**PHYSICS** **Max Marks: 100**

**(SINGLE CORRECT ANSWER TYPE)**

This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

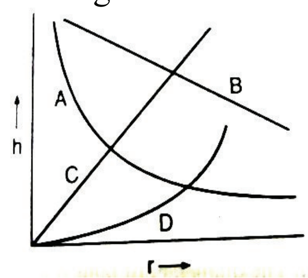
**Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.**

26. n droplets of water each of radius r coalesce to form a big drop of radius R. If the energy released during coalescence goes into heating the drop,(Take T as surface tension of water ). Find energy released during the coalesce

1) $4\pi r^2 T\left[n^{4/3}-n^{2/3}\right]$ 2) $4\pi r^2 T\left[n-n^{2/3}\right]$

3) $4\pi r^2 T\left[n^{2/3}-n^{1/3}\right]$ 4) $4\pi r^2 T\left[n-n^{1/3}\right]$

27. If the radius 'r' of capillary tube dipped in water is changed, the height 'h' to which water rises in the capillary also changes. Variation of h with r will be as in:




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

28. A spherical object falling in air attains a terminal speed 15m/s. Terminal speed of this object when it falls in vacuum will be

1) 15 m/s 2) Less than 15 m/s

3) more than 15m/s 4) There is no terminal speed in this situation

29. A capillary tube is dipped in water. Water rises in the capillary to such a height that the upward force because of surface tension is balanced by $1.4\times10^{-3}$ newton weight of water. If surface tension of water is $70\times10^{-3}$ N/m, inner circumference of capillary is:

1) 2 cm 2) 4cm 3) 1.2 cm 4) 3.4cm

30. X and Y are two capillary tubes with lengths $l_x$ and $l_y$ and with radii $r_x$ and $r_y$ respectively. When a pressure difference P is maintained between the ends of X, the rate of flow of water through X is 10cc/sec. X and Y are now connected in series and the same pressure difference P is maintained across the combination. If $l_x = 2\, l_y$ and, rate of flow of water through the combination will be

1) 3cc/sec 2) 52/7 cc/sec

3)20/7 cc/sec 4) 9/4 cc/sec

31. Two soap bubbles of different radii are in communication with each other.
1) Air flows from the larger bubble into the smaller one until the two bubbles are of equal Size.
2) The size of the bubbles remains the same.
3) Air flows from the smaller bubble into the larger one and the larger bubble grows at the expense of the smaller one.
4) The air flows from the larger into the smaller bubble until the radius of the smaller one becomes equal to that of the large one and of the large one equal to that of the smaller one.

32. If two soap bubbles of radii $r_1$ and $r_2$,($r_2$>$r_1$) are in contact, the radius of their common interface is
1) $r_1+r_2$ 2) $(r_1+r_2)^2$ 3) $r_1r_2/(r_2-r_1)$ 4) $\sqrt{r_1r_2}$

33. An oil drop of density $\rho$ is floating half immersed inside a liquid of density $\sigma$. If the surface tension of the liquid be T, then the radius R of the oil drop is:
1) $\sqrt{3T/g(2\rho-\sigma)}$ 2) $\sqrt{\dfrac{3T}{2g(\rho-\sigma)}}$
3) $\sqrt{\dfrac{3T}{g(2\rho-\sigma)}}$ 4) None of these

34. A 20cm long capillary tube is dipped in water. The water rises upto 8cm. If the entire arrangement is put in a freely falling elevator the length of water column in the capillary tube will be
1) 4cm 2) 20cm 3) 8cm 4) 10cm

35. Two capillaries of length L and 2L and of radii R and 2R are connected in series. The net rate of flow of fluid through them will be : (given rate of the flow through single capillary
$X=\pi PR^4/8\eta L)$
1) 8/9X 2) 9/8X 3) 5/7X 4) 7/5X

36. A body of density $D_1$ and mass M is moving downward in glycerine of density $D_2$) What is the viscous force acting on it ?
1) $Mg\left(1-\dfrac{D_2}{D_1}\right)$ 2) $Mg\left(1-\dfrac{D_1}{D_2}\right)$ 3) $MgD_1$ 4) $MgD_2$

