PHYSICS **Max Marks : 60**

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

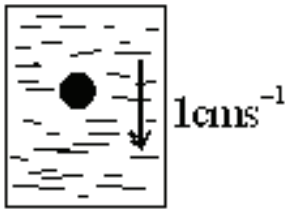
This section contains 10 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONLY ONE option can be correct.

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

1. A cylindrical tank of base area A has a small hole of area 'a' at the bottom. At time t = 0, a tap starts to supply water into the tank at a constant α m^3/sec. then find the maximum level of water in the tank

A) $\frac{\alpha^2}{ga^2}$ B) $\frac{2\alpha^2}{ga^2}$ C) $\frac{3}{4}\frac{\alpha^2}{ga^2}$ D) $\frac{\alpha^2}{2ga^2}$

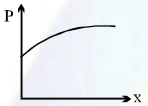
2. A steel ball with a volume of $1cm^3$ is sinking at a speed of $1cms^{-1}$ in a closed jar filled with honey. What is the momentum of the honey if its density is $2gcm^{-3}$

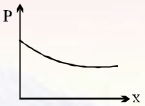


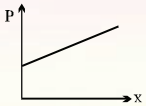
A) zero B) $2g\ cm\ s^{-1}$ in upward direction

C) $2g\ cm\ s^{-1}$ in downward direction D) data is insufficient

3. The cross sectional area of a horizontal tube increases along its length linearly, as we move in the direction of flow. The variation of pressure, as we move along its length in the direction of flow (x-direction), is best depicted by which of the following graphs

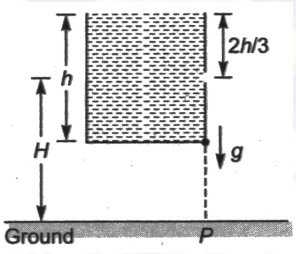
A) 

B) 

C) 

D) 

4. An open vessel full of water is falling freely under gravity. There is a small hole in one face of the vessel, as shown in the figure. The water which comes out from the hole at the instant when hole is at height H above the ground, strikes the ground at a distance of x from P. Which of the following is correct for the situation described?



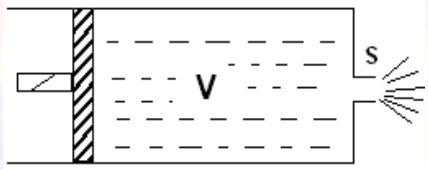
A) The value of x is $2\sqrt{\frac{2hH}{3}}$

B) The value of x is $\sqrt{\frac{4hH}{3}}$

C) The value of x can't be computed from information provided.

D) The question is irrelevant as no water comes out from the hole

5. Water is filled in a horizontal cylindrical tank filled with piston. The volume of water in tank is 'V' and there is small orifice of area of cross-section 'S' at other side of tank as shown in fig.(neglect atmospheric pressure)



If the 'W' is least total amount of work done in squeezing all volume of water due to apply constant force 'F' acting on piston in time ' t ', then …….

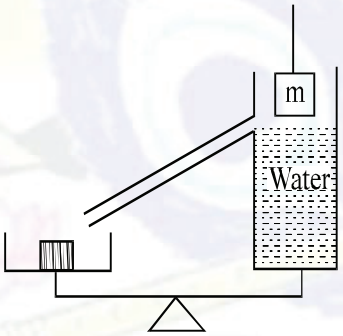
A) $W \alpha V^{3/2}$ B) $W \alpha V^{3}$ C) $W \alpha V^{2}$ D) $W \alpha V^{2/3}$

6. A wide vessel with a small hole in the bottom is filled with water and kerosene. Neglecting viscosity, the velocity of water flow v if the thickness of water layer is h_1 and that of kerosene layer is h_2 is (density of water is ρ_1 and that of kerosene is ρ_2)(water forms lower layer and kerosene forms upper layer)

A) $v = \sqrt{2g(h_1 + h_2)}$ B) $\sqrt{2g\left(h_1 + h_2\frac{\rho_2}{\rho_1}\right)}$

C) $v = \sqrt{2g\left(h_1\rho_1 + h_2\rho_2\right)}$ D) $v = \sqrt{2g\left(h_1\frac{\rho_1}{\rho_2} + h_2\right)}$

7. A pan balance has a container of water with an overflow spout on the right-hand pan as shown. It is full of water right up to the overflow spout. A container on the left-hand pan is positioned to catch any water that overflows. The entire apparatus is adjusted so that it's balanced. A brass weight on the end of a string is then lowered into the water, but not allowed to rest on the bottom of the container. What happens next?



