MasterJEE

IIT-JEE | Medical | Foundations

Master JEE CLASSES

Kukatpally, Hyderabad.

JEE-ADVANCE-2016-P1-Mode **Max.Marks:186**

2016_PAPER-I

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-P1-Model

IMPORTANT INSTRUCTIONS **Max Marks: 186**

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 5)	Questions with Single Correct Choice	3	-1	5	15
Sec – II(Q.N : 6 – 13)	Questions with Multiple Correct Choice (Partial Marking +1)	4	-2	8	32
Sec – III(Q.N : 14 – 18)	Questions with Integer Answer Type	3	0	5	15
Total				**18**	**62**

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 19 – 23)	Questions with Single Correct Choice	3	-1	5	15
Sec – II(Q.N : 24 – 31)	Questions with Multiple Correct Choice (Partial Marking +1)	4	-2	8	32
Sec – III(Q.N : 32 – 36)	Questions with Integer Answer Type	3	0	5	15
Total				**18**	**62**

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 37 – 41)	Questions with Single Correct Choice	3	-1	5	15
Sec – II(Q.N : 42 – 49)	Questions with Multiple Correct Choice (Partial Marking +1)	4	-2	8	32
Sec – III(Q.N : 50 – 54)	Questions with Integer Answer Type	3	0	5	15
Total				**18**	**62**

space for rough work

PHYSICS **Max Marks: 62**

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 5 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.

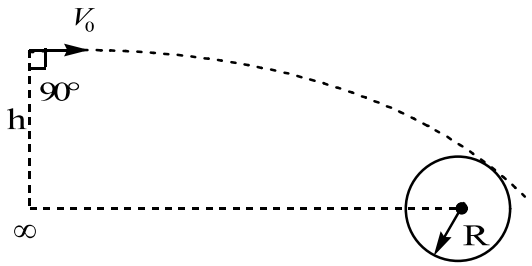
Marking scheme: +3 for correct answer, 0 if not attempted and –1 in all other cases.

1. The gravitational potential energy of interactions of a system of six identical particles, each of mass m placed at the vertices of a regular hexagon of side 'a' is [PE = 0 at infinite separation]

A) $-\frac{Gm^2}{a}\left(1+\frac{1}{\sqrt{3}}+\frac{1}{4}\right)$ B) $\frac{-3Gm^2}{a}\left(1+\frac{1}{\sqrt{3}}+\frac{1}{4}\right)$

C) $\frac{-6Gm^2}{a}\left(1+\frac{1}{\sqrt{3}}+\frac{1}{4}\right)$ D) $\frac{-2Gm^2}{a}\left(1+\frac{1}{\sqrt{3}}+\frac{1}{4}\right)$

2. An un powered spacecraft has to hit a far off planet of mass M, radius R. Maximum entrance area $\left(\pi h^2\right)$ from which 'the spacecraft can be projected so as to hit the planet. Size of the spacecraft is negligible compared to planet



A) $\pi R^2\left(1+\frac{GM}{RV_0^2}\right)$ B) $\pi R^2\left(1+\frac{2GM}{RV_0^2}\right)$

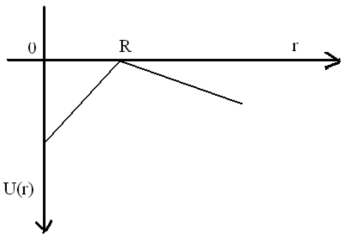
C) $4\pi R^2\left(1+\frac{2GM}{RV_0^2}\right)$ D) $4\pi R^2\left(1-\frac{2GM}{RV_0^2}\right)$

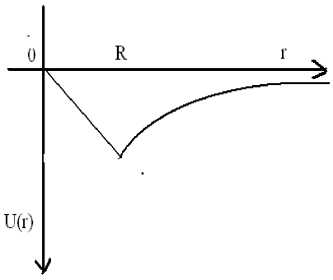
3. If a satellite is revolving around a planet of mass M in an elliptic orbit of semi-major axis a, the orbital speed of the satellite when it is at a distance r from the focus.

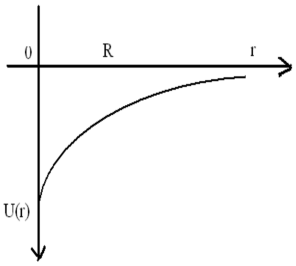
A) $V^2 = GM\left[\frac{2}{r}-\frac{1}{a}\right]$ B) $V^2 = GM\left[\frac{2}{r^2}-\frac{1}{a}\right]$

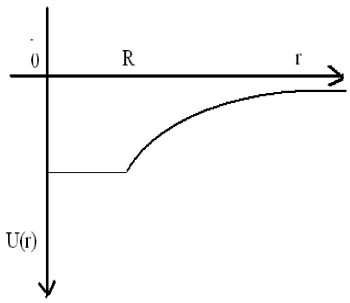
C) $V^2 = GM\left[\frac{2}{r^3}-\frac{1}{a^2}\right]$ D) $V^2 = G\left[\frac{2}{r}-\frac{1}{a}\right]$

