PHYSICS **Max.Marks:70**

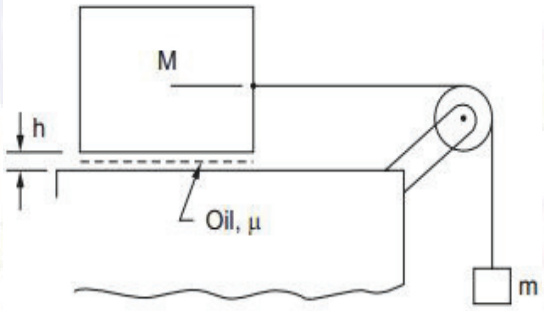
SECTION – I

(SINGLE CORRECT CHOICE TYPE)

This section contains 10 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONLY ONE is correct

Passage for questions 1 and 2:

As shown in figure, a block of mass M slides on a horizontal table on oil film of thickness h and coefficient of viscosity μ. The mass m is released from rest at time t =0. Area of base is A.



1. Velocity of system with time t is given by

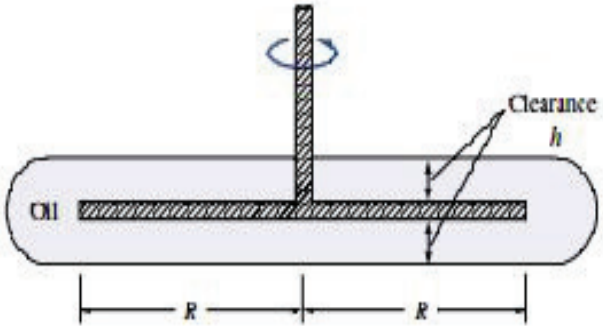
A) $\frac{mgh}{\mu A}(1-e^{-\frac{\mu MAt}{m(m+M)}})$ B) $\frac{mgh}{\mu A}(1-e^{-\frac{m\mu At}{M(m+M)}})$

C) $\frac{mgh}{\mu A}(1-e^{-\frac{\mu At}{h(m+M)}})$ D) $\frac{m^2gh}{\mu MA}(1-e^{-\frac{\mu At}{(m+M)}})$

2. Maximum speed of the system is

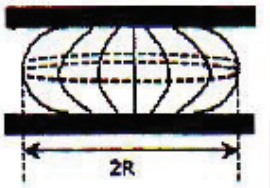
A) $\frac{mgh}{\mu A}$ B) $\frac{Mgh}{\mu A}$ C) $\frac{m^2gh}{\mu MA}$ D) $\frac{2mgh}{\mu A}$

3. A thin horizontal disc of radius R is located within a cylindrical cavity filled with oil whose coefficient of viscosity is 'η'. The distance between the disc and horizontal planes of cavity (clearance) is 'h'. The power developed by the viscous forces acting on the disc when it rotates with angular velocity ω is (The end effects are to be neglected)



A) $\frac{4\pi\eta\omega^2R^2}{h}$ B) $\frac{\pi\eta\omega^2R^2}{4h}$ C) $\frac{\pi\eta\omega^2R^4}{2h}$ D) $\frac{\pi\eta\omega^2R^4}{h}$

4. A liquid drop is sandwiched between two plates as shown. Consider the contact angle to be 180°. The separation between the plates is H (<<R). What is excess pressure in the drop? (Neglect the effect of gravity. the shape of the drop is like a circular tablet.Take surface tension as S.



A) 2S/H + S/R B) 2S/R C) S/H D) S/H + S/R

5. Consider the following statements.

1) Adhesive force helps us in writing

2) Cohesive force keeps mercury away from container

3) Separation of plates in contact with water is difficult due to adhesive force

4) Separation of plates in contact with water is difficult due to cohesive force

No. of correct statements:

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

6. Consider the following statements.

1) A needle can float on clear water but sinks when some detergent is added to it. This is because addition of detergent reduces the surface tension of water

2) Angle of contact between pure water and silver is 90^0

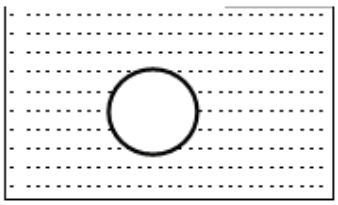
3) The potential energy of molecules in the surface film is greater than that of those molecules which are inside the liquid (non gravitational potential energy)

