MasterJEE

IIT-JEE | Medical | Foundations

Master JEE CLASSES

Kukatpally, Hyderabad.

JEE-ADVANCE-2016-P2-MODEL

Max. Marks: 186

IMPORTANT INSTRUCTIONS:

1) This booklet is your Question Paper.
2) Use the Optical Response Sheet (ORS) provided separately for answering the questions
3) Blank spaces are provided within this booklet for rough work.
4) Write your name, roll number and sign in the space provided on the back cover of this booklet.
5) You are allowed to take away the Question Paper at the end of the examination.

OPTICAL RESPONSE SHEET:

6) Darken the appropriate bubbles on the ORS by applying sufficient pressure. This will leave an impression at the corresponding place on the Candidate's sheet.
7) The ORS will be collected by the invigilator at the end of the examination.
8) Do not tamper with or mutilate the ORS. **Do not use the ORS for rough work**.
9) Write your name, roll number and code of the examination center, and sign with pen in the space provided for this purpose on the ORS. **Do not write any of these details anywhere else** on the ORS. Darken the appropriate bubble under each digit of your roll number.

DARKENING THE BUBBLES ON THE ORS

10) Use a **BLACK BALL POINT PEN** to darken the bubbles on the ORS.
11) Darken the bubble **COMPLETELY**.
12) The correct way of darkening a bubble is as :
13) The ORS is machine-gradable. Ensure that the bubbles are darkened in the correct way.
14) Darken the bubbles ONLY IF you are sure of the answer. There is NO WAY to erase or "un-darken" a darkened bubble.

JEE-ADVANCE-2016-P2-Model

IMPORTANT INSTRUCTIONS **Max Marks: 186**

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 6)	Questions with Single Correct Choice	3	-1	6	18
Sec – II(Q.N : 7 – 14)	Questions with Multiple Correct Choice (Partial Marking +1)	4	-2	8	32
Sec – III(Q.N : 15 – 18)	Questions with Comprehension Type (2 Comprehensions – 2 + 2 = 4Q)	3	0	4	12
Total				**18**	**62**

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 19 – 24)	Questions with Single Correct Choice	3	-1	6	18
Sec – II(Q.N : 25 – 32)	Questions with Multiple Correct Choice (Partial Marking +1)	4	-2	8	32
Sec – III(Q.N : 33 – 36)	Questions with Comprehension Type (2 Comprehensions – 2 + 2 = 4Q)	3	0	4	12
Total				**18**	**62**

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 37 – 42)	Questions with Single Correct Choice	3	-1	6	18
Sec – II(Q.N : 43 – 50)	Questions with Multiple Correct Choice (Partial Marking +1)	4	-2	8	32
Sec – III(Q.N : 51 – 54)	Questions with Comprehension Type (2 Comprehensions – 2 + 2 = 4Q)	3	0	4	12
Total				**18**	**62**

PHYSICS

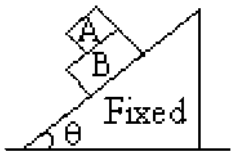
Max Marks : 62

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 6 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONLY ONE option can be correct.

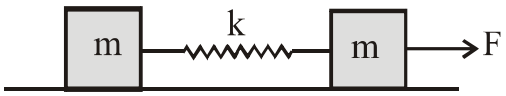
Marking scheme: +3 for correct answer, 0 if not attempted and –1 in all other cases.

1. A block A placed over another block B which is placed over a smooth inclined plane as shown in figure. The coefficient of friction between the two blocks A and B is μ. Mass of block B is two times the mass of block A. Now the blocks are released. The acceleration of the centre of mass of two blocks is



A) $g\sin\theta$ B) $\frac{g\sin\theta-\mu g\cos\theta}{3}$ C) $\frac{g\sin\theta}{3}$ D) $\frac{2g\sin\theta-\mu g\cos\theta}{3}$

2. Two blocks of equal mass m are connected by an unstretched spring and the system is kept at rest on a frictionless horizontal surface. At t=0, a constant force F is applied on the first block pulling it away from the other as shown in figure.



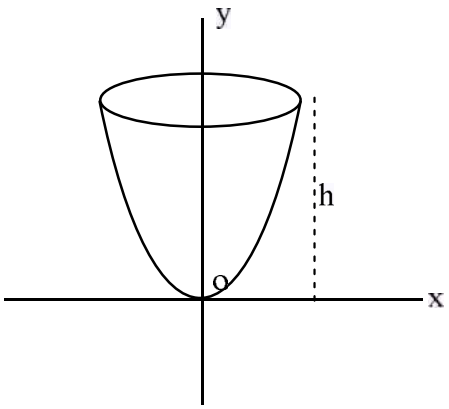
If the extension of the spring is x_0 at time t, then the displacement of the first block in time t is

A) $\frac{1}{2}\left(\frac{Ft^2}{2m}+x_0\right)$ B) $-\frac{1}{2}\left(\frac{Ft^2}{4m}+x_0\right)$ C) $\frac{1}{2}\left(\frac{Ft^2}{2m}-x_0\right)$ D) $\left(\frac{Ft^2}{2m}+x_0\right)$

3. In a boat of mass 4M and length 'L' on a frictionless water surface. Two men A (mass = M) B(mass = 2M) are standing on the opposite ends. Now A travels a distance L/4 relative to boat towards its centre and B moves a distance 3L/4 relative to boat and meet A. The displacement of the boat on water till A and B meet is

