}$ is $\frac{\pi}{6}$, then $\vec{A} = k\left(\vec{B} \times \vec{C}\right)$ and |k| is equal to

SECTION 2 (Maximum Marks: 40)

- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct.
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- Marking scheme:
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–2** In all other cases

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49. Let $\vec{u}, \vec{v}, \vec{w}$ be three unit vectors such that $\vec{u} + \vec{v} + \vec{w} = \vec{a}, \vec{a} \cdot \vec{u} = \frac{3}{2}, \vec{a} \cdot \vec{v} = \frac{7}{4}$ and $|\vec{a}| = 2$, then

(A) $\vec{u} \cdot \vec{v} = \frac{3}{4}$ (B) $\vec{v} \cdot \vec{w} = 0$ (C) $\vec{u} \cdot \vec{w} = -\frac{1}{4}$ (D) none of these

---

Space for rough work

50. Non-zero vectors $\vec{a}$ and $\vec{b}$ are equally inclined to vector $\vec{c}$, if $\vec{c}$ is equal to

(A) $\frac{|\vec{b}|}{|\vec{a}|+|\vec{b}|}\vec{a}+\frac{|\vec{a}|}{|\vec{a}|+|\vec{b}|}\vec{b}$ (B) $\frac{|\vec{a}|}{|\vec{a}|+|\vec{b}|}\vec{a}+\frac{|\vec{b}|}{|\vec{a}|+|\vec{b}|}\vec{b}$

(C) $\frac{|\vec{a}|}{|\vec{a}|+2|\vec{b}|}\vec{a}+\frac{|\vec{b}|}{|\vec{a}|+2|\vec{b}|}\vec{b}$ (D) $\frac{|\vec{b}|}{2|\vec{a}|+|\vec{b}|}\vec{a}+\frac{|\vec{a}|}{2|\vec{a}|+|\vec{b}|}\vec{b}$

51. Let the unit vectors $\vec{a}$ and $\vec{b}$ be perpendicular and the unit vector $\vec{c}$ be inclined at an angle θ to both $\vec{a}$ and $\vec{b}$. If $\vec{c}=\alpha\vec{a}+\beta\vec{b}+\gamma\left(\vec{a}+\vec{b}\right)$, then

(A) $\alpha = \beta$ (B) $\gamma^2 = 1 - 2\alpha^2$ (C) $\gamma^2 = -\cos 2\theta$ (D) $\beta^2 = \frac{1+\cos 2\theta}{2}$

52. If the vectors $\vec{b}=\left(\tan\alpha,-1,2\sqrt{\sin\frac{\alpha}{2}}\right)$ and $\vec{c}=\left(\tan\alpha,\tan\alpha,-\frac{3}{\sqrt{\sin\frac{\alpha}{2}}}\right)$ are orthogonal and a vector $\vec{a}$ = (1, 3, sin 2α) makes an obtuse angle with the z-axis, then the value of α is

(A) $\alpha = (4n + 1)\pi - \tan^{-1}2$ (B) $\alpha = (4n + 2)\pi - \tan^{-1}2$

(C) $\alpha = (4n + 1)\pi + \tan^{-1}2$ (D) $\alpha = (4n + 2)\pi + \tan^{-1}2$

53. If $\vec{a},\vec{b},\vec{c}$ are three non-coplanar vectors such that $\vec{r}_1=\vec{a}-\vec{b}+\vec{c},\vec{r}_2=\vec{b}+\vec{c}-\vec{a},\vec{r}_3=\vec{c}+\vec{a}+\vec{b},\vec{r}=2\vec{a}-3\vec{b}+4\vec{c}$
If $\vec{r}=\lambda_1\vec{r}_1+\lambda_2\vec{r}_2+\lambda_3\vec{r}_3$, then

(A) $\lambda_1 = \frac{7}{2}$ (B) $\lambda_1 + \lambda_2 = 3$ (C) $\lambda_1 + \lambda_2 + \lambda_3 = 4$ (D) $\lambda_2 + \lambda_3 = 2$

54. If the unit vectors $\vec{a}$ and $\vec{b}$ are inclined at an angle 2θ such that $|\vec{a}-\vec{b}| < 1$ and $0 \le \theta \le \pi$, then θ lies in the interval

(A) $\left[0,\frac{\pi}{6}\right]$ (B) $\left(\frac{5\pi}{6},\pi\right]$ (C) $\left[\frac{\pi}{6},\frac{\pi}{2}\right]$ (D) $\left[\frac{\pi}{2},\frac{5\pi}{6}\right]$

Space for rough work

55. Let $\vec{a}$ and $\vec{b}$ be two non-collinear unit vectors. If $\vec{u} = \vec{a} - (\vec{a} \cdot \vec{b})\vec{b}$ and $\vec{v} = \vec{a} \times \vec{b}$, then $|\vec{v}|$ is

(A) $|\vec{u}|$ (B) $|\vec{u}| + |\vec{u} \cdot \vec{a}|$ (C) $|\vec{u}| + |\vec{u} \cdot \vec{b}|$ (D) $|\vec{u}| + \vec{u} \cdot (\vec{a} + \vec{b})$

56. The vectors (x, x + 1, x + 2), (x + 3, x + 4, x + 5) and (x + 6, x + 7, x + 8) are coplanar for
(A) all values of x (B) x < 0 (C) x > 0 (D) none of these

57. If vectors $\vec{a}$ and $\vec{b}$ are non-collinear, then $\frac{\vec{a}}{|\vec{a}|} + \frac{\vec{b}}{|\vec{b}|}$ is

(A) a unit vector (B) in the plane of $\vec{a}$ and $\vec{b}$

(C) equally inclined to $\vec{a}$ and $\vec{b}$ (D) perpendicular to $\vec{a}$ and $\vec{b}$

