FIITJEE RET – 11

(2018 – 2020)(1ST YEAR_CHAMPIONS (20S))

IIT-2015 (P1)

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.

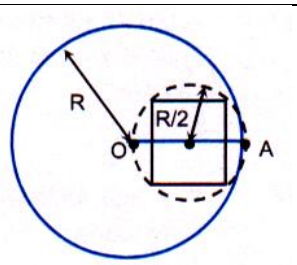
NAME: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

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.

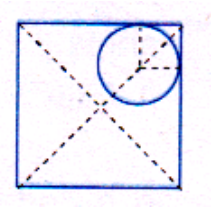
1. There is thin uniform disc of radius R and mass per unit area σ, in which a hole of radius R/2 has been cut out as shown in the figure. Inside the hole a square plate of same mass per unit area σ is inserted so that its corners touch the periphery of the hole. Centre of mass of the system is $\frac{R(2-\pi)}{(6\pi+N)}$.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



2. A uniform steel rod of 1 m in length is bent in a 90^0 angle at its mid point. The position of its centre of mass from the corner at bent is $\frac{1}{n\sqrt{2}}$, from corner along 45^0 bisector line and inside the right angle. Find n.

3. A shell of mass 5 kg moving with a speed of 20 m/s explodes into two particle of 3 kg and 2kg. If the 3 kg particle just comes to rest after explosion, the speed of the 2 kg particle is $(N\times 10)m/s$. Find N.

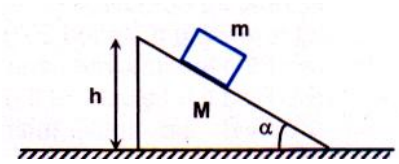
4. A disc of radius R is placed on a square plate of edge 4R made up of the same sheet with their planes parallel such that any two adjacent sides of square touch the disc. The distance of the centre of mass of the system from the centre of square plate is $\frac{\sqrt{2}\pi R}{(2N+\pi)}$. Find N



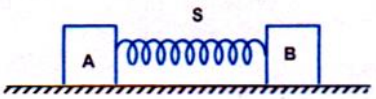
5. A pulley fixed to a rigid support carries a rope whose one end is tied to a ladder with a man and the other end to the counterweight of mass M. The man of mass m climbs up a distance h with respect to the ladder and then stops. IF the mass of the rope and the friction in the pulley axle are negligible, the displacement of the centre of mass of this system is $\frac{3mh}{N.M}$. Find N.

Space for rough work

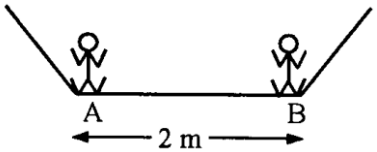
6. A cubical block of mass m is released from rest at a height h on a frictionless surface of a movable wedge of mass M, which is, in turn is placed on a horizontal frictionless surface as shown in the figure. The velocity of the triangular block when the smaller block reaches the bottom is $\frac{2\sqrt{N}}{3}$.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



7. Bock A in the figure has a mass of 1 kg and block B has a mass of 2 kg. The blocks are forced together compressing a massless spring between them and the system is released from rest on a level frictionless surface. The spring is not fastended to either of the blocks, when spring regains its natural length, block B acquired a speed of 0.5 m/s. The potential energy stored in the compressed in was $\frac{N}{4}$. Find N.



8. 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.



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. Two particles of equal mass are projected simultaneously from the roof of a tower of height 20m with same speed 20 m/s, one horizontally and the other vertically upwards. Choose the correct alternative(s)

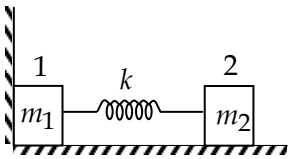
(A) the acceleration of centre of mass is g/2 downward

(B) the acceleration of centre of mass is 2g downward

(C) maximum height of centre of mass from the ground is 25 m

(D) maximum height of centre of mass from the ground is 40 m

10. Two bars of masses m_1 and m_2 are connected by a weight less Spring of Stiffness K as shown in the figure. Bar 2 is shifted to left to a small distance x and released. When bar 1 breaks off the wall



(A) velocity of bar 2 is $x\sqrt{k/m_2}$

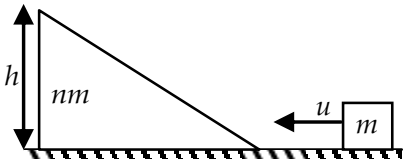
(B) velocity of bar 2 is $2x\sqrt{k/m_2}$

(C) velocity of centre of mass of the blocks is $\frac{x\sqrt{km_2}}{m_1+m_2}$

(D) For the entire duration momentum of the system (m_1,m_2 and spring) is conserved

Space for rough work

11. 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.