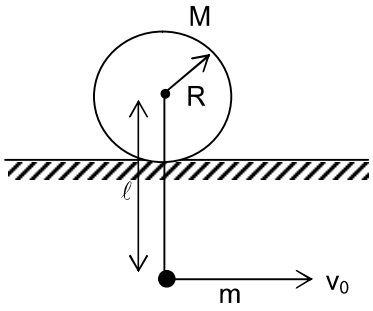
A) $\frac{5L}{28}$ B) zero C) $\frac{L}{2}$ D) $\frac{23L}{2}$

4. A paraboloid shaped solid object is formed by rotating on parabola $y = 2x^2$ about y-axis as shown in figure. If the height of the body is 'h' then the position of centre of mass from origin. (Assume density to be uniform throughout).



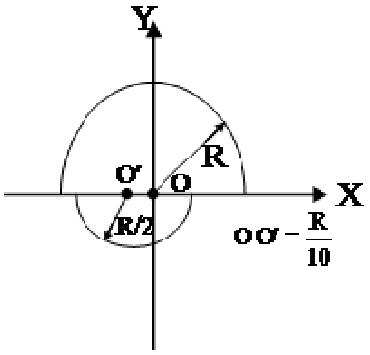
A) $\frac{h}{3}$ B) $\frac{h}{4}$ C) $\frac{2h}{3}$ D) $\frac{2h}{4}$

5. A disc of radius R and mass M is placed on smooth horizontal surface as shown in figure. A light rod of length ℓ is hanged from the centre of disc and a small mass m is attached at the end as shown in figure. Now a velocity V_0 is given to mass m. Find the maximum height which mass m can attain. (Assume rod can rotate < 90°)



A) $\frac{1}{2}\frac{V_0^2}{g}\frac{m}{M+m}$ B) $\frac{1}{2}\frac{V_0^2}{g}\frac{M}{2m}$ C) $\frac{1}{2}\frac{V_0^2}{g}\frac{m}{2M}$ D) $\frac{1}{2}\frac{V_0^2}{g}\frac{M}{M+m}$

6. Two solid hemispheres of radii R and R/2 with centers O and O' respectively as shown in figure. The density of bigger hemisphere is ρ and that of smaller hemisphere is 2ρ. Taking center of bigger hemisphere is at origin and the distance between centers of two hemispheres OO' is R/10, find co-ordinates of center of mass of the system.



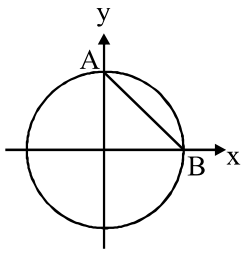
A) $\left(\frac{-R}{50},\frac{21R}{80}\right)$ B) $\left(\frac{-R}{30},\frac{21R}{80}\right)$ C) $\left(\frac{-R}{50},\frac{7R}{16}\right)$ D) $\left(\frac{-R}{30},\frac{7R}{16}\right)$

SECTION – II
(MULTIPLE CORRECT ANSWER TYPE)

This section contains 8 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

Marking scheme: +4 for all correct options & +1 partial marks, 0 if not attempted and -2 in all wrong cases

7. An object comprises of a uniform ring of radius R and a uniform chord AB (not necessarily made of the same material) as shown. Which of the following can not be the center of mass of system



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

8. Which of the following is/are correct?

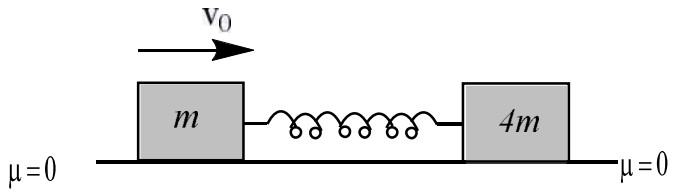
A) If the center of mass of three particles is at rest and it is known that two of them are moving along different non- collinear lines, then the third particle must also be moving.

B) If the center of mass of a system remains at rest, then the net work done by all the forces acting on the system must be zero.

C) If the velocity of center of mass of a system remains zero, then the net external force acting on the system must be zero.

D) If the speed of center of mass is changing, then there must be some work being done by the internal forces on the system.

9. Two blocks of masses *m* and *4m* lie on a smooth horizontal surface connected with a spring in its natural length. Mass *m* is given initial velocity V_0 as shown in figure. Which of the following is true about subsequent motion?



A) Kinetic energy of mass m is maximum in ground frame and centre of mass (CM) frame simultaneously.

B) Value of maximum and minimum kinetic energy is same in CM and ground frame.

C) Minimum kinetic energy is zero in CM frame but non-zero in ground frame.

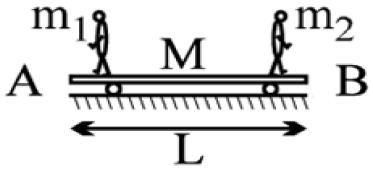
D) Maximum and minimum kinetic energy of *m* in ground frame is, respectively, $\frac{1}{2}mv_0^2$ and zero.