4. A shell of mass M and radius R has a point mass m placed at a distance r from the centre. The gravitational potential energy U (r) vs r will be [assume potential energy at infinity to be zero]

A) 

B) 

C) 

D) 

5. A uniform hollow sphere has internal radius a and external radius b. The ratio of gravitational potential at a point on its outer surface to that of a point on its inner surface is

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

6. A satellite is orbiting the earth in a circular orbit of radius r. Its

A) kinetic energy varies as 1/r B) angular momentum varies as $\frac{1}{\sqrt{r}}$

C) linear momentum varies as $\frac{1}{\sqrt{r}}$ D) frequency of revolution varies as $\frac{1}{r^{3/2}}$

7. A double star system consists of two stars having masses M and 2M. The distance between their centres is equal to r. They revolve under their mutual gravitational interaction. Then, which of the following statements are not correct.

A) Heavier star revolves in circular orbit of radius 2r/3

B) Both the stars revolve with same angular speed, period of which is equal to $\frac{2\pi}{\sqrt{3GM}} r^{3/2}$

C) Kinetic energy of the heavier star is twice that of the other star.

D) Kinetic energy of the heavier star is $\frac{GM^2}{3r}$

8. A satellite of mass m orbits around the Earth in an elliptical path of semi-major and semi-minor axis 2a and a respectively such that the Earth is located at one of the foci of the elliptical path. At an instant when the satellite is located at a distance of r, its velocity is u at an angle of 60^0 with respect to the position vector of the satellite from the centre of the Earth. Consider only the gravitational force between the satellite and the Earth and assume that the Earth is a perfect sphere.

(Assume that mass of the satellite is negligible as compared to mass of the Earth)

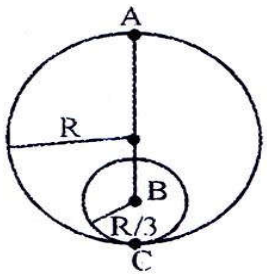
A) Orbital angular momentum of the satellite with respect to centre of the Earth is $\frac{\sqrt{3}}{2}mur$

B) Areal velocity of position vector of the satellite with respect to centre of the Earth is $\frac{\sqrt{3}}{4}ur$

C) Time period of orbital motion of the satellite around the Earth is $\frac{8\pi a^2}{\sqrt{3}ur}$

D) Time period of satellite's orbital motion is independent of mass of the Earth

9. Inside a uniform sphere of mass M (M is mass of complete sphere) and radius R, a cavity of radius $\frac{R}{3}$ is made in the sphere as shown. Then



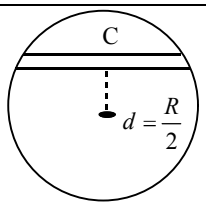
A) Gravitational field inside the cavity is uniform.

B) Gravitational field inside the cavity is non-uniform

C) The escape velocity of a particle projected from point A is $\sqrt{\frac{88GM}{45R}}$

D) Escape velocity is defined for earth and particle system only.

10. A tunnel is dug along a chord of non-rotating earth (hypothetical) at a distance d as shown. A small block is released from rest in the tunnel from the surface of earth. The block comes to rest at the centre C of tunnel. If μ is the coefficient of friction between block and tunnel then



A) The work done by the friction on the block is $\frac{-3GMm}{8R}$

B) $\mu = \frac{\sqrt{3}}{2}$

C) $\mu = \frac{1}{2}$

D) The gravity does +ve work on block

11. Assuming Earth, an uniform sphere of mass M and radius R. At a point P inside Earth at a distance r measured from centre of Earth (r < R)

A) Pressure (p) caused by gravitational compression is $\frac{3}{8}\left[1+\frac{r^2}{R^2}\right]\frac{Gm}{\pi R^3}$

B) Pressure (p) caused by gravitational compression is $\frac{3}{8}\left[1-\frac{r^2}{R^2}\right]\frac{GM^2}{\pi R^4}$

C) Gravitational field Intensity at the centre is $\frac{3}{2}\frac{GM}{R^2}$

D) Gravitational field Intensity at the centre is zero.

12. If a body is projected with speed lesser than escape velocity:

A) the body can reach a certain height and may fall down following a straight line path

B) the body can reach a certain height and may fall down following a parabolic path

C) the body may orbit the earth in a circular orbit

D) the body may orbit the earth in an elliptic orbit

13. Orbital velocity of a satellite revolving around a planet in a circular orbit depends on

A) Mass of the satellite

B) Mass of the planet

C) Radius of the orbit

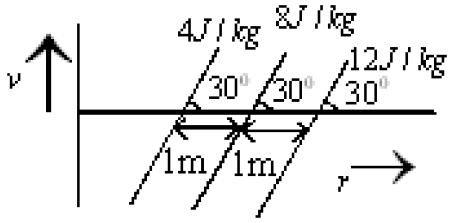
D) angular velocity of rotation of the planet

SECTION – III
(INTEGER ANSWER TYPE)

This section contains 5 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).
Marking scheme +3 for correct answer , 0 if not attempted and 0 in all other cases.