58. If $\overrightarrow{DA} = \vec{a}, \overrightarrow{AB} = \vec{b}$ and $\overrightarrow{CB} = k\vec{a}$, where k > 0 and X, Y are the mid points of DB and AC respectively such that $|\vec{a}|$ = 17 and $|\overrightarrow{XY}|$ = 4, then k is equal to

(A) $\frac{8}{17}$ (B) $\frac{9}{17}$ (C) $\frac{25}{17}$ (D) $\frac{4}{17}$

SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entries (A), (B), (C) and (D)
- **Column II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column I** with the entries in **Column II**
- One or more entries in **Column I** may match with one or more entries in **Column II**.
- The ORS contains a 4 × 5 matrix whose layout will be similar to the one shown below:

(A)	(P)	(Q)	(R)	(S)	(T)
(B)	(P)	(Q)	(R)	(S)	(T)
(C)	(P)	(Q)	(R)	(S)	(T)
(D)	(P)	(Q)	(R)	(S)	(T)

- For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in **Column I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (V), (C) and (D).
- Marking entry in Column I.

+2 If only the bubble(s) corresponding to all the correct match (s) is (are) darkened.
0 If none of the bubbles is darkened.
–1 In all other cases.

Space for rough work

59. $\vec{a}$ and $\vec{b}$ form the consecutive sides of a regular hexagon ABCDEF.

Column I		Column II	
(A)	If $\overrightarrow{CD} = x\vec{a} + y\vec{b}$, then	p.	x = –2
(B)	If $\overrightarrow{CE} = x\vec{a} + y\vec{b}$, then	q.	x = –1
(C)	If $\overrightarrow{AE} = x\vec{a} + y\vec{b}$, then	r.	y = 1
(D)	If $\overrightarrow{AD} = -x\vec{b}$, then	s.	y = 2

60. Match the following

Column I		Column II	
(A)	The possible value of a if $\vec{r} = (\hat{i} + \hat{j}) + \lambda(\hat{i} + 2\hat{j} - \hat{k})$ and $\vec{r} = (\hat{i} + 2\hat{j}) + \mu(-\hat{i} + \hat{j} + a\hat{k})$ are not consistent, where λ and μ are scalars, is	p.	–4
(B)	The angle between vectors $\vec{a} = \lambda\hat{i} - 3\hat{j} - \hat{k}$ and $\vec{b} = 2\lambda\hat{i} + \lambda\hat{j} - \hat{k}$ is acute, whereas vector $\vec{b}$ makes an obtuse angle with the axes of coordinates. Then λ may be	q.	–2
(C)	The possible value of 'a' such that $2\hat{i} - \hat{j} + \hat{k}, \hat{i} + 2\hat{j} + (1+a)\hat{k}$ and $3\hat{i} + a\hat{j} + 5\hat{k}$ are coplanar is	r.	2
(D)	If $\vec{A} = 2\hat{i} + \lambda\hat{j} + 3\hat{k}, \vec{B} = 2\hat{i} + \lambda\hat{j} + \hat{k}, \vec{C} = 3\hat{i} + \hat{j}$ and $\vec{A} + \lambda\vec{B}$ is perpendicular to $\vec{C}$, then $\lvert 2\lambda \rvert$ is	s.	3
		t.	0

Space for rough work

FIITJEE RET – 11

(2018 – 2020)(1ST YEAR_REGULAR)

IIT-2015 (P1)_SET–A

DATE: 17.09.2018

ANSWERS

PHYSICS

1.	**4**	2.	**Bonus**	3.	**3**	4.	**6**
5.	**4**	6.	**5**	7.	**1**	8.	**3**
9.	**A**	10.	**A**	11.	**C**	12.	**A,C**
13.	**A,B,C**	14.	A,**B,C,D**	15.	**B,C**	16.	**B,C**
17.	**A,D**	18.	**B,C**	19.	**A- r; B- s;C-p; D-q**		
20.	**A- r; B- q;C-p; D-r**						

CHEMISTRY

21.	**8**	22.	**1**	23.	**1**	24.	**9**
25.	**9**	26.	**1**	27.	**8**	28.	**1**
29.	**A, B, C**	30.	**A, B, C**	31.	**B, C**	32.	**A, B, C**
33.	**B, C**	34.	**A, B, C, D**	35.	**A, B, D**	36.	**A, C**
37.	**A, B, D**	38.	**D**	39.	**A → r ; B → s; C → q ; D → p**		
40.	**A → r; B → q ; C → s; D → p**						

MATHEMATICS

41.	**8**	42.	**5**	43.	**6**	44.	**2**
45.	**5**	46.	**2**	47.	**0**	48.	**2**
49.	**ABC**	50.	**AD**	51.	**A**	52.	**AB**
53.	**AC**	54.	**B**	55.	**AC**	56.	**ABC**
57.	**BC**	58.	**BC**	59.	**A → q, r; B → p, r; C → q, s; D → p**		
60.	**A → p, q, r, s, t; B → p, q; C → p, r; D → r**						

FIITJEE RET – 11

(2018 – 2020)(1ST YEAR_REGULAR)

IIT-2015 (P1)_SET–B

DATE: 17.09.2018

Time: 3 hours **Maximum Marks: 264**

INSTRUCTIONS:

A. General

1. This booklet is your Question Paper containing 60 questions.
6. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed to be carried inside the examination hall.
7. Fill in the boxes provided for Name and Enrolment No.
8. The answer sheet, a machine-readable Objective Response (ORS), is provided separately.
9. DO NOT TAMPER WITH / MULTILATE THE ORS OR THE BOOKLET.