10. Two identical buggies move one after other due to inertia (without friction) with the same velocity v_O . A man of mass m rides the rear buggy. At a certain moment the man jumps into the front buggy with a velocity u relative to his buggy. If mass of each buggy is equal to M and velocity of buggies after jumping of man are v_{rear} *and* v_{front} . Then

A) $v_{rear} = v_0 + \frac{m}{m+M}u$ B) $v_{rear} = v_0 - \frac{m}{m+M}u$

C) $v_{front} = v_0 + \frac{m}{(m+M)^2}u$ D) $v_{front} = v_0 - \frac{m}{(m+M)^2}u$

11. Two person of mass m_1 and m_2 are standing at the two ends A and B respectively, of a trolley of mass M as shown. When the person standing at A jumps from the trolley towards left with u_{rel} with respect to the trolley, then (Ground it frictionless)



A) the trolley moves towards right

B) the trolley rebounds with velocity $\frac{m_1 u_{rel}}{m_1 + m_2 + M}$

C) the trolley rebounds with velocity $\frac{m_1 u_{rel}}{m_2 + M}$

D) the centre of mass of the system consisting of two persons and trolley remains stationary

12. Choose the correct statement(s) regarding center of mass frame

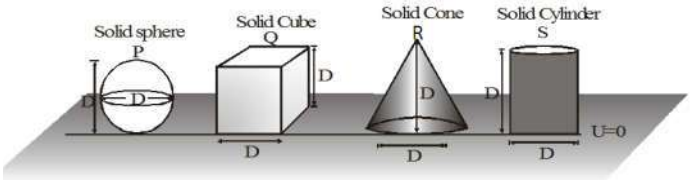
A) If $\overrightarrow{F_{ext}} = 0$ center of mass frame is inertial frame

B) Centre of mass frame is a zero momentum frame

C) Kinetic energy of a system is minimum in centre of mass frame

D) None of these

13. Assuming potential energy 'U' at ground level to be zero.



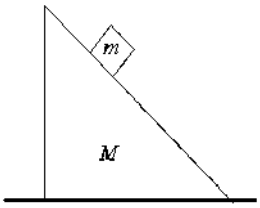
All objects are made up of same material.

U_P = Potential energy of solid sphere U_Q = Potential energy of solid cube

U_R = Potential energy of solid cone U_S = Potential energy of solid cylinder

A) $U_S > U_P$ B) $U_Q > U_S$ C) $U_P > U_Q$ D) $U_S > U_R$

14. A block of mass m is placed at rest on a smooth wedge of mass M placed at rest on a smooth horizontal surface. As the system is released



A) The COM of the system remains stationary

B) The COM of the system has an acceleration g vertically downward

C) Momentum of the system is conserved along the horizontal direction

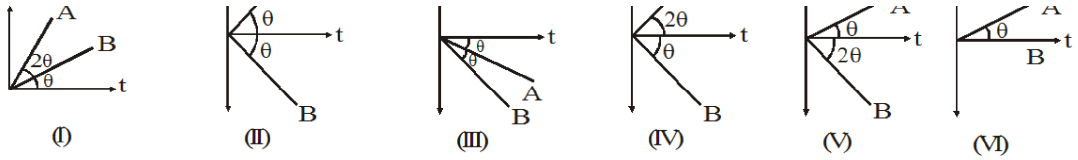
D) Acceleration of COM vertically downward is a < g

SECTION – III
(PARAGRAPH TYPE)

This section contains **2 groups of questions.** Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices A), B), C) and D) for its answer, out of which **ONLY ONE** is **correct.**
Marking scheme: +3 for correct answer, 0 if not attempted and 0 in all other cases.

Paragraph For Questions 15 and 16:

An initially stationary box on a frictionless floor explodes into two pieces, piece A with mass m_A and piece B with mass m_B. Two pieces then move across the floor along x–axis. Graph of position versus time for the two pieces are given.



15. Based on the above question, Match column A with the column B.

	Column A	**Column B (Graph number)**
P)	$m_A = m_B$	I
Q)	$m_A > m_B$	II
R)	$m_A < m_B$	III
		IV
		V
		VI

A) P – VI, Q – III, R – I B) P – II, Q – V, R – IV

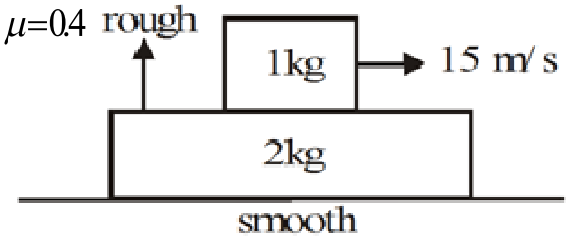
C) P – II, Q – IV, R – V D) P – VI, Q – II, R – IV

16. If all the graphs are possible then, in which of the following cases external force must be acting on the box :-

A) I & II B) II & III C) I, III & VI D) I, III, V

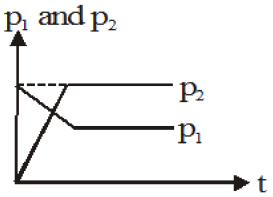
Paragraph For Questions 17 and 18:

A 1 kg block is given a velocity of 15 m/s towards right over a very long rough plank of mass 2 kg as shown in figure.