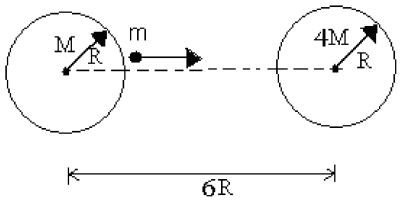
14. Assuming V as the gravitational potential at the centre of earth, the potential at a distance half the radius from its centre will be $\frac{11V}{10+x}$. The value of x is

15. Gravitational potential versus distance r graph is represented in fig. The magnitude of gravitational field intensity is equal to X (N/Kg). Then find X



16. A particle is projected vertically upwards from the surface of the earth (radius R_e) with a speed equal to one fourth of escape velocity. The maximum height attained by it from the surface of the earth is $\frac{R_e}{5N}$. Then 'N' is

17. Two uniform solid spheres of equal radii R, but mass M and 4M have a centre to centre separation. 6R, as shown in the figure.



The two spheres are held fixed. A projectile of mass 'm' is projected with minimum velocity from the surface of the sphere of mass M directly towards the centre of the second sphere so that it reaches the surface of the second sphere. If the speed with which the projectile reaches the surface of the sphere of mass 4M is $3\sqrt{\frac{xGM}{5R}}$ find x

18. A bullet is fired vertically upwards with velocity v from the surface of a spherical planet. When it reaches its maximum height, its acceleration due to the planet's gravity is 1/4th of its value at the surface of the planet. If the escape velocity from the planet is $v_{esc} = v\sqrt{N}$, then the value of N is (ignore energy loss due to atmosphere)

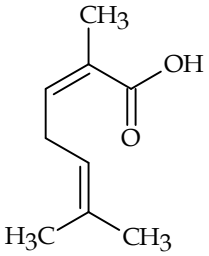
CHEMISTRY **Max Marks: 62**

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 5 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. The IUPAC name of the following compound is



A) 2,6-dimethylhepta-2,5-dienoicacid.

B) 3,7-dimethylhepta-2,5-dienoicacid.

C) 1-Hydroxy-2,6-dimethylhepta-2,5-dienone

D) 3-Hydroxy -2,6-dimethylhepta-2,5-dienone.

20. Some statements about structural isomers of $C_5H_{11}Br$ are given below.

i) It has four primary bromides

ii) It has three secondary bromides

iii) It has two tertiary bromides.

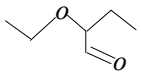
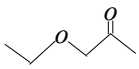
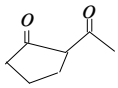
space for rough work

iv) It has one tertiary bromide.

Select the correct ones..

A) i, ii B) i, ii,iv C) ii, iii D) iii

21. Which of the following compounds have both aldehydic and etheric functional groups?

i)  ii)  iii)  iv) 

A) i, iii B) ii, iii C) i, iv D) i, ii, iii

22. Which of the following pairs are correctly matched ?

A) n-butylchloride and iso-butyl chloride are positional isomers.
B) n-pentylalcohol and neo-pentyl alcohol are functional isomers.
C) n-propylmethanoate and ethylethanoate are metamers
D) ortho-dichlorobenzene and meta-dichlorobenzene are chain isomers

23. Identify the correct statement among the following

A) The number of monochloroderivatives for propane (ignore stereoisomers) is three.
B) The number of dichloroderivatives for propane(ignore stereoisomers) is three.
C) The number of trichloroderivatives for propane(ignore stereoisomers) is five.
D) The number of monochloroderivatives for isobutane(ignore stereoisomers) is three.

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

24. Which of the following pairs are functional isomers?

A) Acetaldehyde and acetone

B) Propanenitrile and ethyl isocyanide

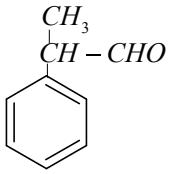
C) diethylamine and Butanamine

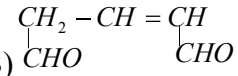
D) Ortho-methylphenol and Benzylalcohol

25. Which of the following compounds having four structural isomers?

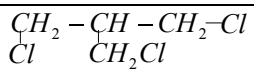
A) C_4H_9Cl B) $C_4H_{10}O$ C) $C_4H_{11}N$ D) C_3H_9N

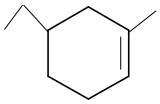
26. Which of the following given IUPAC names are not correct?

A)  :Formylethylbezene

B)  :Propene-1,3-dicarbaldehyde

space for rough work

C)  :1,3-dichloro-2-chloromethylpropane

D)  :1-methyl-3-ethylcyclohexene

27. Metamerism can be shown by

A) Ketones B) Esters C) Ethers D) tertiary amines

28. The correct names of functional isomers of butanoicacid is/ are

A) Ethylethanoate B) Methylpropanoate

C) Propylmethanoate D) Isopropylmethanoate

29. Identify the correct statement/s among the following is/are

A) N,N-dimethylaniline and Phenylmethyl amine are functional isomers.