B. Filling in the OMR:

6. The instructions for the OMR sheet are given on the OMR itself.

C. Question paper format:

14. The question paper consists of **3 parts (Physics, Chemistry and Mathematics)**. Each part consists of **two sections**.
15. **Section I** contains **8 questions**. The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).
16. **Section II** contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.
17. **Section III** contains **2 Match the following** type questions and you will have to match entries in Column I with the entries in Column II

D. Marking Scheme

18. For each question in **Section I**, you will be awarded **4 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **No negative marks** will be awarded for incorrect answers in this section.
19. For each question in **Section II**, you will be awarded **4 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **–2 marks** will be awarded for incorrect answers in this section.
20. For each question in **Section III**, you will be awarded **2 marks** for each entry in Column I; if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **–1 marks** will be awarded for incorrect answers in this section.

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.: ☐☐☐☐☐☐☐☐☐☐

PAPER–I
PART I: PHYSICS
SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- Marking scheme:
  - **+4** If the bubble corresponding to the answer is darkened.
  - **0** In all other cases.

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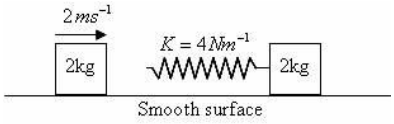
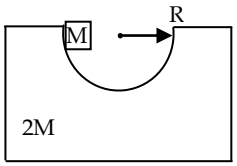
1. A body of mass m_1= 4kg moves at $5\hat{i}$ m/s and another body of mass m_2 = 2 kg moves at $10\hat{i}$ m/s. The kinetic energy of centre of mass is found to be $\frac{100n}{3}$ J. Find the value of n ?

2. The linear mass density of a ladder of length ℓ increases linearly from λ_0 to $2\lambda_0$ from one end A to the other end B. The position of the centre of mass from end A is $\frac{nL}{9}$, find n?

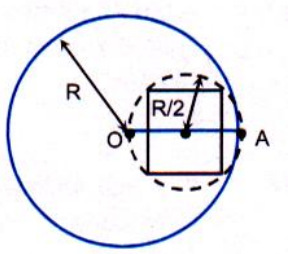
3. In the arrangement shown in figure the velocity of centre of mass after collision (in SI units)



4. A block of mass $2M$ with a semi circular track of radius R rests on a smooth horizontal floor. A sphere of mass M and radius $R/10$ is released from the top of track as shown. When sphere reaches the bottom of track then block has moved by a distance of $\frac{K_0R}{10}$. Then K_0 is ____

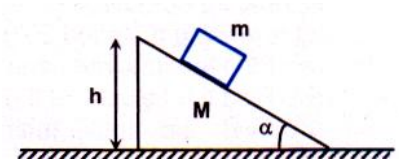


5. There is thin uniform disc of radius R and mass per unit area σ, in which a hole of radius R/2 has been cut out as shown in the figure. Inside the hole a square plate of same mass per unit area σ is inserted so that its corners touch the periphery of the hole. Centre of mass of the system is $\frac{R(2-\pi)}{(6\pi+N)}$. Find N.

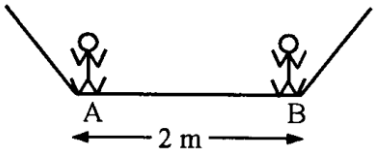


Space for rough work

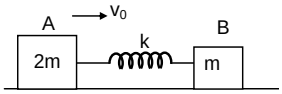
6. A cubical block of mass m is released from rest at a height h on a frictionless surface of a movable wedge of mass M, which is, in turn is placed on a horizontal frictionless surface as shown in the figure. The velocity of the triangular block when the smaller block reaches the bottom is $\frac{2\sqrt{N}}{3}$. Find N.



7. Two persons A and B of weight 80 kg and 50 kg respectively are standing at opposite ends of a boat of mass 70 kg and length 2 m, at rest. When they interchange their positions then displacement of the centre of mass of the boat will be (n x 10) cm. Find n.



8. Two blocks A & B of mass 2m and m respectively are placed on a smooth surface connected by a spring of constant k = 100 N/m. The spring is initially unstretched when the block A is given a velocity v_0 = 9 m/s. Find the velocity (in m/s) of block A at the instant when the spring has maximum compression (given m = 2 kg)



SECTION 2 (Maximum Marks: 40)

- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct.
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- Marking scheme:
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–2** In all other cases

9. Choose the incorrect statement
   (A) if the linear momentum of a particle is known, we can find its kinetic energy
   (B) if the kinetic energy of a particle is known, we can necessary find its linear momentum
   (C) if the total mechanical energy of a particle is zero, its linear momentum is necessarily zero
   (D) if the total mechanical energy of a particle is zero, its linear momentum is necessarily non–zero

Space for rough work

10. The momentum of a particle is given by $\vec{P}=\left(4\sin t\vec{i}-4\cos t\vec{j}\right)$ kg m/s. Select the correct alternative(s)

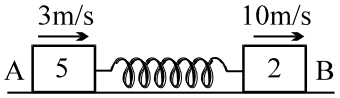
(A) momentum $\vec{P}$ of the particle is always parallel to $\vec{F}$

(B) momentum $\vec{P}$ of the particle is always perpendicular to $\vec{F}$

(C) magnitude of momentum $\vec{P}$ is always constant

(D) none of the above

11. Two blocks A (5kg) and B(2kg) attached to the ends of a spring constant 1120N/m are placed on a smooth horizontal plane with the spring undeformed. Simultaneously velocities of 3m/s and 10m/s along the line of the spring in the same direction are imparted to A and B then



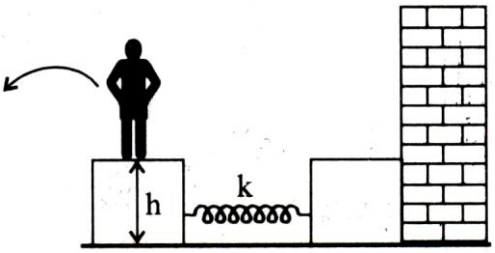
(A) when the extension of the spring is maximum the velocities of A and B are zero.

(B) the maximum extension of the spring is 25cm.

(C) maximum extension and maximum compression occur alternately.