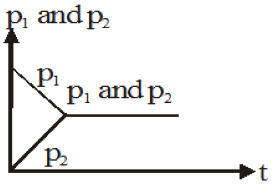


17. The correct graph showing linear momentum of 1 kg (i.e. p_1) and of 2kg (i.e. p_2) versus time is :

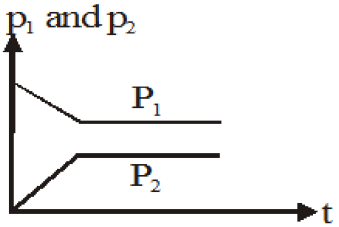
A)



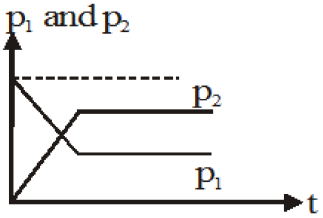
B)



C)



D)



18. Momentum of both the blocks are equal at time t = ...seconds:

A) 1.75 B) 1.875 C) 2.5 D) 1.25

CHEMISTRY Max Marks: 62

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 6 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +3 for correct answer, 0 if not attempted and –1 in all other cases.

19. Which of the following species will have the lone pair effects cancelled

A) ICl_2^- B) ClF_3 C) PCl_3 D) BrF_5

20. SH_6 does not exist because

A) Hydrogen is too small to overlap with large orbital of sulphur atom

B) Hydrogen cannot cause contraction of d-orbital of sulphur as it cannot induce a high positive formal charge on sulphur

C) Sulphur cannot expand it's octet

D) Sulphur is unreactive towards Hydrogen

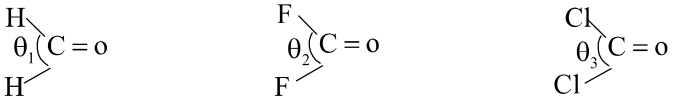
21. What hybridization is expected on the central atom of each of the following molecules.

i) BeH_2 ii) CH_2Br_2

iii) PF_6^- iv) BF_3

A) SP^2, SP, SP^3, SP^2 B) SP, SP^3, SP^3d, SP^2

C) SP, SP^3, SP^3d^2, SP^2 D) SP^2, SP, SP^2, SP^3

22. 

Identify the correct order of bond angle

A) $\theta_1 > \theta_2 > \theta_3$ B) $\theta_1 > \theta_3 > \theta_2$ C) $\theta_3 > \theta_2 > \theta_1$ D) $\theta_1 = \theta_2 = \theta_3$

23. Which is correct statement

As the % S-character of a hybrid orbital decreases

I) The bond angle decreases

II) Size of orbital decreases

III) The bond length increase

IV) Size of orbital increase

A) I,III,IV B) II,III,IV C) I & II D) All are correct

24. Shape of IF_7 molecule is

A) Pentagonal bipyramidal B) Trigonal pyramidal

C) Tetrahedral D) Square planar

SECTION – II
(MULTIPLE CORRECT ANSWER TYPE)

This section contains 8 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

Marking scheme: +4 for all correct options & +1 partial marks, 0 if not attempted and -2 in all wrong cases

25. In the structure of H_2CSF_4 which of the following statement is /are correct.

A) Two C-H bonds are in the same plane of axial S-F bonds.

B) Two C-H bonds are in the same plane of equatorial S-F bonds

C)Total six atoms are in the same plane

D) Equitorial S-F bonds are perpendicular to plane of $\pi - bond$

26. Identify the correct statement in the following

A) Hybridisation of carbon in C_3O_2 $is\ SP$

B) $N(Me)_3$ and $N(SiMe_3)_3$ are iso structural

C) In trigonal bipyramidal arrangement lone pair of electron are usually occupied at equatorial position.

D) The shape of I_3^- is linear.

27. Which of the following statement(s) is/are a valid postulate(s) of valence bond theory?

A) Overlapping orbitals have unpaired electron

B) Greater is the extent of overlapping higher is the bond strength

C) Greater is the orbital overlapping higher is the bond length

D) Lateral overlapping of atomic orbitals results in formation of $\pi - bond$

28. Which of the following statement is (are) correct?

A) In ClF_3 , the axial $Cl-F$ bond length is longer than equatorial $Cl-F$ bond length.

B) In SF_4 $F-S-F$ equatorial bond angle is 120°

C) In $[ICl_4]^-$ $Cl-I-Cl$ bond angle is 90°

D) There are two $P^{\Pi}-d^{\Pi}$ bonds in SO_3

29. There is a change in the hybridisation when

A) NH_3 combines with H^+

B) AlH_3 combines with H^-

C) NH_3 forms NH_2^-

D) SiF_4 forms SiF_6^{-2}

30. Which of the following orbital can form δ-bond (Delta bond).

A) $dx^2 - y^2$ *orbital* B) dz^2 *orbital* C) *dxy Orbital* D) P_z *orbital*

31. In which compound vacant orbitals take part in hybridisation

A) Al_2Cl_6 B) C_2H_5Cl C) B_2H_6 D) H_3BO_3

32. Indentify the incorrect statement(s) amongst the following.

A) molecule having trigonal bipyramidal geometry and SP^3d hypridisation, the d- orbital involved in hybridization is $dx^2 - y^2$

B) In SP^3d^2 hybridisation, $dx^2 - y^2, dz^2$ sets of d-orbital is involved

C) I_3^+ and XeF_7^+ have same hybridization

D) CO_3^{-2} and SO_3 are iso electronic and isostructural.