B) N-methylaniline and phenylethanamine are functional isomers.

C) iso-butylamine and tertiarybutyl amine are chain isomers.

D) n-butylamine and iso-butylamine are chain isomers.

30. Which of the following names are correct for the compound containing molecular formula is C_7H_8O?

A) Phenylmethanol B) 2-methylphenol

C) 3-methylphenol D) methoxybenzene.

31. Select the correct combination/s among the following is/are

A) Ortho-cresol : 2-methylphenol.

B) Catechol : Benzene-1,3-diol.

C) Resorcinol : Benzene-1,2-diol.

D) Hydroquinone : Benzene -1,4-diol

SECTION – III
(INTEGER ANSWER TYPE)

This section contains 5 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).
Marking scheme +3 for correct answer , 0 if not attempted and 0 in all other cases

32. No of metamers from the following molecules whose molecular formula is $C_6H_{12}O$ is/are.....

$CH_3-CH_2-CO-CH_2-CH_2-CH_3$	$CH_3-CO-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_3$
$CH_3-CH_2-CH_2-CH_2-CH_2-CHO$	$CH_3-CH_2-CO-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_3$
$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_2-CH_2-CHO$	$CH_3-CO-CH_2-CH_2-CH_2-CH_3$
$CH_3-CO-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_2-CH_3$	$CH_3-CO-CH_2-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_3$
$CH_3-CO-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{\vert}{\underset{\vert}{C}}}}-CH_3$	$CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{\vert}{\underset{\vert}{C}}}}-CO-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{\vert}{\underset{\vert}{C}}}}-CH_3$

space for rough work

33. The number of structural isomers of $C_4H_{10}O$ is 'X' and for C_2H_6O is 'Y'.

Then the X + Y is..

34. The number of correct IUPAC names for the given compounds is..

i) $CH_3-CH=CH-CH_2-C\equiv C-CH_3$: hept-2-en-5-yne.

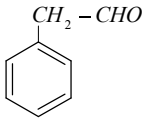
ii) $CH_2=CH-CH_2-C\equiv CH$: pent-1-en-4-yne.

iii) $CH_3-CH=CH-CH_2-C\equiv CH$: hex-4-en-1-yne.

iv) $CH_2=CH-CH_2-C\equiv C-CH_3$:hex-5-en-2-yne.

v) $(CH_3)_3C-CH=CH-C(CH_3)_3$:1,2-di(3^0-butyl)ethene.

vi) $NC-CH_2-\underset{\displaystyle CN}{\underset{|}{CH}}-CH_2-CN$: propane -1,2,3-tricarbonitrile.

vii)  : benzeneacetaldehyde.

35. The number of structural isomers possible for $C_6H_6O_3$ containing benzene ring (Do not consider peroxybond containing isomers) is X.
The number of structural isomers possible for C_7H_9N containing benzene ring is Y.
Then X + Y is....

36. The number of cyclic isomers for C_5H_{10} is 'X' and the number of open chain structural isomers for C_5H_{10} is 'Y'. Then $X-Y$ is..

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 5 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. If $3x+2y=1$ acts as a tangent to $y=f(x)$ at $x=1/2$ and if

$$p=\lim_{x\to 0}\frac{x(x-1)}{f\left(\frac{e^{2x}}{2}\right)-f\left(\frac{e^{-2x}}{2}\right)} \text{ then, } \sum_{r=1}^{\infty}p^r = \_\_\_\_\_$$

A) 1/2 B) 1/3 C) 1/6 D) 1/7

38. If the equation $x^{5/3}-5x^{2/3}=K$ has exactly one positive root, then, the complete solution set of K is,

A) $(-\infty,\infty)$ B) $(-\infty,0)$ C) $(3,\infty)$ D) $(0,\infty)$

39. A sphere of radius 10cm shrinks to radius 9.8cm. The approximate decrease in volume is ____ cu.cm

A) 80π B) -80π C) 16π D) -16π

space for rough work

40. If the point on $y = x\tan\alpha - \frac{ax^2}{2u^2\cos^2\alpha}, 0 < \alpha < \frac{\pi}{2}$ where the tangent is parallel to y=x has an Ordinate $\frac{u^2}{4a}$ then the value of α is

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

41. A horse runs along a circle with a speed of 20km/h. A lantern is at the centre of the circle. A fence is there along the tangent to the circle at the point at which the horse starts. The speed with which the shadow of the horse moves along the fence at the moment when it covers 1/8 of the circle in km/h is

A) 20 B) 40 C) 30 D) 60

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

42. Which of the following curves are orthogonal

A) $\frac{x^2}{21}+\frac{y^2}{17}=1, \frac{x^2}{3}-\frac{y^2}{1}=1$ B) $\frac{x^2}{47}+\frac{y^2}{4}=1, \frac{x^2}{21}+\frac{y^2}{23}=1$