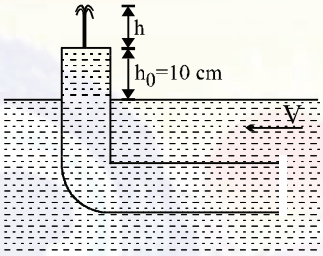
A) Water overflows and the right side of the balance tips down.

B) Water overflows and the left side of the balance tips down.

C) Water overflows but the balance remains balanced.

D) Water overflows but which side of the balance tips down depends on whether the brass weight s partly or completely submerged.

8. A bent tube is lowered into water stream as shown in the figure. The velocity of the stream relative to the tube is equal to V = 2 m/s. The closed upper end of the tube located at height h_0 = 10 cm above free surface of water has a small orifice. To what height h will the water get spurt?



A) 5 cm B) 10 cm C) 20 cm D) 40 cm

9. Water jet coming out of a stationary horizontal tube at speed v strikes horizontally a massive wall moving in opposite direction with same speed. Water comes to rest relative to wall after striking. Treating A as cross-section of jet and density of water as ρ. Select the correct alternative(s)

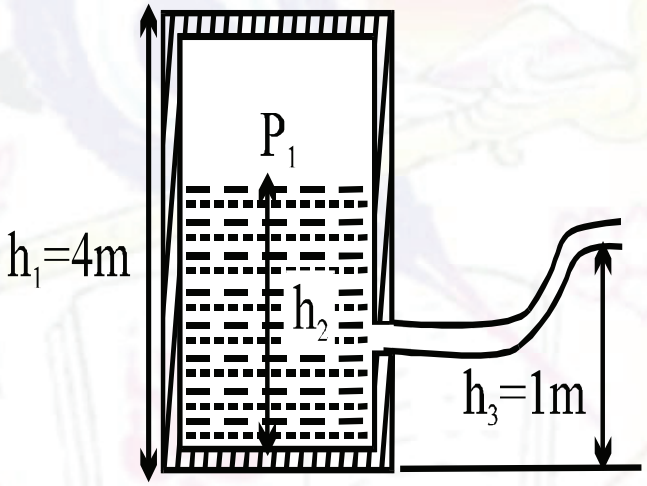
A) Force exerted on the wall is $2\rho Av^2$

B) Force exerted on the wall is $4\rho Av^2$

C) Rate of change of kinetic energy of water jet striking the wall is $8\rho Av^3$

D) Rate of change of kinetic energy of water jet striking the wall is $4\rho Av^3$.

10. A large tank of (height $h_1 = 4m$) water has a hose connected to it, as shown in figure. The tank is sealed at the top and has compressed air between the water surface & the top. When the water height h_2 is 3m, the gauge pressure of air $P_1 = 1 \times 10^5 N/m^2$. Assume that the air above the water surface expands isothermally. What is the velocity of flow out of the hose (in m/s) when h_2 Has decreased to 2m? Assume ideal fluid flow. $P_{atm} = 10^5 N/m^2$ ($g=10m/s^2$)



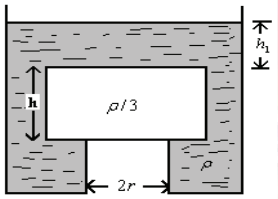
A) $\sqrt{20}$ **B)** $\sqrt{30}$ **C)** $\sqrt{40}$ **D)** $\sqrt{10}$

SECTION - II
(PARAGRAPH TYPE)

This section contains **3 Paragraph of questions.** Each paragraph 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 -1 in all other cases.**

Paragraph for Question Nos. 11 to 12

A wooden cylinder of diameter 4r, height h and density $\rho/3$ is kept on a hole of diameter 2r of a tank, filled with liquid of density ρ as shown in the figure.



11. Now level of the liquid starts decreasing slowly. When the level of the liquid is at a height h_1 above the cylinder the block just starts to lift. At what value of h_1, will the block rise.

A) $\frac{4h}{9}$ B) $\frac{5h}{9}$ C) $\frac{5h}{3}$ D) will not rise for value

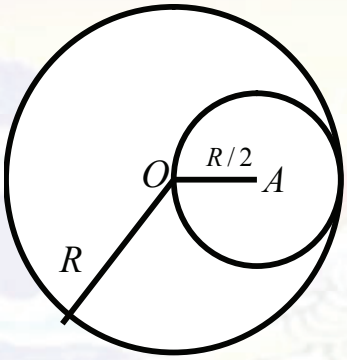
12. The block in the above question is maintained at the position by external means and the level of liquid is lowered. The height h_2 when the external force reduces to zero is

A) $\frac{4h}{9}$ B) $\frac{5h}{9}$ C) $\frac{2h}{3}$ D) None

Paragraph for Question Nos. 13 to 14

A fixed sphere of radius R and Uniform density 'ρ' has spherical cavity of Radius R/2 such that the surface of the cavity passes through the centre of the sphere.