SECTION – III
(PARAGRAPH TYPE)

This section contains **2 groups of questions.** Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices A), B), C) and D) for its answer, out of which **ONLY ONE** is **correct.**
Marking scheme: +4 for correct answer, 0 if not attempted and -2 in all other cases.

Paragraph for Questions 33 and 34:

The Approximate shape of a molecule can often be predicted by using what is called the valence shell Electron pair repulsion (VSEPR) model. Electrons in bonds and in lone

pairs can be thought of as charge cloud that repel one another and stay as far apart as possible , thus causing molecules to assume specific shapes.

The repulsive interactions of Electron pairs decrease in the order.

Lone pair- lone pair > lone pair – bond pair > bond pair – bond pair.

These repulsion effect result in deviations from idealised shapes and alteration in bond angles in molecule.

33. Among the following molecules

i) XeO_3 ii) $XeOF_4$ iii) XeO_2F_2 iv) XeF_6

Those having different molecular geometry but same number of lone pairs on Xe are,

A) (i),(ii) and (iii) only B) (i),(ii),(iv) only

C) (ii)(iii) and (iv) only D) (i),(ii),(iii) and iv

34. which of the fallowing represent the isostructural pair?

A) SF_5^- and IF_5 B) ClO_2F_3 and SOF_4

C) SeF_3^+ and XeO_3 D) All of the above

Paragraph for Questions 35 and 36:

Different types of bonds are present in the chemical compounds. These bonds have different strengths and bond energies associated with them. These bonds are formed in different environments associated with atoms and the compounds in which they are present.

35. which of the following will form only σ bond (generally).

A) s-s overlapping

B) Hybrid orbital overlapping

C) s-p overlapping

D) All of these

36. Shape of the molecule is decided by

A) σ bond

B) π bond

C) both σ and π bond

D) neither σ nor π-band

MATHEMATICS

Max Marks : 62

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 6 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +3 for correct answer, 0 if not attempted and –1 in all other cases.

37. The number of solutions of $\sin x = \frac{x}{10}$ is

A) 6 B) 7 C) 10 D) 9

38. The number of solutions of $2^x + 3^x + 4^x - 5^x = 0$ is

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

39. If $f : R \to R$ is a function satisfying the property $f(x+1) + f(x+3) = 2$ for $x \in R$, then the period of $f(x)$ is

A) 3 B) 2 C) 4 D) 5

40. Let $f(x) = 2x(2-x); 0 \le x \le 2$, then the number of solution of $f(f(f(x))) = \frac{x}{2}$ is

A) 2 B) 4 C) 8 D) 12

space for rough work

41. The number of ordered pairs (a,b) from the set $A=\{1,2,3,4,5\}$ so that the function

$f(x)=\frac{x^3}{3}+\frac{ax^2}{2}+bx+10$ is an injective mapping $\forall x\in R$, is

A) 13 B) 14 C) 15 D) 16

42. $f(x)$ is a function satisfying the equation $f(1-x)+2.f(x)=3x,\forall x\in R$ then $f(0)=$

A) -2 B) -1 C) 0 D) 1

SECTION – II

(MULTIPLE CORRECT ANSWER TYPE)

This section contains 8 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

Marking scheme: +4 for all correct options & +1 partial marks, 0 if not attempted and -2 in all wrong cases

43. Let $f(x)$ be invertible function and let $f^{-1}(x)$ be its inverse, let equation

$f\left(f^{-1}(x)\right)=f^{-1}(x)$ has two real roots α,β (within the domain of $f(x)$) then

A) $f(x)=x$ also has same two real roots

B) $f^{-1}(x)=x$ also has same two real roots

C) $f(x)=f^{-1}(x)$ also has the same two real roots

D) Area of triangle formed by $(0,0)(\alpha,f(\alpha)),(\beta,f(\beta))$ is 1 unit

44. Let 'n' be a +ve integer with $f(n)=\underline{1}+\underline{2}+\underline{3}+.....+\underline{n}$ and $p(x), q(x)$ be polynomials in 'x' such that $f(n+2)=p(n).f(n+1)+q(n).f(n)$ for all $n\geq 1$, then

A) $p(x)=x+3$ B) $q(x)=-x-2$ C) $p(x)=-x-2$ D) $q(x)=-x+3$

45. All the periodic functions are

A) one-one B) Many one

C) Invertible D) Invertible by restricting the domain

46. If $f:[1,\infty)\to[2,\infty)$ is given by $f(x)=x+\frac{1}{x}$ then $f^{-1}(x)=$

A) $\frac{x+\sqrt{x^2-4}}{2}$ B) $\frac{x-\sqrt{x^2-3}}{2}$ C) $\frac{x+\sqrt{x^2-3}}{2}$ D) $\frac{x-\sqrt{x^2-4}}{2}$

47. Let f:(2,4) → (1,3) be a function defined by f(x) $=x-\left[\frac{x}{2}\right]$ (where [.] denotes the greatest integer function), then which of the following is/are true?