(D) none of these

12. Two identical blocks of mass 2M are joined by means of a light spring of spring constant k. A man of mass M is standing on one of the block as shown in the diagram. If man jumps horizontally with a velocity V relative to block and horizontal surface is smooth, then



(A) the maximum compression in the spring is $\sqrt{\frac{2M}{k}}\left(\frac{V}{3}\right)$

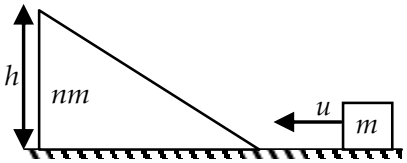
(B) man lands at horizontal distance $V\sqrt{\frac{2h}{g}}$ from initial position of the block

(C) right block loses contact with wall when the elongation in spring is maximum

(D) velocity of centre of mass of two blocks after 2M loses contact with wall is $\frac{V}{6}$

Space for rough work

13. A block of mass m is moving with velocity u as shown in the figure. The wedge has mass nm and height h. All surfaces are smooth.



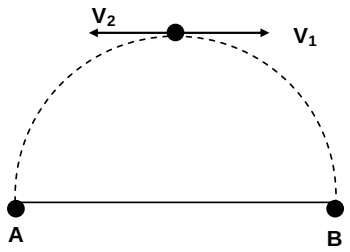
(A) Velocity of centre of mass is zero when block reaches the highest point on the wedge

(B) horizontal component of velocity of centre of mass is $\frac{u}{1+n}$

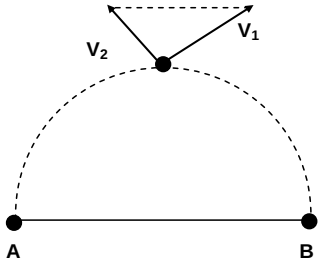
(C) If the block has to reach the top of wedge then $u=\sqrt{2gh\ 1+1/n}$

(D) Block reaches top of the wedge when velocity $u=\sqrt{2gh}$

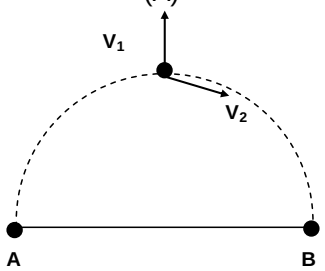
14. A bomb projected from A lands at B in absence of an explosion. At top most point , it explodes into two equal fragments. After explosion each fragment moves in a separate path and come to rest after hitting the ground. Find out in which of the following cases centre of mass of the system will finally(after landing of both fragments) be at ' B' (v_1,v_2 are velocities of fragments after explosion)



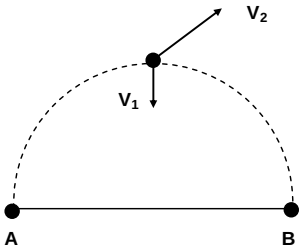
(A)



(B)



(C)



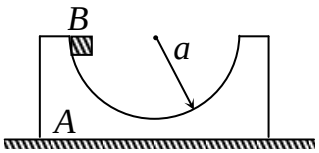
(D)

15. A bomb of mass 7 m explodes into two fragments of masses 4 m and 3m. If the momentum of the lighter fragment is 'P', then the energy released in the explosion is

(A) $\frac{7P^2}{24m}$ (B) $\frac{9P^2}{16m}$ (C) $\frac{11P^2}{24m}$ (D) $\frac{5P^2}{14m}$

Space for rough work

16. Figure shows a block *A* of mass 6*m* having a smooth semi-circular groove of radius a placed on a smooth horizontal surface. A block *B* of mass *m* is released from a position in groove where its radius is horizontal. The speed of block *A* when block *B* reaches its bottom is



(A) $\sqrt{ga}$ (B) $\sqrt{\frac{2ga}{7}}$ (C) $\sqrt{\frac{ga}{21}}$ (D) zero

17. A strip of wood of mass M and length ℓ is placed on a smooth horizontal surface. An insect of mass m starts at one end of the strip and walks to the other end in time t, moving with a constant speed.

(A) The speed of the insect as seen from the ground is $< \frac{\ell}{t}$

(B) The speed of the strip as seen from the ground is $\frac{\ell}{t}\left(\frac{M}{M+m}\right)$

(C) The speed of the strip as seen from the ground is $\frac{\ell}{t}\left(\frac{m}{M+m}\right)$

(D) The total kinetic energy of the system is $\frac{1}{2}(m+M)\left(\frac{\ell}{t}\right)^2$

18. A shell of mass 2 kg is fired with a velocity of 40 m/s at an angle of inclination of 30^o with horizontal. It explodes into two identical fragments at its highest point. One of the fragments retraces the path. Then

(A) velocity of the other fragment just after the explosion is $60\sqrt{3}$ m/s

(B) distance between the two fragments when both have reached the ground [assuming they come to rest after hitting the ground] is $160\sqrt{3}$ m

(C) both the fragments reach the ground simultaneously

(D) the velocity of separation of the two fragments just after the explosion is $40\sqrt{3}$ m/s

Space for rough work

SECTION 3 (Maximum Marks: 16)