4) An air bubble of radius R in water is at a depth h below the water surface. If P_0 is atmospheric pressure and $\rho \& \sigma$ are the density and surface tension of water respectively, then the pressure inside the bubble will be $P_0 + hpg + \frac{2\sigma}{R}$

No. of incorrect statements:

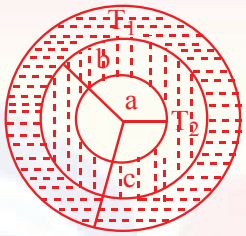
A) 1 B) 4 C) 0 D) 3

7. A smooth spherical ball of radius 1 cm and density $4x10^3$ kg/m^3 is dropped gently in a large container containing viscous liquid of density $2x10^3$ kg/m^3, n=0.1 N-s/m^2. The distance moved by the ball in 0.1 sec after it attains terminal velocity is.



A) $\frac{4}{5}$ m up B) $\frac{4}{9}$ m up C) $\frac{2}{3}m$ down D) $\frac{4}{9}m$ down

8. Two different liquid films of surface tensions T_1 and T_2 are held between three concentric wires of radii a, b and c as shown in the figure. The outermost and the innermost wires are fixed. Neglecting gravity, the tension in the middle wire is



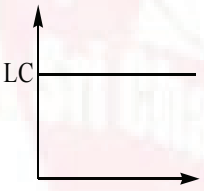
A) $(T_1 - T_2)b$

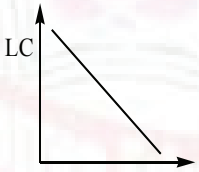
B) $(T_1c - T_2b)\left(\frac{a}{b+c}\right)$

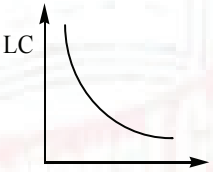
C) $2(T_1 - T_2)b$

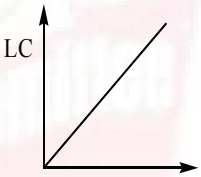
D) $(T_1c - T_2b)$

9. For fixed value of main scale division (MSD), the relation between least count (LC) and number of vernier scale division (VSD, n) will be shown by following graph.

A) 

B) 

C) 

D) 

10. In certain vernier callipers 25 divisions on vernier scale have same length as 24 divisions on main scale. One division on main scale is 1mm long. The least count of the instrument is

A) 0.04 mm B) 0.01 mm

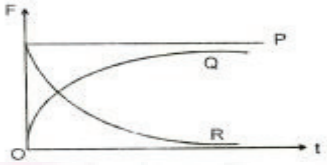
C) 0.02 mm D) 0.08 mm

SECTION – II

(MULTIPLE CORRECT CHOICE TYPE)

This section contains 5 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONE OR MORE is/ are correct

11. A spherical ball is dropped at time t = 0 in a long column of viscous liquid under the influence of uniform earth gravitational field. Consider the following graphs which represent variation of a physical quantity (**F**) with time t.



A) P may represent variation of gravitational force on the ball with time.

B) Q may represent variation of viscous force on the ball with time.

C) R may represent variation of net force acting on the ball with time.

D) R may represent variation of velocity of the ball with time.

12. A spherical solid body is dropped inside a vast expanse of viscous liquid of large depth and of coefficient of viscosity η. The density of the solid is greater than of the liquid. The time taken by the body to attain the 90% of the steady state velocity is dependent on

A) Density of the liquid B) density of the solid

C) Diameter of the sphere D) coefficient of viscosity

13. Two bubbles of same liquid have radii 3r and 4r.

A) When they are placed in contact externally so that they form a tiny common contacting surface, then radius of curvature of common surface will be 12r

B) When they coalesce to form bigger bubble isothermally in vacuum, the radius of new bubble is $(91)^{1/3}r$

C) When they coalesce to form bigger bubble isothermally in vacuum, the radius of new bubble is 5r

D) When they are interconnected by means of a thin tube, air flows from bigger bubble to smaller bubble