A) $f^{-1}\left(\frac{5}{4}\right)=\frac{9}{4}$ B) $f^{-1}\left(\frac{7}{4}\right)=\frac{11}{4}$

C) $f^{-1}(2)=3$ D) f is not bijective function

48. The function $f: X \to Y$ where $f(x) = \sin x + \cos x + 2\sqrt{2}$ is invertible if

A) $X = \left[\frac{\pi}{4}, \frac{5\pi}{4}\right], Y = \left[\sqrt{2}, 3\sqrt{2}\right]$

B) $X = \left[\frac{\pi}{4}, \frac{\pi}{2}\right], Y = \left[1+\sqrt{2}, 3\sqrt{2}\right]$

C) $X = \left[\frac{3\pi}{4}, \frac{5\pi}{4}\right], Y = \left[\sqrt{2}, 2\sqrt{2}\right]$

D) $X = \left[\frac{-\pi}{4}, \frac{3\pi}{4}\right], Y = \left[2\sqrt{2}, 3\sqrt{2}\right]$

49. For the function $f(x) = \log_{10}\left(3x^2 - 4x + 5\right)$

A) domain is $(0, \infty)$

B) range is R

C) domain is R

D) range is $\left[\log_{10}\left(\frac{11}{3}\right), \infty\right)$

50. The equation $\left||x-1|+a\right| = 4 \;\; a \in R$ has

A) 3 distinct real roots for unique value of 'a'

B) 4 distinct real roots for $a \in (-\infty, -4)$

C) 2 distinct real roots for $|a| < 4$

D) no real root for $a > 4$

SECTION – III
(PARAGRAPH TYPE)

This section contains **2 groups of questions**. Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices A), B), C) and D) for its answer, out of which **ONLY ONE** is **correct.**
Marking scheme: +4 for correct answer, 0 if not attempted and -2 in all other cases.

Paragraph for Questions 51 and 52:

Let $f(x)$ be a real valued continuous function such that

$f(0)=\frac{1}{2}; f(x+y)=f(x)f(a-y)+f(y).f(a-x)\forall x,y\in R$ then for some real values of 'a'

51. $f(x)$ is a

A) periodic function B) periodic function with no fundamental period

C) Not a periodic function D) increasing function

52. $f(x)=$

A) $\frac{\cos x}{2}$ B) $\frac{-1}{2}$ C) $\frac{1}{2}$ D) $\sin x$

Paragraph for Questions 53 and 54:

53. Consider the function f : $R\to(0,\infty)$ defined by $f(x)=2^x+2^{|x|}$

$f(x)$ is

A) One-One Onto B) One-One IntoS

C) Many-One Onto D) Many-One Into

54. The number of solutions of $f(x)=2x+3$ is

A) 0 B) 1 C) 2 D) 4

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Max.Marks: 186

KEY SHEET

PHYSICS

1	A	2	A	3	A	4	C	5	D
6	A	7	BCD	8	AC	9	ACD	10	BC
11	ABD	12	ABC	13	ABD	14	CD	15	B
16	C	17	D	18	C				

CHEMISTRY

19	A	20	B	21	C	22	B	23	A
24	A	25	AC	26	ACD	27	ABD	28	ACD
29	BD	30	AC	31	AC	32	ACD	33	D
34	D	35	D	36	A				

MATHS

37	B	38	B	39	C	40	C	41	C
42	B	43	ABC	44	AB	45	BD	46	A
47	ABC	48	ABC	49	CD	50	ABCD	51	B
52	C	53	D	54	C				

SOLUTIONS
PHYSICS

01. There is no friction between the blocks and $a_{cm} = \sin\theta$

02. $\vec{S}_{\text{block wrt g}} = \vec{S}_{\text{wrt cm}} + \vec{S}_{\text{cm,g}}$

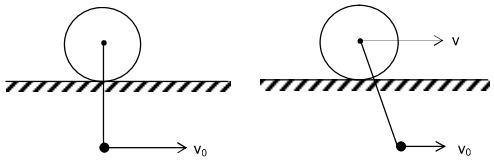
$$= \frac{x_0}{2} + \frac{1}{2} \times a_{cm} \times t^2$$

03. $2M\left(\frac{3L}{4} - x\right) = M\left(\frac{L}{4} + x\right) + 4Mx$

04. $h_{cm} = \frac{\int y\, dm}{\int dm} = \frac{\int y\, dV}{\int dV}$

$dV = \left(\pi x^2\right) dy$

05.



$mV_0 = (M + m)\, V$

$V = \frac{mV_0}{M+m}$

From energy conservation

$\frac{1}{2} mV_0^2 + Mg\ell = mgh + Mg\ell + \frac{1}{2}(M+m)V^2$

$\frac{1}{2} mV_0^2 - \frac{1}{2} \frac{m^2 v_0^2}{(M+m)} = mgh$

$\frac{1}{2} \frac{mV_0^2 [M+m-m]}{[M+m]} = mgh$

$h = \frac{1}{2} \frac{V_0^2}{g} \frac{M}{(M+m)}$

06. $x_{cm} = \frac{M_1(O) - M_2\left(\frac{R}{10}\right)}{M_1 + M_2}$ $\qquad$ $y_{cm} = \frac{M_1\left(\frac{3R}{8}\right) - M_2\left(\frac{3R}{16}\right)}{M_1 + M_2}$

07. Centre of mass always lies b/w centre of mass of segments and always lies on

axis of symmetry.