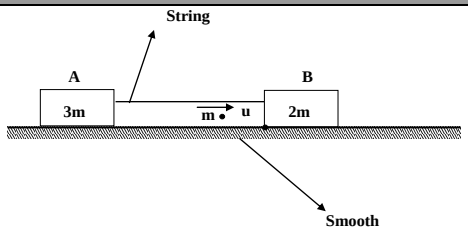
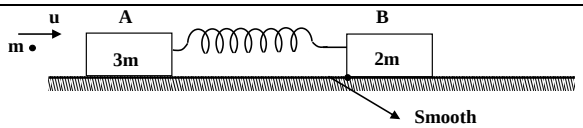
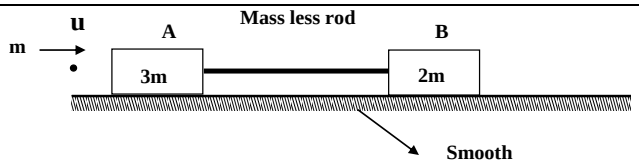
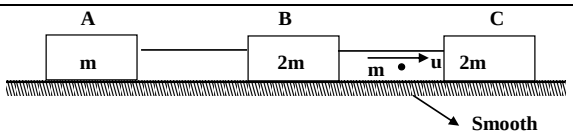
- This section contains **TWO** questions.
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entries (A), (B), (C) and (D)
- **Column II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column I** with the entries in **Column II**
- One or more entries in **Column I** may match with one or more entries in **Column II**.
- The ORS contains a 4×5 matrix whose layout will be similar to the one shown below:

(A)	(P)	(Q)	(R)	(S)	(T)
(B)	(P)	(Q)	(R)	(S)	(T)
(C)	(P)	(Q)	(R)	(S)	(T)
(D)	(P)	(Q)	(R)	(S)	(T)

- For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in **Column I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (V), (C) and (D).
- Marking entry in Column I.
  - **+2** If only the bubble(s) corresponding to all the correct match (s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–1** In all other cases.

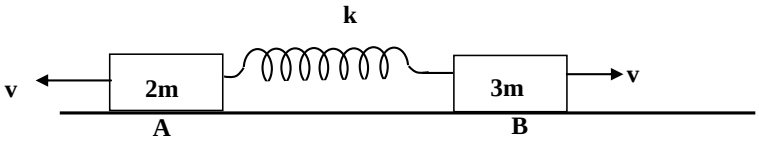
Space for rough work

19. In the column – I different situations are shown. In each case particle is moving with speed u and sticks to the blocks as shown in figure. Match the following.

Column – I		Column – II	
(A)	 Particle of mass 'm' sticks to block 'B'. Then magnitude of impulse of tension on block B during collision is ___	(p)	$\frac{mu}{3}$
(B)	 Particle of mass 'm' sticks to block 'A'. after colliding. Find the magnitude of normal on the particle during collision.	(q)	$\frac{3mu}{4}$
(C)	 Particle sticks to block A. Then impulse of rod force on block A during collision will be __	(r)	$\frac{mu}{2}$
(D)	 Particle sticks to block 'C'. Impulse of tension force (between block B and block C) on block B during collision is__	(s)	$\frac{2mu}{3}$
		(t)	None of these

Space for rough work

20. Two blocks A and B of masses 2m and 3m placed on smooth horizontal surface are connected with a light spring. The two blocks are given velocities as shown when spring is at natural length. Match the following



Column – I		Column – II	
(A)	Minimum magnitude of velocity of A $\left(v_{A_{min}}\right)$ during motion	(p)	v
(B)	Maximum magnitude of velocity of A $\left(v_{A_{max}}\right)$ during motion	(q)	$\frac{v}{5}$
(C)	Maximum magnitude of velocity of B $\left(v_{B_{max}}\right)$ during motion	(r)	0
(D)	Velocity of centre of mass $\left(v_{CM}\right)$ of the system comprised of blocks A, B and spring	(s)	$\frac{7v}{5}$

Space for rough work

PART II: CHEMISTRY

SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- Marking scheme:
  - **+4** If the bubble corresponding to the answer is darkened.
  - **0** In all other cases.

21. For a reversible system $X_{(g)} \rightleftharpoons Y_{(g)} + Z_{(g)}$ a quantity of X was heated at constant pressure P at a certain temperature. The equilibrium partial pressure of X was found to be $\frac{P}{7}$. The value of K_P at given temperature is $P.\frac{X}{7}$. Then $\frac{x}{4}$ is _____

22. If in an equilibrium reaction if $\Delta G^0 = 0$, then the equilibrium constant , K should be equal to

23. If concentration of SO_2 and O_2 in the equilibrium reaction, $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ are quadrupled, the concentration of SO_3 now will be …. Times.

24. For the reaction involving oxidation of ammonia by oxygen to form nitric oxide and water vapour, the equilibrium constant has the units $(bar)^n$. Then n is

25. An ideal gas on heating shows a rise in temperature by 8% at constant pressure. The % increase in volume of gas is.

26. A gas has a vapour density 11.2. The volume occupied by 1g of the gas at STP is x litre. What is x ?

27. Ammonium carbamate (NH_2COONH_4) when heated to 200^0C gives a mixture of NH_3 and CO_2 vapour with a vapour density of 13. What is the degree of dissociation of ammonium carbamate ?

28. Two solid compounds X and Y dissociate at a certain temperature as follows :
$X(s) \rightleftharpoons A(g) + 2B(g)$; $K_{P_1} = 7.2 \times 10^{-2}$ atm^3 ; $Y(S) \rightleftharpoons 2B(g) + C(g)$; $K_{P_2} = 3.6 \times 10^{-2}$ atm^3
The total pressure of gases over the mixture of X and Y is P x 10^{-1} atm. Find the value of P

Space for rough work

SECTION 2 (Maximum Marks: 40)

- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct.
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- Marking scheme:
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–2** In all other cases

29. The equilibrium, $SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$ is attained at 25^0C in a closed container and an inert gas, helium is introduced. Which of the following statements is not correct?
(A) Concentration of SO_2, Cl_2 and SO_2Cl_2 change
(B) More chlorine is formed
(C) Concentration of SO_2 is reduced
(D) more SO_2Cl_2 is formed.