37. A spherical solid ball of volume V is made of a material of density $\rho_1$. It is falling through a liquid of density $\rho_2(\rho_2<\rho_1)$. Assume that the liquid applies a viscous force on the ball that is proportional to the square of its speed $v, i.e, F_{viscous}=kv^2\,(k>0)$ .The terminal speed of the ball is
1) $\sqrt{\dfrac{Vg(\rho_1-\rho_2)}{k}}$ 2) $\dfrac{Vg\rho_1}{k}$ 3) $\sqrt{\dfrac{Vg\rho_1}{k}}$ 4) $\dfrac{Vg(\rho_1-\rho_2)}{k}$

38. A capillary tube is taken from the earth to the surface of moon. Rise of the liquid column on the moon (acceleration due to gravity on earth is 6 times that on moon) is:
1) six times that on the earth's surface 2) 1/6 that on the earth's surface
3) equal to that on the earth's surface 4) Zero

39. A liquid drop of radius R breaks into 64 tiny drops each of radius r. If the surface tension of liquid is T, then the gain in energy is:
1) $48\pi R^2 T$ 2) $12\pi R^2 T$ 3) $96\pi R^2 T$ 4) $192\pi R^2 T$

40. Two spheres of equal masses but radii $r_1$ and $r_2$ are allowed to fall in a liquid of infinite column. The ratio of their terminal velocities are
1) 1 2) $r_1 : r_2$ 3) $r_2 : r_1$ 4) $\sqrt{r_1} : \sqrt{r_2}$

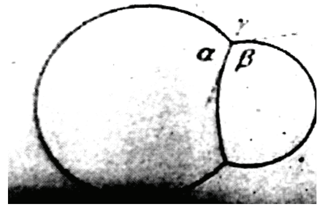
41. A sphere of radius r and density $\rho$ is dropped under gravity through a fluid of viscosity $\eta$. If the average acceleration is half of initial acceleration, what is the time required to attain terminal velocity?
1) $4\rho r^2/(9\eta)$ 2) $9\rho r^2/(4\eta)$ 3) $4\rho r^2/(3\eta)$ 4) $\rho r^2/\eta$

42. Sixty four spherical rain drops of equal size are falling vertically through air with a terminal velocity 1.5 $ms^{-1}$.If these drops coalesce to form a big spherical drop, then terminal velocity of big drop is
1) 8 $ms^{-1}$ 2) 16 $ms^{-1}$ 3) 24 $ms^{-1}$ 4) 32 $ms^{-1}$

43. A long capillary tube of radius $r$ is put in contact with surface of a perfectly wetting liquid of density $\rho$ and very low viscosity. What maximum height $h$ the liquid can rise inside the capillary? Here height is measured above the level of the liquid outside the capillary. Surface tension of the liquid and acceleration due to gravity are denoted by $\sigma$ and $g$ respectively.
1) $h = \frac{2\rho}{\rho g r}$ 2) $h = \frac{4\sigma}{\rho g r}$ 3) $\frac{2\rho}{\rho g r} < h < \frac{4\sigma}{\rho g r}$ 4) Insufficient information

44. Consider two hollow glass spheres; one of them containing water in approximately 10% of its volume, and the other containing a similar volume of mercury. If the spheres are brought in a zero gravity environment of a space – shuttle, what will you observe?
1) Water and mercury both float in their spheres as spherical drops.
2) Water forms a layer on inner surface of the sphere while mercury floats as a spherical drop
3) Mercury forms a layer on inner surface of the sphere while water floats as a spherical drop
4) In each case, some amounts of the liquids from layers on inner surfaces of the spheres and remaining amounts float as spherical drops.

45. When two soap bubbles of different radii coalesce, some portions of their surfaces make a common surface. At any point on the circumference of the common surface, the three surfaces meet at angles $\alpha, \beta$ *and* $\gamma$. What relation should these angles bear?