08. Conceptual

09. In both CM and ground frame, K_{max} is there, when x is zero in spring, which occurs simultaneously.

$$v_{CM} = \frac{m(v_0)+0}{5m} = \frac{v_0}{5}$$

$$K_{\max CM} = \frac{1}{2}m\left(\frac{4v_0}{5}\right)^2 + \frac{1}{2}(4m)\left(\frac{v_0}{5}\right)^2 = \frac{2}{5}mv_0^2$$

$$K_{\max\ ground} = \frac{1}{2}mv_0^2$$

$$K_{\min\ CM} = 0$$

$$K_{\min\ ground} = \frac{1}{2}(m+4m)v_{CM}^2 = \frac{mv_0^2}{10}$$

$K_{\max\ m} = \frac{1}{2}mv_0^2$ (ground frame)

$K_{\min\ m} = 0$ (ground frame when energy is shared by spring and 4m and m will reverse direction of motion).

10. $(M+m)V_0 = MV + m(V+u)$

$$V = v_0 - \frac{mu}{M+m}$$

$$m(u+v) + MV_0 = (M+m)V^1$$

$$V^1 = v_0 + \frac{Mmu}{(M+m)^2}$$

11.

(A), (B), (D)

F_{ext} on the system $(m_1 + m_2 + M)$ in horizontal direction is zero.

$\therefore$ centre of mass of the system remains stationary.

Again $\vec{v}_{m_1 g} = \vec{v}_{m_1 t} + \vec{v}_{tg} = (-u_{rel} + v)\hat{i}$

$$\vec{v}_{(m_2+M)g} = v\hat{i}$$

Conserve linear momentum in horizontal direction

$$m_1(-u_{rel} + v)\hat{i} + (m_2 + M)v\hat{i} = 0$$

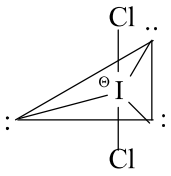
$$\therefore \quad v = \left(\frac{m_1 u_{rel}}{m_1 + m_2 + M}\right)\hat{i}$$

13. Potential energy depends on both mass and centre of gravity.

CHEMISTRY

19. Ans: A

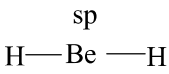
ICl^-_2 have a Linear structure and lone pair of electrons occupied at equatorial positions

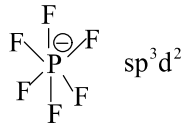


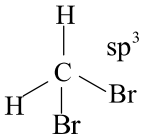
20. Ans: B

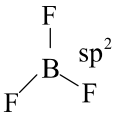
Conceptual

21. Ans : c



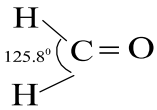


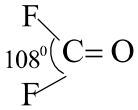


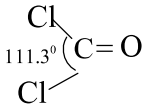


SINGLE BOND

22. Ans: B



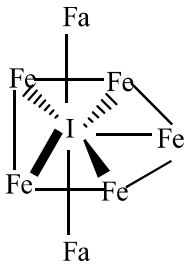




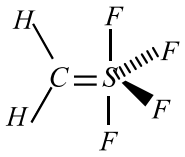
Higher the electronegativity of surrounding atom, lesser is the bond angle between the bonds.

23. Ans: A

24. Ans: A



25. Sol: A & C



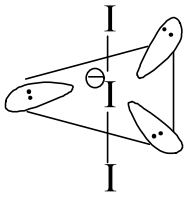
C- SP^2 HYBRIDISATION

S- SP^3d HYBRIDISATION

26. Sol: A,C,D

$O=C=C=C=O\left(C_3O_2\right)$

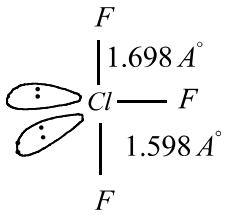
$N\left(Me\right)_3$: pyramidal, $Ni\left(SiMe_3\right)_3$-Trigonal planar

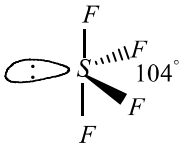


27. Sol: A,B,D

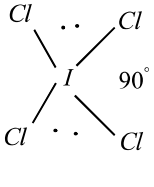
Conceptual

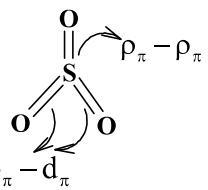
28. Sol: A,C, D





due to l.p – l.p repulsion





29. Sol: B,D

$NH_3 \quad N\overset{+}{H}_4$

A) $SP^3 \quad SP^3$

B) $AlH_3 \quad AlH_4^-$
$SP^2 \quad SP^3$

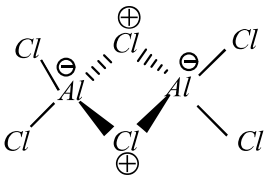
C) $NH_3 \quad NH_2^-$
$SP^3 \quad SP^3$

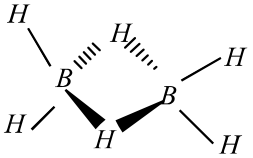
D) $SiF_4 \quad SP^3$
$SiF_6^{-2} \quad SP^3d^2$

30. Sol: A & C

Conceptual

31. Sol: A & C



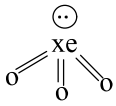


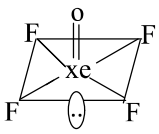
32. Sol: A, C, D

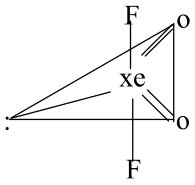
In Sp^3d hybridization dz^2 orbital is used I_3^+ have Sp^3 hybridisation, XeF_7^+ have Sp^3d^3

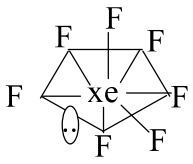
Comphrensinon :I CO_3^{2-} and SO_3 are is isostructural but not isoelectronic

33. Ans :D









Pyramides square pyramides see-saw capped octa hedron

34. Ans: d

All pairs having same no of sigmas bonds and lone pair of e^-

Comphrensinon :II

35. Ans:d

All the orbitals are overlap along the axis

36. Ans : a

Only sigma bond decided the shape of molecule.