30. An example of irreversible reaction is
(A) $AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$
(B) $2Na + 2H_2O \rightarrow 2NaOH + H_2\uparrow$
(C) $NaOH + CH_3COOH \rightarrow CH_3COONa + H_2O$
(D) $Pb(NO_3)_2 + 2NaI \rightarrow PbI_2(S) + 2NaNO_3$

31. Steam is passed over hot carbon to attain the equilibrium at 400 K,

$$C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$$

The equilibrium constant K = 1.34 (dimension less) and the total pressure of the equilibrium mixture is 200 kPa. Which one is correct when equilibrium is attained ?
(A) Mole fraction of CO = mole fraction of H_2 = 0.388
(B) Mole fraction of CO = mole fraction of H_2 = 0.075
(C) Mole fraction of H_2O = 0.224
(D) Mole fraction of H_2O = 0.85

32. The following statement(s) is/are correct
(A) A plot of log K_p vs. 1/T is linear
(B) A plot of log [X] vs. time is linear for a first order reaction, $X \rightarrow P$
(C) A plot of log Pvs. 1/T is linear at constant volume
(D) A plot of P vs. 1/V is linear at constant temperature.

Space for rough work

33. For the equilibrium

LiCl. $3NH_3(s) \rightleftharpoons LiCl.NH_3(s) + 2NH_3(g)$;

$K_p = 9atm^2$ at 37°C. A 5 litre vessel contains 0.1 mole of LiCl. NH_3. How many moles of NH_3 should be added to the flask at this temperature to derive the backward reaction for completion ?
Use : R = 0.082 atm –L/mol K
(A) 0.2 (B) 0.59 (C) 0.69 (D) 0.79

34. In the equation PV = RT, the value of R will not depend on (one or more)
(A) the nature of the gas (B) the temperature of the gas
(C) the pressure of the gas (D) units of measurement.

35. Which of the following represents the molar volume of the gas correctly
(A) 22.4 L at 0°c and 1 atm pressure (B) 22.7 L at 0°c and 1 bar pressure
(C) 24.8 L at SATP conditions (D) 22.5 L at 25°C and 1 bar pressure.

36. Unit of equilibrium constant is
(A) $(mol/L)^{1-n}$ (B) $(mol/L)^{\Delta n}$
(C) $(atm)^{\Delta n}$ (D) all of these

37. Degree of dissociation of reaction A $\rightleftharpoons$ nB. (initial no. of moles of A = 1)

(A) $\frac{D-d}{(n-1)d}$ (B) $\frac{M-m}{(n-1)m}$ (C) $\frac{x}{1}$ (D) none of the above

38. According to Charles' law :

(A) $V \propto \frac{1}{T}$ (B) $\left(\frac{dV}{dT}\right)_P = K$ (C) $\left(\frac{dT}{dV}\right)_P = K$ (D) $\left(\frac{1}{T} - \frac{V}{T^2}\right)_P = 0$

Space for rough work

SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entries (A), (B), (C) and (D)
- **Column II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column I** with the entries in **Column II**
- One or more entries in **Column I** may match with one or more entries in **Column II**.
- The ORS contains a 4×5 matrix whose layout will be similar to the one shown below:

(A) (P) (Q) (R) (S) (T)
(B) (P) (Q) (R) (S) (T)
(C) (P) (Q) (R) (S) (T)
(D) (P) (Q) (R) (S) (T)

- For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in **Column I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (V), (C) and (D).
- Marking entry in Column I.
  - **+2** If only the bubble(s) corresponding to all the correct match (s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–1** In all other cases.

39.

Column – I		Column - II	
(A)	Boyle's Law	(p)	$V \propto n$ at const T & P
(B)	Charle's Law	(q)	$V \propto T$ at const n and P
(C)	Gay Lussac's Law	(r)	$P \propto \frac{1}{V}$ at const n and T
(D)	Avogadro's Law	(s)	$P \propto T$ at const n and V

Space for rough work

40.

Column – I		Column - II	
(A)	$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$	(p)	Kp = Kc
(B)	$N_2O_4(g) \rightleftharpoons 2NO_2(g)$	(q)	$Kp = \frac{27\alpha^4 p^2}{16(1-\alpha^2)^2}$
(C)	$2ClF_3(g) \rightleftharpoons Cl_2(g) + 3F_2(g)$	(r)	$Kp = \frac{\alpha^2 p}{1-\alpha^2}$
(D)	$NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$	(s)	$Kp = \frac{4\alpha^2 p}{1-\alpha^2}$

PART III: MATHEMATICS

SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- Marking scheme:
  - **+4** If the bubble corresponding to the answer is darkened.
  - **0** In all other cases.

41. Let $\vec{a} = 2\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{b}$ be another vector such that $\vec{a} \cdot \vec{b} = 14$ and $\vec{a} \times \vec{b} = 3\hat{i} + \hat{j} - 8\hat{k}$, then the value of $\frac{|\vec{b}|^2}{6}$ is

42. Given the vectors $\vec{a}$ and $\vec{b}$, the angle between which equals 120°. If $|\vec{a}| = 3, |\vec{b}| = 4$ and the length of the vector $2\vec{a} - \frac{3\vec{b}}{2}$ is k, then the value of $\frac{1}{3\sqrt{3}}k$ is

Space for rough work

43. If I be the incentre of the triangle ABC and a, b, c be the lengths of the sides then the vector $a\overrightarrow{IA}+b\overrightarrow{IB}+c\overrightarrow{IC}$ is equal to

44. Let $\vec{A},\vec{B}$ and $\vec{C}$ be unit vectors. Suppose that $\vec{A}\cdot\vec{B}=\vec{A}\cdot\vec{C}=0$ and that the angle between $\vec{B}$ and $\vec{C}$ is $\frac{\pi}{6}$, then $\vec{A}=k\left(\vec{B}\times\vec{C}\right)$ and |k| is equal to

45. 'P' is any arbitrary point on the circumcircle of the equilateral triangle of side length 2 unit, then the value of $\left|\overrightarrow{PA}\right|^2+\left|\overrightarrow{PB}\right|^2+\left|\overrightarrow{PC}\right|^2$ must be