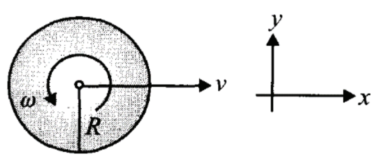



1) $\alpha > \beta$ 2) $\alpha > \beta > \gamma$ 3) $\alpha = \beta < \gamma$ 4) $\alpha = \beta = \gamma$

**(NUMERICAL VALUE TYPE)**

This section contains 5 questions. Each question is numerical value. For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to second decimal place.
(e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30).
**Marking scheme: +4 for correct answer , 0 if not attempted and 0 in all other cases.**

46. When liquid medicine of density $\rho$ is to be put in the eye, it is done with the help of a dropper. As the bulb on the top of the dropper is pressed, a drop forms at the opening of the dropper. We wish to estimate the size of the drop. We first assume that the drop formed at the opening is spherical because that requires a minimum increase in its surface energy. To determine the size, we calculate the net vertical force due to the surface tension T when the radius of the drop is R. When the force becomes smaller than the weight of the drop, the drop gets detached from the dropper. If r = 5 x $10^{-4}$m, $\rho$ = $10^3$ kg $m^{-3}$, g = 10m/$s^2$, T = 0.42 $Nm^{-1}$, the radius of the drop when it detaches from the dropper is approximately in mm.
47. Two spheres of the same material but of radii 0.01 and 0.02 m are dropped one by one in the same viscous fluid. Their terminal velocities respectively will be in the ratio.
48. If a superman attempts to drink water through a very long straw, his great strength allows him to achieve maximum suction. The maximum height through which be can lift the water on the earth is $H_1$. if superman attempts on moon then maximum height through which be can lift the water is $H_2$. Find the value of $H_1 \times H_2$.
49. A basket ball of radius R is spun with an angular speed $\vec{\omega} = \omega\hat{k}$ and its CM moves with a speed v. The aerodynamic lift experienced by the ball is $K\pi\rho R^3 v\omega$. Then find the value of K. Assume ρ = density of air.




50. One end of a glass capillary tube with a radius r = 0.005cm is immersed into water to a depth of h = 2 cm. The gauge pressure required to blow an air bubble of the same radius out of the lower end of the tube is $x \times 10^3$ Pa. Value of x is:
($T = 7\times10^{-2}$ N/m and $p_0 = 10^5$ Pa)

# Sri Chaitanya IIT Academy., India.

A.P, TELANGANA, KARNATAKA, TAMILNADU, MAHARASHTRA, DELHI, RANCHI

*A right Choice for the Real Aspirant*

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| Time: 3 Hr's | WTM-18 | Max.Marks:300 |

# Key Sheet

## MATHEMATICS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | **4** | 2 | **4** | 3 | **3** | 4 | **4** | 5 | **3** |
| 6 | **2** | 7 | **3** | 8 | **4** | 9 | **1** | 10 | **2** |
| 11 | **2** | 12 | **4** | 13 | **3** | 14 | **2** | 15 | **2** |
| 16 | **2** | 17 | **3** | 18 | **4** | 19 | **4** | 20 | **4** |
| 21 | **4** | 22 | **1** | 23 | **0.5** | 24 | **-2** | 25 | **15** |

## PHYSICS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 26 | **2** | 27 | **3** | 28 | **4** | 29 | **1** | 30 | **3** |
| 31 | **3** | 32 | **3** | 33 | **3** | 34 | **2** | 35 | **1** |
| 36 | **1** | 37 | **1** | 38 | **1** | 39 | **4** | 40 | **3** |
| 41 | **1** | 42 | **3** | 43 | **3** | 44 | **2** | 45 | **4** |
| 46 | **2** | 47 | **4** | 48 | **0** | 49 | **2** | 50 | **3** |

## CHEMISTRY

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 51 | **2** | 52 | **3** | 53 | **3** | 54 | **2** | 55 | **4** |
| 56 | **2** | 57 | **4** | 58 | **1** | 59 | **4** | 60 | **2** |
| 61 | **2** | 62 | **1** | 63 | **2** | 64 | **3** | 65 | **2** |
| 66 | **2** | 67 | **3** | 68 | **1** | 69 | **2** | 70 | **4** |
| 71 | **5** | 72 | **3** | 73 | **1** | 74 | **0** | 75 | **5** |

# PHYSICS

26. Initial Volume = final volume

$n.\frac{4}{3}\pi r^3 = \frac{4}{3}rR^3$ Also energy released = change in surface energy

$r\,n^{1/3} = R$

$= = n\left(4\pi r^2\right)T - 4rR^2T$

27. $\frac{2T\cos\theta}{r} = \rho gh$

28. In vacuum no viscous force is there

29.

$T \times 2\pi r = mg$

$70\times10^{-3}\,N/m \times (2\pi r) = 1.4\times10^{-3}\,N$

30.