14. The pitch of a screw-guage having 50 divisions on its circular scale is 1mm. When the two jaws of the screw gauge are in contact with each other, 47^{th} division of circular scale is on reference line. When a wire is placed between the jaws, 3 linear scale division are clearly visible while 31^{st} division on the circular scale coincides with the reference line. Then

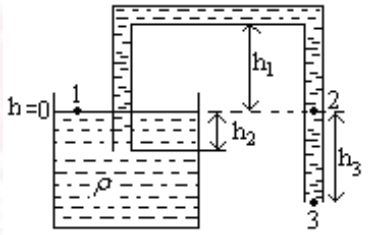
A) Zero error in the screw gauge is 0.94mm

B) Zero error in the screw-gauge is -0.06mm

C) Diameter of the wire is 3.68mm

D) Diameter of the wire is 3.56mm

15. Figure shows a siphon, tube cross section is uniform. Choose the correct statement. (P_0 is atmospheric pressure)



A) When siphon works $h_3 > 0$ B) Pressure at point 2 *is* $P_2 = P_0 - \rho g h_3$

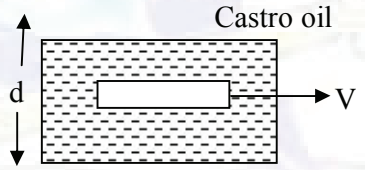
C) Pressure at point 2 is $P_2 = P_0 - \rho g h_2$ D) Pressure at point 3 is P_0

SECTION –III

(INTEGER ANSWER TYPE)

This section contains 5 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to be darkened.

16. A thin square plate of side l is dragged in the exact middle with constant velocity v in castor oil of thickness d. If the horizontal force required to move it with given velocity is $\frac{x\eta v l^2}{d}$, what is x? (Coefficient of viscosity is η) (Assume top and bottom layers are at rest and velocity decrease linearly with distance from plate to extreme layers)



17. Several spherical drops of radius r of a liquid of surface tension T coalesce to form a single drop of radius R and volume V. The energy released in the process is $nVT\left[\frac{1}{r}-\frac{1}{R}\right]$, where n =

18. Two narrow bores of diameters 3.0mm and 6.0mm are joined together to form a U-shaped tube open at both ends. If the U-tube contains water, the difference in its levels in the two limbs of the tube is nearly X mm. Surface tension of water at the temperature for the experiment is $7.3\times10^{-2}\,Nm^{-1}$. Take the angle of contact to be zero. Find X.

19. The time period of oscillation of a simple pendulum is given by T = $2\pi\sqrt{l/g}$

The length of the pendulum is measured as l = 10 ± 0.1cm and the time period as T = 0.5 ± 0.02 s. Determine percentage error in the value of g.

20. An air bubble of radius 1 mm is allowed to rise through a long cylindrical column of a viscous liquid of radius 5 cm and travels at a steady rate of

2.1 cm per sec. If the density of the liquid is 1.47 g per cc. Its viscosity is nearly $\frac{n}{2}$ poise. Then find the value of n. Assume g = 980 cm/sec^2 and neglect the density of air

Sri Chaitanya IIT Academy., India.

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

A right Choice for the Real Aspirant

ICON CENTRAL OFFICE, MADHAPUR - HYD

Sec: Jr.Super60 | (2012-P1) | Dt: 17-10-16

Time: 07:30 AM to 10:30 AM | WTA-23 | Max.Marks: 210

KEY SHEET

PHYSICS:

1	C	2	A	3	D	4	A	5	B
6	C	7	D	8	C	9	C	10	A
11	ABC	12	BCD	13	AC	14	BC	15	ABD
16	4	17	3	18	5	19	9	20	3

CHEMISTRY:

21	B	22	B	23	D	24	A	25	B
26	B	27	B	28	D	29	D	30	D
31	ABCD	32	ABCD	33	ABC	34	AC	35	ABCD
36	4	37	6	38	8	39	6	40	4

MATHS:

41	B	42	D	43	B	44	C	45	A
46	D	47	D	48	A	49	D	50	B
51)	CD	52)	AD	53)	AC	54)	ABC	55)	BC
56	5	57	4	58	2	59	5	60	0

SOLUTIONS:

PHYSICS:

1. & 2. $mg-\frac{\mu A\vartheta}{h}=(m+M)a$

$$mg-\frac{\mu A\vartheta}{h}=(m+M)\frac{d\vartheta}{At}$$

$$\int_0^{\vartheta}(m+M)\frac{d\vartheta}{\left(mg-\frac{\mu A\vartheta}{n}\right)}=\int dt$$

ϑ is became maximum as $t\to\infty$

3. $\tau=2\int Fr=2\int_0^R\frac{\mu\omega r}{h}(2\pi rdr)r$

4. Excess pressure in drop $=\frac{S}{(H/2)}+\frac{S}{R}=\frac{2S}{H}+\frac{S}{R}$

5. Adhesive force F_a is between heterogeneous molecules and binding them through, while cohesive force F_c is between homogenous molecules.

$F_a>F_c$ (for sticky liquid)

$F_a>F_c$ (for non-sticky liquid)

So choices (1) and (2) are correct.

Due to the adhesive nature of water, the molecules of water and plate are glued together

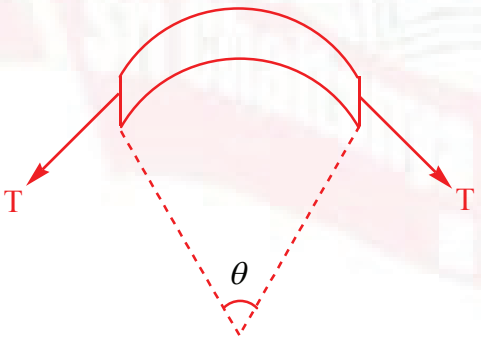
So choice (3) is correct and choice (4) is incorrect

6. adding detergent to water will decrease the surface tension.

Excess pressure inside the air bubble which below the liquid surface is $\frac{2\sigma}{R}$

7. after attaining terminal velocity distance traveled in t sec is $S=V_t t$

8.



$2T\sin\theta/2=(T_1-T_2)2R\theta$

$2T\sin\theta/2=2R\theta(T_1-T_2)(\theta\,is\,small)$

$T = 2b(T_1 - T_2)$

9. Least count $= \frac{1MSD}{n}$ so $LC \propto \frac{1}{n}$

10. L.C $\frac{1M.S.D}{no.of\ vernier\ scale\ divisions}$

11. Here gravitational force on the body remains constant with respect to time & viscous force is $F_V = 6\pi\eta rv$

12.

$mg - 6\pi\eta rv - F_B = \frac{dv}{dt}$

13. a) $\left(P_0 + \frac{4T}{a}\right) - \left(P_0 + \frac{4T}{b}\right) = \frac{4T}{c}$

b) $\left(P_0 + \frac{4T}{a}\right)a^3 + \left(P_0 + \frac{4T}{b}\right)c^3 = \left(P_0 + \frac{4T}{b}\right)c^3$

c) In vacuum $P_0 = 0 \Rightarrow c^2 = a^2 + b^2$

14. L.C of screw guage = $\frac{Pitch\ of\ the\ screw}{No.of\ circular\ scale\ divisions}$

15. Working of syphon.

16. $F = -\eta A\frac{dv}{dx}$

17. $\left(n4\pi r^2 - 4\pi R^2\right) = \Delta E$

$\frac{4}{3}\pi R^3 = n\frac{4}{3}\pi R^3$

18. $\Delta h = \frac{2\sigma}{\rho g}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$

19. $g = 4\pi^2 l / T^2$

$\frac{dg}{g} = \frac{dl}{l} \times 100 + 2\frac{dT}{T} \times 100$

20. Here due to force of buoyancy the bubble will move up and so viscous force which opposes the motion will act downward and as weight of bubble is zero, in dynamic equilibrium,

Th = F,

$i.e., \quad \frac{4}{3}\pi r^3 \sigma g = 6\pi\eta r u_T$

$or \quad \eta = \frac{2}{9}\frac{\sigma r^2 g}{u_T} = \frac{2}{9} \times \frac{1.47 \times (0.1)^2 \times 980}{2.1}$

$i.e., \quad \eta = 1.524\ poise$

FINAL KEY

S.NO	SUB	Q.NO	GIVEN KEY	FINALIZED KEY	EXPLANATION
1	PHY	14	BC	A or BC	Key Change