46. Let $\vec{a}$ and $\vec{b}$ be unit vectors such that $\left|\vec{a}+\vec{b}\right|=\sqrt{3}$, then the value of $\frac{10}{39}\left(2\vec{a}+5\vec{b}\right)\cdot\left(3\vec{a}+\vec{b}+\vec{a}\times\vec{b}\right)$ must be

47. ABCD is a parallelogram. A_1 and B_1 are the midpoints of sides BC and CD respectively. If $\overrightarrow{AA_1}+\overrightarrow{AB_1}=\lambda\overrightarrow{AC}$, then the value of 4λ must be

48. If the distance of the point $B\left(\hat{i}+2\hat{j}+3\hat{k}\right)$ from the line which is passing through $A\left(4\hat{i}+2\hat{j}+2\hat{k}\right)$ and which is parallel to the vector $\vec{c}=2\hat{i}+3\hat{j}+6\hat{k}$ is λ, then the value of $\frac{2}{11}\left(\lambda^2+1\right)$ must be

SECTION 2 (Maximum Marks: 40)

- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct.
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- Marking scheme:
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  - **0** If none of the bubbles is darkened.
  - **–2** In all other cases

49. If the unit vectors $\vec{a}$ and $\vec{b}$ are inclined at an angle 2θ such that $\left|\vec{a}-\vec{b}\right|<1$ and $0\le\theta\le\pi$, then θ lies in the interval

(A) $\left[0,\frac{\pi}{6}\right]$ (B) $\left(\frac{5\pi}{6},\pi\right]$ (C) $\left[\frac{\pi}{6},\frac{\pi}{2}\right]$ (D) $\left[\frac{\pi}{2},\frac{5\pi}{6}\right]$

Space for rough work

50. Let $\vec{a}$ and $\vec{b}$ be two non-collinear unit vectors. If $\vec{u} = \vec{a} - (\vec{a} \cdot \vec{b})\vec{b}$ and $\vec{v} = \vec{a} \times \vec{b}$, then $|\vec{v}|$ is

(A) $|\vec{u}|$ (B) $|\vec{u}| + |\vec{u} \cdot \vec{a}|$ (C) $|\vec{u}| + |\vec{u} \cdot \vec{b}|$ (D) $|\vec{u}| + \vec{u} \cdot (\vec{a} + \vec{b})$

51. The vectors (x, x + 1, x + 2), (x + 3, x + 4, x + 5) and (x + 6, x + 7, x + 8) are coplanar for
(A) all values of x (B) x < 0 (C) x > 0 (D) none of these

52. If vectors $\vec{a}$ and $\vec{b}$ are non-collinear, then $\frac{\vec{a}}{|\vec{a}|} + \frac{\vec{b}}{|\vec{b}|}$ is

(A) a unit vector (B) in the plane of $\vec{a}$ and $\vec{b}$
(C) equally inclined to $\vec{a}$ and $\vec{b}$ (D) perpendicular to $\vec{a}$ and $\vec{b}$

53. If $\overrightarrow{DA} = \vec{a}, \overrightarrow{AB} = \vec{b}$ and $\overrightarrow{CB} = k\vec{a}$, where k > 0 and X, Y are the mid points of DB and AC respectively such that $|\vec{a}| = 17$ and $|\overrightarrow{XY}| = 4$, then k is equal to

(A) $\frac{8}{17}$ (B) $\frac{9}{17}$ (C) $\frac{25}{17}$ (D) $\frac{4}{17}$

54. Let $\vec{u}, \vec{v}, \vec{w}$ be three unit vectors such that $\vec{u} + \vec{v} + \vec{w} = \vec{a}$, $\vec{a} \cdot \vec{u} = \frac{3}{2}$, $\vec{a} \cdot \vec{v} = \frac{7}{4}$ and $|\vec{a}| = 2$, then

(A) $\vec{u} \cdot \vec{v} = \frac{3}{4}$ (B) $\vec{v} \cdot \vec{w} = 0$ (C) $\vec{u} \cdot \vec{w} = -\frac{1}{4}$ (D) none of these

55. Non-zero vectors $\vec{a}$ and $\vec{b}$ are equally inclined to vector $\vec{c}$, if $\vec{c}$ is equal to

(A) $\frac{|\vec{b}|}{|\vec{a}| + |\vec{b}|}\vec{a} + \frac{|\vec{a}|}{|\vec{a}| + |\vec{b}|}\vec{b}$ (B) $\frac{|\vec{a}|}{|\vec{a}| + |\vec{b}|}\vec{a} + \frac{|\vec{b}|}{|\vec{a}| + |\vec{b}|}\vec{b}$

(C) $\frac{|\vec{a}|}{|\vec{a}| + 2|\vec{b}|}\vec{a} + \frac{|\vec{b}|}{|\vec{a}| + 2|\vec{b}|}\vec{b}$ (D) $\frac{|\vec{b}|}{2|\vec{a}| + |\vec{b}|}\vec{a} + \frac{|\vec{a}|}{2|\vec{a}| + |\vec{b}|}\vec{b}$

Space for rough work

56. Let the unit vectors $\vec{a}$ and $\vec{b}$ be perpendicular and the unit vector $\vec{c}$ be inclined at an angle θ to both $\vec{a}$ and $\vec{b}$. If $\vec{c} = \alpha\vec{a} + \beta\vec{b} + \gamma\left(\vec{a} + \vec{b}\right)$, then

(A) $\alpha = \beta$ (B) $\gamma^2 = 1 - 2\alpha^2$ (C) $\gamma^2 = -\cos 2\theta$ (D) $\beta^2 = \frac{1+\cos 2\theta}{2}$

57. If the vectors $\vec{b} = \left(\tan\alpha, -1, 2\sqrt{\sin\frac{\alpha}{2}}\right)$ and $\vec{c} = \left(\tan\alpha, \tan\alpha, -\frac{3}{\sqrt{\sin\frac{\alpha}{2}}}\right)$ are orthogonal and a vector $\vec{a}$ = (1, 3, sin 2α) makes an obtuse angle with the z-axis, then the value of α is