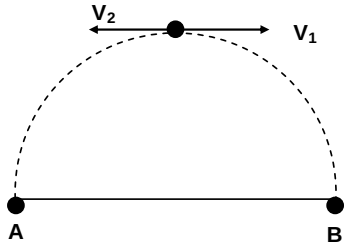
(A) Velocity of centre of mass is zero when block reaches the highest point on the wedge

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

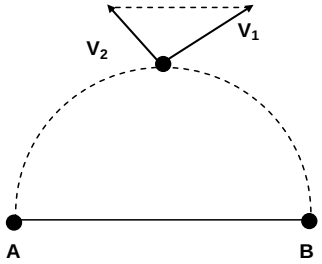
(C) If the block has to reach the top of wedge then $u=\sqrt{2gh\ 1+1/n}$

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

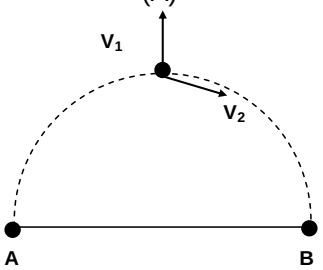
12. A bomb projected from A lands at B in absence of an explosion. At top most point , it explodes into two equal fragments. After explosion each fragment moves in a separate path and come to rest after hitting the ground. Find out in which of the following cases centre of mass of the system will finally(after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



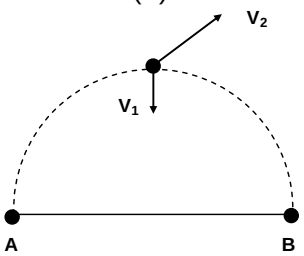
(A)



(B)



(C)



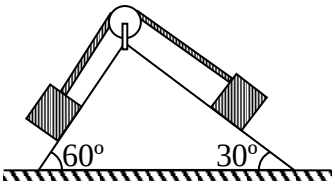
(D)

Space for rough work

13. 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

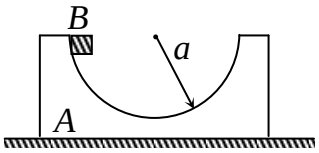
(A) $\frac{7P^2}{24m}$ (B) $\frac{9P^2}{16m}$ (C) $\frac{11P^2}{24m}$ (D) $\frac{5P^2}{14m}$

14. Two blocks of equal mass are tied with a light string, which passes over a massless pulley as shown in figure. The magnitude of acceleration of centre of mass of both blocks is: (wedge is fixed and smooth)



(A) $\left(\frac{\sqrt{3}-1}{4\sqrt{2}}g\right)$ (B) $(\sqrt{3}-1)g$ (C) $\frac{g}{2}$ (D) $\left(\frac{\sqrt{3}-1}{\sqrt{2}}\right)g$

15. 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

16. 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 $\frac{1}{2}(m+M)\left(\frac{\ell}{t}\right)^2$

Space for rough work

17. Two particles of equal mass are projected simultaneously from the roof of a tower of height 20 m with same speed 20 m/s, one horizontally and the other vertically upwards.
Choose the correct alternative(s).
(A) The acceleration of centre of mass is g/2 downward
(B) The acceleration of centre of mass is g downwards
(C) Maximum height of centre of mass from the ground is 25 m
(D) Maximum height of centre of mass from the ground is 40m

18. A man of mass m is stationary on a stationary flat car. The car can move without friction along horizontal rails. The man starts walking with velocity v relative to the car. Work done by him:
(A) is less than $\frac{1}{2}$ mv^2, if he walks along the rails
(B) is equal to $\frac{1}{2}$ mv^2, if he walks normal to rails
(C) can never be less than $\frac{1}{2}$ mv^2
(D) is greater than $\frac{1}{2}$ mv^2, if he walks along the rails

Space for rough work

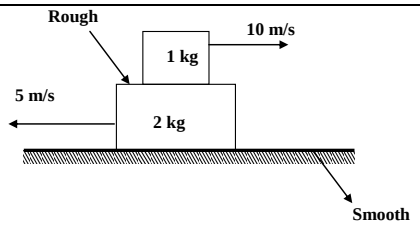
SECTION 3 (Maximum Marks: 16)

- 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.

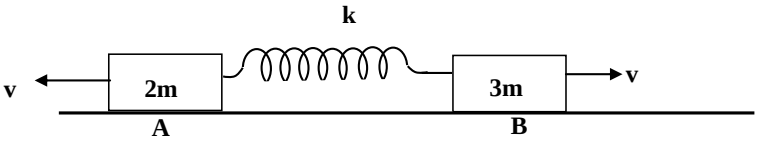
19. In a two block system shown in figure, velocities are given to the blocks at an instant as shown. Match the following



Column – I		Column – II	
(A)	Velocity of centre of mass	(p)	Keep on changing all the time
(B)	Momentum of centre of mass	(q)	First decreases then becomes zero
(C)	Magnitude of momentum of 1 kg block	(r)	Increases from zero
(D)	Kinetic energy of 2 kg block	(s)	Constant
		(t)	zero

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. 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.
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  - **–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)
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(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).
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  - **–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

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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_CHAMPIONS (20S))

IIT-2015 (P1)

DATE: 17.09.2018

ANSWERS

PHYSICS

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

CHEMISTRY

21.	**8**	22.	**1**	23.	**1**	24.	**9**
25.	**2**	26.	**1**	27.	**8**	28.	**1**
29.	**A, B, C**	30.	**A, B**	31.	**B, C**	32.	**Bonus**
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.	**bonus**	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**						