C) $\frac{x^2}{49}+\frac{y^2}{4}=1, \frac{x^2}{23}-\frac{y^2}{22}=1$ D) $\frac{x^2}{21}+\frac{y^2}{9}=1, \frac{x^2}{42}+\frac{y^2}{30}=1$

43. Points on the curve $f(x)=\frac{x}{1-x^2}$, where the tangent is inclined at an angle of $\frac{\pi}{4}$ to x axis are

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

44. The family of curves defined by the equations $y=ax$ and $x^2+y^2=c^2$ are perpendicular for

A) $a=2,c=4$ B) $a=-2,c=3$ C) $a=3,c=2$ D) $a=3,c=-2$

45. The normal to the curve $y^2=5x-1$ at the point $(1,-2)$ is of the form $ax-5y+b=0$ then

A) a = 4 B) b = – 14 C) a + b = – 10 D) ab = 40

46. Two motor cars start with the same velocity 'v' km/hour from distances 'a' km and 'b' km from the junction of two roads inclined at 90^0 and travel towards the junction and after 2 hours, they are nearing each other at the rate of

A) $\frac{4v^2-(a+b)v}{\sqrt{a^2+b^2-4(a+b)v+8v^2}}km/hour$ B) $\frac{2v^2-(a+b)v}{\sqrt{a^2+b^2-2(a+b)v+8v^2}}km/hour$

C) $\frac{6v^2-(a+b)v}{\sqrt{a^2+b^2-6(a+b)v+8v^2}}km/hour$ D) $\frac{8v^2-(a+b)v}{\sqrt{a^2+b^2-8(a+b)v+8v^2}}km/hour$

47. The radius of a right circular cylinder increases at the rate of 0.1 cm/min, and the height decreases at the rate of 0.2 cm/min. The rate of change of the volume of the cylinder, in cm^3/min, when the radius is 2 cm and the height is 3 cm, is

A) -2π B) $-\frac{8\pi}{5}$ C) $-\frac{3\pi}{5}$ D) $\frac{2\pi}{5}$

48. A point on the parabola $y^2 = 18x$ at which the ordinate increases at twice the rate of the abscissa is

A) (2, 6) B) (2, – 6) C) $\left(\frac{9}{8}, -\frac{9}{2}\right)$ D) $\left(\frac{9}{8}, \frac{9}{2}\right)$

49. An error of $0.01cm$ is made while measuring the radius $5cm$ of a circle.

A) The error in circumference will be $0.02\pi\ cm$

B) The error in area will be $0.1\pi\ sq.cm$

C) The relative error in circumference will be 0.002

D) The percentage error in area will be 0.004

SECTION – III
(INTEGER ANSWER TYPE)

This section contains 5 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).
Marking scheme +3 for correct answer , 0 if not attempted and 0 in all other cases

50. Water is dripping out from a conical funnel of semi vertical angle $\frac{\pi}{4}$ at the uniform rate of $2cm^3/s$ .Through a tiny hole at the vertex at the bottom when the slant height of the water is 4cm. If $\lambda cm/s$ be the rate of decreases of the slant height of the water, then the value of $4\pi\sqrt{2}\lambda$ must be

51. The rate of change of the volume of a sphere with respect to its surface area, when the radius is 2 cm, is

52. If $y=4x-5$ is tangent to the curve $y^2=px^3+q$ at the point (2, 3) then $p-q=$

53. If the normal to the curve $y=f(x)$ at $x=0$ be given by the equation $3x-y+3=0$, then the value of $\lim_{x\to o} x^2\left\{f\left(x^2\right)-5f\left(4x^2\right)+4f\left(7x^2\right)\right\}^{-1}$ is $\frac{-1}{k}$ then k=

54. A man 1.6m high walks at the rate of 30m per minute away from a lamp which is 4m above ground. If k is the rate at which the man's shadow is lengthening, then the value of $k/4$ is _____

space for rough work

Master JEE CLASSES
Kukatpally, Hyderabad.

JEE-ADVANCE-2016-P1-Mode
MAX MARKS : 186

KEY SHEET
2016-P1

PHYSICS

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

CHEMISTRY

19	**A**	20	**B**	21	**C**	22	**C**	23	**C**
24	**BCD**	25	**AD**	26	**ABD**	27	**ABCD**	28	**ABCD**
29	**D**	30	**ABCD**	31	**AD**	32	**6**	33	**9**
34	**4**	35	**8**	36	**0**				

MATHS

37	**A**	38	**D**	39	**A**	40	**C**	41	**B**
42	**AC**	43	**AD**	44	**ABCD**	45	**ABC**	46	**A**
47	**D**	48	**CD**	49	**ABCD**	50	**2**	51	**1**
52	**9**	53	**3**	54	**5**				

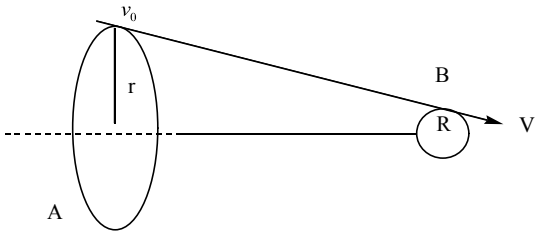
SOLUTIONS

PHYSICS

1. Total potential energy is $V = \sum U_{ij}$

$$= \frac{-Gm^2}{a}\left[6\times\left(\frac{1}{a}\right)\right] + 6\left(\frac{1}{\sqrt{3}a}\right) + 3\left(\frac{1}{2a}\right) = \frac{-6Gm^2}{a}\left(1+\frac{1}{\sqrt{3}}+\frac{1}{4}\right)$$

2.