(A) $\alpha = (4n + 1)\pi - \tan^{-1}2$ (B) $\alpha = (4n + 2)\pi - \tan^{-1}2$
(C) $\alpha = (4n + 1)\pi + \tan^{-1}2$ (D) $\alpha = (4n + 2)\pi + \tan^{-1}2$

58. If $\vec{a}, \vec{b}, \vec{c}$ are three non-coplanar vectors such that $\vec{r}_1 = \vec{a} - \vec{b} + \vec{c}, \vec{r}_2 = \vec{b} + \vec{c} - \vec{a}, \vec{r}_3 = \vec{c} + \vec{a} + \vec{b}, \vec{r} = 2\vec{a} - 3\vec{b} + 4\vec{c}$
If $\vec{r} = \lambda_1\vec{r}_1 + \lambda_2\vec{r}_2 + \lambda_3\vec{r}_3$, then

(A) $\lambda_1 = \frac{7}{2}$ (B) $\lambda_1 + \lambda_2 = 3$ (C) $\lambda_1 + \lambda_2 + \lambda_3 = 4$ (D) $\lambda_2 + \lambda_3 = 2$

SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column I** and **Column II**
- **Column I** has **four** entries (A), (B), (C) and (D)
- **Column II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column I** with the entries in **Column II**
- One or more entries in **Column I** may match with one or more entries in **Column II**.
- The ORS contains a 4 $\times$ 5 matrix whose layout will be similar to the one shown below:

(A)	(P)	(Q)	(R)	(S)	(T)
(B)	(P)	(Q)	(R)	(S)	(T)
(C)	(P)	(Q)	(R)	(S)	(T)
(D)	(P)	(Q)	(R)	(S)	(T)

- For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in **Column I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (V), (C) and (D).
- Marking entry in Column I.

+2 If only the bubble(s) corresponding to all the correct match (s) is (are) darkened.
0 If none of the bubbles is darkened.
–1 In all other cases.

Space for rough work

59. Match the following

Column I		Column II	
(A)	The possible value of a if $\vec{r}=\left(\hat{i}+\hat{j}\right)+\lambda\left(\hat{i}+2\hat{j}-\hat{k}\right)$ and $\vec{r}=\left(\hat{i}+2\hat{j}\right)+\mu\left(-\hat{i}+\hat{j}+a\hat{k}\right)$ are not consistent, where λ and μ are scalars, is	p.	–4
(B)	The angle between vectors $\vec{a}=\lambda\hat{i}-3\hat{j}-\hat{k}$ and $\vec{b}=2\lambda\hat{i}+\lambda\hat{j}-\hat{k}$ is acute, whereas vector $\vec{b}$ makes an obtuse angle with the axes of coordinates. Then λ may be	q.	–2
(C)	The possible value of 'a' such that $2\hat{i}-\hat{j}+\hat{k},\hat{i}+2\hat{j}+(1+a)\hat{k}$ and $3\hat{i}+a\hat{j}+5\hat{k}$ are coplanar is	r.	2
(D)	If $\vec{A}=2\hat{i}+\lambda\hat{j}+3\hat{k},\vec{B}=2\hat{i}+\lambda\hat{j}+\hat{k},\vec{C}=3\hat{i}+\hat{j}$ and $\vec{A}+\lambda\vec{B}$ is perpendicular to $\vec{C}$, then $\lvert 2\lambda\rvert$ is	s.	3
		t.	0

60. $\vec{a}$ and $\vec{b}$ form the consecutive sides of a regular hexagon ABCDEF.

Column I		Column II	
(A)	If $\overrightarrow{CD}=x\vec{a}+y\vec{b}$, then	p.	x = –2
(B)	If $\overrightarrow{CE}=x\vec{a}+y\vec{b}$, then	q.	x = –1
(C)	If $\overrightarrow{AE}=x\vec{a}+y\vec{b}$, then	r.	y = 1
(D)	If $\overrightarrow{AD}=-x\vec{b}$, then	s.	y = 2

Space for rough work

FIITJEE RET – 11

(2018 – 2020)(1ST YEAR_REGULAR)

IIT-2015 (P1)_SET–B

DATE: 17.09.2018

ANSWERS

PHYSICS

1.	**4**	2.	**5**	3.	**1**	4.	**3**
5.	**4**	6.	**Bonus**	7.	**3**	8.	**6**
9.	A,**B,C,D**	10.	**B,C**	11.	**B,C**	12.	**A,D**
13.	**B,C**	14.	**A**	15.	**A**	16.	**C**
17.	**A,C**	18.	**A,B,C**	19.	**A → r; B → q; C → p; D → r**		
20.	**A → r; B → s; C → p; D → q**						

CHEMISTRY

21.	**9**	22.	**1**	23.	**8**	24.	**1**
25.	**8**	26.	**1**	27.	**1**	28.	**9**
29.	**A, B, C, D**	30.	**A, B, D**	31.	**A, C**	32.	**A, B, D**
33.	**D**	34.	**A, B, C**	35.	**A, B, C**	36.	**B, C**
37.	**A, B, C**	38.	**B, C**	39.	**A → r; B → q; C → s; D → p**		
40.	**A → r ; B → s; C → q ; D → p**						

MATHEMATICS

41.	**5**	42.	**2**	43.	**0**	44.	**2**
45.	**8**	46.	**5**	47.	**6**	48.	**2**
49.	**B**	50.	**AC**	51.	**ABC**	52.	**BC**
53.	**BC**	54.	**ABC**	55.	**AD**	56.	**A**
57.	**AB**	58.	**AC**	59.	**A → p, q, r, s, t; B → p, q; C → p, r; D → r**		
60.	**A → q, r; B → p, r; C → q, s; D → p**						