$\theta = \frac{dv}{dt} = \frac{\pi R^4}{8nl}\Delta P$

$\Delta P = \frac{8nl}{\pi R^4}\theta$ R = resistance by velocity

$\Delta P = R\theta$

31. Conceptual

32. $p_0 + \frac{4T}{r_2} + \frac{4T}{r_{constant}} = p_0 + \frac{4T}{r_1}$

$\frac{1}{r_{constant}} = \frac{1}{r_1} - \frac{1}{r_2}$ $\frac{1}{r_{constant}} = \frac{r_2 - r_1}{r_1 r_2}$

$r_{constant} = \frac{r_1 r_2}{r_2 - r_{12}}a$

33. Surface tension force + Buoyancy force =mg

34. $g_{effective} = 0$ ( in free fall )

35. Conceptual

36. Mg= force of buoyancy + viscous force

Body will move with terminal speed

37. Conceptual

38. $g_{moon} = \frac{g_{earth}}{6}$

39. same as question no 26

40. Conceptual

41. Conceptual

42. $V_T \alpha (radius)^2$

43. angle of contact =0, ( for perfectly wetting liquid)

44. angle of contact of water <$90^0$ ( wetting)Angle of contact of mercury > $90^0$ ( nonwetting)

45. Conceptual

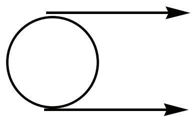
46. $(2\pi r)T = mg$

r- radius of drop m-mass of drop $\left(\frac{4}{3}\pi r^3\rho\right)$

47. Conceptual

48. maximum height $=\dfrac{p_0}{p_g}$ For moon no atmosphere $(p_0=0)$ so $(H_2=0)$

49.



$V-R\omega=V_2$

$V+R\omega=V_1$

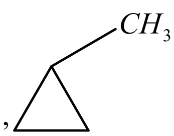
$\Delta p=\dfrac{1}{2}\rho\left(v_1^2-v_2^2\right)+\rho g\Delta h$ Neglecting $\rho g\Delta h$

$\Delta p=\dfrac{1}{2}\rho\times 2v\times 2R\omega$ Aerodynamic lift $=\Delta p\pi R^2$ $=2\rho Rv\omega\pi R^2$

$\Delta p=2\rho Rv\omega$

50. Conceptual

# CHEMISTRY

51. Same molecular formula but different functional groups.
52. Conceptual
53. $CH_3-CH=CH-CH_3, CH_2=CH-CH_2-CH_3,$ $\begin{array}{c} CH_2-CH_2 \\ | \quad\quad | \\ CH_2-CH_2 \end{array}$ , 
54. Conceptual
55. All $i, 2^e$ & $3^e$ amides
56. Due to Intramolecular Hydrogen bonding.
57. CIP rules
58. On $(C=C)$ 'C' atoms should not have two identical atoms or groups
59. CIP rules
60. Generally, dipolemoment of Trans isomer is zero
61. CIP rules
62. Have parent chain of different lengths.
63. Posses two types of different 'H' atoms.
64. Conceptual
65. Conceptual
66. Functional should be same.
67. H & OH on same side of (C=N)
68. Conceptual
69. Conceptual
70. Unsaturated compounds can exhibit.
71. Conceptual (All chain isomers)
72. Conceptual
73. Only one type of "H" atoms
74. Conceptual
75. Conceptual

# Final Key

| S.NO | SUB | Q.NO | GIVEN KEY | FINALIZED KEY | EXPLANATION |
|---|---|---|---|---|---|
| 2 | PHY | **30** | **3** | **Delete** | $r_x$ and $r_y$ relation is required to solve |
| 3 | PHY | **33** | **3** | **1 or 3** | Same options |
| 4 | PHY | **39** | **4** | **2** | $\frac{64}{16}\times 4\pi R^2T - 4\pi R^2T = 12\pi R^2T$ |
| 5 | PHY | **40** | **3** | **Delete** | Without density of liquid we can't solve |
| 6 | PHY | **43** | **3** | **Delete** | Printing mistake (in option 3) |
| 7 | PHY | **47** | **4** | **0.25** | We wan $v_1 : v_2$, by that we get 0.25 |
| 8 | PHY | **49** | **2** | **Delete** | Printing Mistake |
| | | | | | |
| | | | | | |