LCAM $mv_0 r = mVR$

$$V = \frac{v_0 r}{R}$$

L.C.E $\frac{1}{2}mv_0^2 = \frac{-GMm}{R} + \frac{1}{2}mv^2$

$$\frac{v_0^2}{2} + \frac{GM}{R} = \frac{1}{2}\frac{v_0^2 r^2}{R^2}$$

$$r^2 = \frac{\left(v_0^2 R + 2GM\right)R}{v_0^2}$$

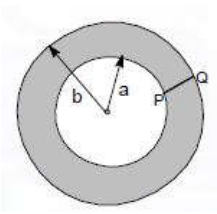
Area = $\pi r^2 = \frac{\pi R^2}{v_0^2}\left(v_0^2 + \frac{2GM}{R}\right)$

3. As in case of elliptic orbit of a satellite mechanical energy E=-(GMm/2a) remains constant , at any position of satellite in the orbit,

Therefore $\frac{1}{2}mv^2 - \frac{GMm}{r} = -\frac{GMm}{2a}, i.e, v^2 = GM\left[\frac{2}{r} - \frac{1}{a}\right]$

4. Potential inside a shell is constant

5.



$$V_Q = -\frac{Gm}{b} = -\frac{G}{b}\frac{4}{3}\pi\left(b^3 - a^3\right)\rho \;\; ; \;\; dV_p = -\frac{Gdm}{x} \;\; ; \;\; dm = 4\pi x^2 (dx)\rho \;\; : V_p = -\int_a^b \frac{G\left(4\pi x^2 dx\right)\rho}{x}$$

$$= -4\pi G\rho\left(\frac{x^2}{2}\right)_a^b \;\; ; \;\; = -4\pi G\rho\left(\frac{b^2 - a^2}{2}\right) \;\; ; \;\; \frac{V_Q}{V_P} = \frac{\frac{G}{b}\frac{4}{3}\pi\left(b^3 - a^3\right)\rho}{+4\pi G\rho\left(\frac{b^2 - a^2}{2}\right)} \;\; ; = \frac{2\left(b^3 - a^3\right)}{3b\left(b^2 - a^2\right)}$$

6. Kinetic energy $\frac{1}{2}mv^2 = \frac{GmM}{2r}$ or $KE\alpha\frac{1}{r}$. Thus choice (A) is correct.

Angular momentum = mvr = $mx\sqrt{\frac{GM}{r}}xr = m\sqrt{GMr}$, which is proportional to $\sqrt{r}$.

Hence choice (B) is wrong.

Linear momentum mv = $m\sqrt{\frac{GM}{r}}$, which is proportional to $\frac{1}{\sqrt{r}}$. Hence choice (C) is correct. The freuqeuncy of revolution is $v = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{GM}{r^3}}$ *i.e.* $v\alpha\frac{1}{r^{3/2}}$.

Hence the correct choices are (A), (C) and (D)

7. A) The centre of mass of the double star system remains stationary and both the stars revolve around in circular orbits which are concentric with the centre of mass

The distance of centre of mass from the heavier star is equal to $\left(\frac{\mathrm{Mr} + 2\mathrm{M}.0}{\mathrm{M} + 2\mathrm{M}}\right) = \frac{\mathrm{r}}{3}$

Hence, the heavier star revolves in a circle of radius r/3 while the lighter star in a circle of radius 2r/3. Hence option(a) is wrong.

B) $(2\mathrm{M})\left(\frac{\mathrm{r}}{3}\right)\omega^2 = 2\mathrm{GM}^2$

$$(2\mathrm{M})\frac{\mathrm{r}}{3}\omega^2 = \frac{2\mathrm{GM}^2}{\mathrm{r}^2} \Rightarrow \omega = \left(\frac{3\mathrm{GM}}{\mathrm{r}^3}\right)^{1/2} = \frac{2\pi}{\mathrm{T}} = \left(\frac{3\mathrm{GM}}{\mathrm{r}^3}\right)^{1/2} \Rightarrow \mathrm{T} = 2\pi\frac{\mathrm{r}^{3/2}}{(3\mathrm{GM})^{1/2}}$$

Where r is distance between two stars. Hence, option (b) is correct.

C) Kinetic energy of a star will be equal to 1/2 mv^2 where v is speed of the star which is equal to (radius of its circular orbit) x ω.