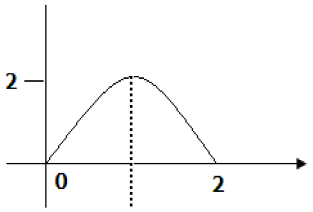
MATHS

37. Draw the graphs of $y = \sin x;\ y = \frac{x}{10}$

38. Draw the graphs of $y = \left(\frac{2}{5}\right)^x + \left(\frac{3}{5}\right)^x + \left(\frac{4}{5}\right)^x$ & $y = 1$

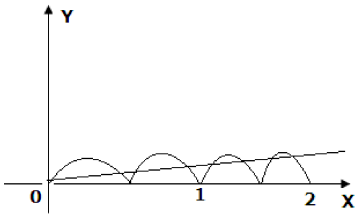
39. $f(x)=f(x+4)\Rightarrow$ period = 4

40.



Since the graph of $y=f(x)$ is symmetrical about the line x = 1

$\Rightarrow$ graph of $y=f(f(x))$ and $y=f(f(x))$ are also symmetrical about the line x = 1



No. of P.O.I = 8

41. $f^1(x)=x^2+ax+b$ is injective if disc ≤ 0

$a=1\Rightarrow b=1,2,3,4,5$

$=2 \qquad =1,2,3,4,5$

$=3 \qquad =3,4,5$

$=4 \qquad =4,5$

42. replace x by $\frac{1}{2}+x$ _____(1)

now replace x by $\frac{1}{2}-x$ _____(2)

(1) + (2) $\Rightarrow f\left(\frac{1}{2}+x\right)=\frac{1}{2}+3x$

Put $x=-\frac{1}{2}\Rightarrow f(0)=-1$

Multi answer question

43. $f^{-1}(f(x))=f(f^{-1}(x))=x$ if $f(f^{-1}(x))=f^{-1}(x)\Rightarrow x=f^{-1}(x)$

If $f(f^{-1}(x))=f^{-1}(x)\Rightarrow f(f^{-1}(f(x)))=f^{-1}(f(x))$

$\Rightarrow f(x)=f^{-1}(f(x))=x$

44. $f(n+2)-f(n+1)=\underline{\lfloor n+2}$

$=(n+2)\underline{\lfloor n+1}$

$=(n+2)[f(n+1)-f(n)]$

$\Rightarrow f(n+2)=(n+3)f(n+1)-(n+2)f(n)$

$\therefore p(x)=x+3; Q(x)=-x-2$

45. Horizontal line test fails

46. $f^{-1}(x)=\dfrac{x\pm\sqrt{x^2-4}}{2}$

But range of $f^{-1}(x)$ is $[1,\infty)$, so ignore $\dfrac{x-\sqrt{x^2-4}}{2}$

47. Conceptual

48. $f(x)=\sqrt{2}\sin\left(x+\dfrac{\pi}{4}\right)+2\sqrt{2}$ (or) $\sqrt{2}\cos\left(x-\dfrac{\pi}{4}\right)+2\sqrt{2}$

$\dfrac{-\pi}{2}\le x+\dfrac{\pi}{4}\le\dfrac{\pi}{2}\Rightarrow X=\left[\dfrac{-3\pi}{4},\dfrac{\pi}{4}\right]$

(or) $X=\left[\dfrac{\pi}{4},\dfrac{5\pi}{4}\right]$

Similarly y = $\left[\sqrt{2},3\sqrt{2}\right]$

49. $3x^2-4x+5>0$

$\Rightarrow\Delta<0\Rightarrow 3x^2-4x+\left(5-10^y\right)=0$

X is real $\Rightarrow\Delta\ge 0$

$10^y\ge\dfrac{11}{3}\Rightarrow y\ge\left[\log_{10}(11/3),\infty\right]$

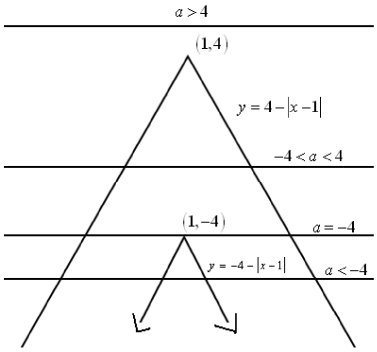
50. If $a>0$

If $a<0$

4 real roots $a\in(-\infty,-4)$

$-4<a<4$ 2 roots

$a>4$ no root



Passage type questions 51 & 52 hint

$f(x) = \frac{1}{2} \Rightarrow$ periodic constant function

Passage type questions 53 & 54 hint

Conceptual