Hence, K.E. of heavier star is

$$\mathrm{E}_1 = \frac{1}{2}(2\mathrm{M})\left(\frac{\mathrm{r}}{3}\omega\right)^2 = \frac{\mathrm{Mr}^2\omega^2}{9}\frac{3\mathrm{GM}}{\mathrm{r}^3} = \frac{\mathrm{GM}^2}{3\mathrm{r}}$$

And that of lighter star, $\mathrm{E}_2 = \frac{1}{2}\mathrm{M}\left(\frac{2\mathrm{r}}{3}\omega\right)^2$.

It means, KE of the lighter star is twice that of the heavier star.

Hence, option (C) is wrong.

8. A) $L = m\left(u\cos 30^0\right)r = \dfrac{\sqrt{3}mur}{2}$

B) $\dfrac{dA}{dt} = \dfrac{L}{2m} = \dfrac{\sqrt{3}ur}{4}$ C) $T = \dfrac{total\ area}{areal\ velocity} = \dfrac{2\pi a^2}{\frac{\sqrt{3}ur}{4}} = \dfrac{8\pi a^2}{\sqrt{3}ur}$

9. $M_{cavity} = \dfrac{M}{\frac{4}{3}\pi R^3} \times \frac{4}{3}\pi\left(\dfrac{R}{3}\right)^3 = \dfrac{M}{27}$

At 'A' $V_{total} = V_{cavity} + V_{remaining}$

$$-\frac{GM}{R} = -\frac{G\frac{M}{27}}{\frac{5R}{3}} + V_{remaing}$$

$$V_R = -\frac{GM}{R} + \frac{GM}{45R} = -\frac{44GM}{45R}$$

For escape velocity

$$\frac{1}{2}mv^2 = \frac{44GMm}{45R}$$

$$V = \sqrt{\frac{88}{45}\frac{GM}{R}}$$

10. Work done due to friction is given by

$$W = \left[\frac{-GMm}{2R^3}\left(3R^2 - \frac{R^2}{4}\right)\right] - \left[\frac{-GMm}{R}\right]$$

$$= \frac{-GMm}{2R^3}\frac{11R^2}{4} + \frac{GMm}{R} = \frac{-3GMm}{8R}$$

$$dW = -\mu\frac{GMm}{R^3}\sqrt{x^2+R^2}\,\frac{d}{\sqrt{x^2+R^2}}dx$$

$$= -\mu\frac{GMm}{2R^2}d\left(dx\right)$$

$$W = -\mu\frac{GMm}{2R^2}\left(x\right)_0^{\sqrt{3R/2}}$$

$$= -\mu\frac{GMm}{2R^2}\frac{\sqrt{3}R}{2} = -\mu\frac{GMm}{4R}\sqrt{3}$$

$$\Rightarrow \mu \frac{GMm}{4R}\sqrt{3} = \frac{3GMm}{8R} \qquad \Rightarrow \mu = \frac{\sqrt{3}}{2}$$

11. Inward gravitational pull on the layer

$$df = \left(\frac{GM}{R^3}.r\right)(4\pi r^2 p.dr),\ P = \frac{3M}{4\pi r^3}$$

$$dp = \frac{df}{4\pi r^2}, P = \int_r^R dp = \frac{3}{8}\left[1 - \frac{r^2}{R^2}\right]\frac{GM^2}{\pi R^4}$$

12. (A) If it is projected radially it will go up and than move down in a straight line

B) If it is projected will a small velocity near the earth`s sarface, g will be almost constant So its path will be almost parabolic. (Projectile Motion)

(C) If the body is projected tangentially with orbital speed $\left(V_0 = \sqrt{\frac{GM}{r}}\right)$ then it will revolve in circular orbit

(D) If the body is projected with a velocity V (Vo,Ve) it may revolve in an elloptical orbit.

13. Conceptual

14. $V = \frac{-3GM}{2R}, V_{at\,r} = \frac{-GM}{2R^3}\left(3R^2 - r^2\right)$

$$\left(at\,r = \frac{R}{2}\right) = \frac{-11GM}{8R} = \frac{11}{8}\left(\frac{2V}{3}\right) = \frac{11V}{12}$$

15. $E = \frac{-dv}{dx}$ here $dx = drSin\theta$

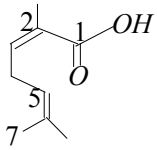
16. $\frac{1}{2}m.\frac{1}{4}\left(\frac{2GM}{R}\right) - \frac{GMm}{R} = -\frac{GMm}{R+h}\ \therefore h = \frac{R}{15}$

17. $-\frac{GMm}{2R} - \frac{G4Mm}{4R} = -\frac{GMm}{5R} - \frac{G4Mm}{R} + \frac{1}{2}mV^2 \Rightarrow V = 3\sqrt{\frac{3GM}{5R}}$

18. At height R from the surface of planet acceleration due to planet's is $\frac{1}{4}$ th in comparison to the value at the surface

So, $-\frac{GMm}{R} + \frac{1}{2}mv^2 = -\frac{GMm}{R+R}$ and $-\frac{GMm}{R} + \frac{1}{2}mv_{esc}^2 = 0$

$\therefore v_{esc} = v\sqrt{2}$

19. 

20. It has 4 primary, 3 secondary and one tertiary bromides.

21. i and iv have aldehydic and etheric groups

22. Different alkyl groups connected to same functional grops are called metamers.

23. For A is 2, for B is 4, for D is 2

24. Acetaldehyde and acetone are non isomers (molecular formula is not same)

25. A has four isomers(n-butyl, sec. butyl, isobutyl and ter. butyl chlorides)

    B has seven structural isomers (four alcoholic and three etheric)

    C has 8 structural isomers (primary amines =4 ,sec. Amines =3 , ter. Amine = 1)

    D has 4 structural isomers (propanamine -1 ,propanamine-2 ,N-methylethanamine and trimethyl amine.)

26. A (2-phenyl propanal) B) pent-2-en-1,5-dial D)4-ehtyl-2methylcyclohexene-1

27. all can show metamerism

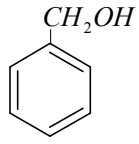
28. A) $CH_3COOC_2H_5$ B) $CH_3CH_2COOCH_3$

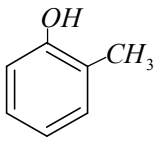
    C) $H-COOCH_2CH_2CH_3$ D) $H-COOCH(CH_2)CH_3$

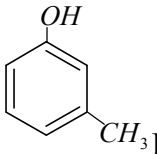
29. A) are not isomers

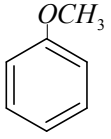
    C) are positional isomers

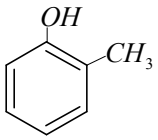
30. All are correct

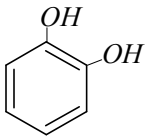
A) 

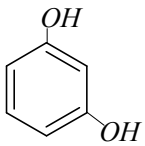
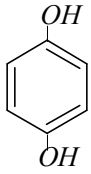
B) 

C) 

D) 

31. ortho cresol- 

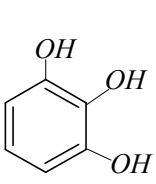
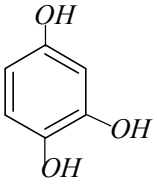
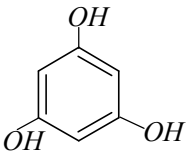
: Catechol- 

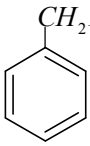
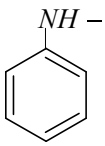
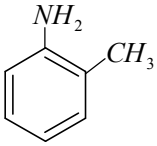
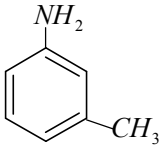
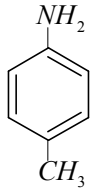
Resorcinol:  : Hydroquinone- 

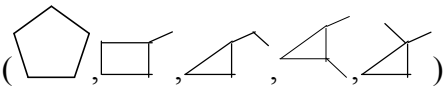
32. ii, x are not isomers for the given compound and iii and v are aldehydes:

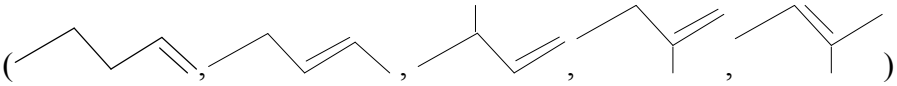
33. X= 7 and Y= 2

34. i, ii, iii, vi are correct.

35. X is 3( ,  , )

Y is 5( ,  ,  ,  , )

36. X = 5 ()

Y = 5()

MATHS

37. Sol. slope of $3x+2y=1$ is $\frac{-3}{2}$

$$\Rightarrow f^1\left(\frac{1}{2}\right)=\frac{-3}{2}$$

$$p=\lim_{x\to 0}\frac{x(x-1)}{f\left(\frac{e^{2x}}{2}\right)-f\left(\frac{e^{-2x}}{2}\right)}\left(\frac{0}{0}\right)=\frac{-1}{f^1\left(\frac{1}{2}\right)+f^1\left(\frac{1}{2}\right)}=\frac{1}{3}$$

$$\therefore \sum_{r=1}^{\infty}p^r=\frac{1}{3}+\frac{1}{3^2}+.....\infty=\frac{1/3}{1-1/3}=\frac{1/3}{2/3}=\frac{1}{2}$$

38. Sol. Sketch $y=x^{5/3}-5x^{2/3}$ and $y=K$

40. Sol. Given m=1 $\Rightarrow \tan\alpha - \frac{ax}{u^2\cos^2\alpha} = 1 \Rightarrow x = \frac{(\tan\alpha - 1)}{a} u^2\cos^2\alpha$ substitute x and y values in given equation $\frac{u^2}{4a} = \frac{u^2}{a}\left[\sin^2\alpha - \frac{1}{2}\right] \Rightarrow \alpha = \frac{\pi}{3}$

42. Conceptual

53. Put $x^2 = t,$ and $f'(0) = -1/3$