A particle of mass 'm' is located at the centre (A) of the cavity calculate



13. The gravitation field at "A" towards "O"

A) $\frac{2}{3}\pi G\rho R$ B) $\frac{2}{5}\pi G\rho R$ C) $\frac{2}{7}\pi G\rho R$ D) *None of these*

14. The velocity with the mass "m" hits the centre 'O'.

A) $v = R\sqrt{\frac{2}{3}\pi G\rho}$ B) $v = R\sqrt{\frac{2}{5}\pi G\rho}$ C) $v = R\sqrt{\frac{2}{7}\pi G\rho}$ D) *None of these*

Paragraph for Question Nos. 15 to 16

A syringe is filled with water. Its volume is 20 cm^3, and the cross section of its interior part is 4 cm^2. The syringe is held vertically such that its nozzle is at its top, and its 100g piston is pressed by external agent and it moves with a constant speed. The ejected water has an initial upward velocity of 2 m/s, and the cross-section of the beam of water at the nozzle is 1 mm^2. (Neglect the dissipated energy due to friction)

15. Find the speed of the piston.

A) 5 mm/s B) 5 cm/s C) 0.5 m/s D) 0.5 mm/s

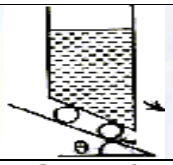
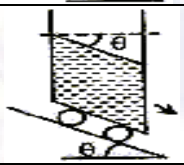
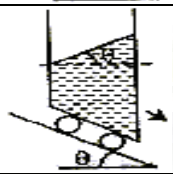
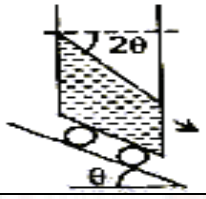
16. What is the total work done by external agent?

A) 0.04 J B) 0.045 J C) 0.095 J D) 4.5 mJ

SECTION - III
(Matching List Type)

This section contains four questions, each having two matching lists (List-1 & List-II). The options for the correct match are provided as (A), (B),(C) and (D) out of which ONLY ONE is correct.

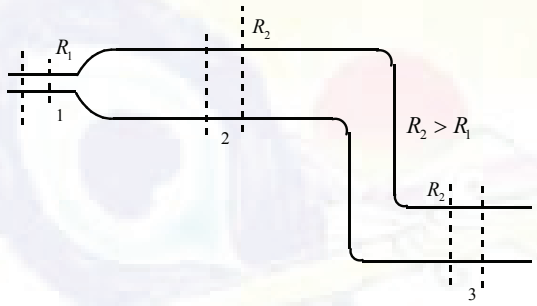
17. A trolley containing a liquid of density ρ moves down an inclined plane of inclination θ with an acceleration **a**. Match the following

	Column I		Column II
(A)		(P)	a = gsinθ down the incline
(B)		(Q)	a $\neq$ gsinθ and directed down the incline
(C)		(R)	a = 0
(D)		(S)	a is directed up the incline

A) A-R, B-P, C-S, D-Q B) A-P, B-Q, C-R, D-S

C) A-Q, B-R, C-S, D-R D) None of these

18. An arrangement of the pipes is shown in the Fig. The flow of water (incompressible and non-viscous through the pipes is steady in nature. Three sections of the pipe are marked in which section (1) and section (2) are at same horizontal level, while being at a greater height than section (3). Correctly match order of the different physical parameter.

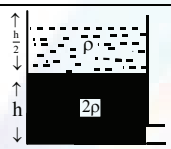
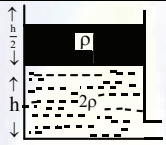
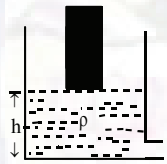


	Column-I		Column- II
(A)	Order of volume flow rate	(P)	1> 2 > 3
(B)	Order of kinetic energy of a mass element	(Q)	1 = 2 = 3
(C)	Order of pressure in the sections	(R)	1 > 2 = 3
(D)	Order of flow speed in sections	(S)	3 > 2 > 1

A) A-R, B-S, C-P, D-S B) A-P, B-Q, C-R, D-S

C) A-Q, B-R, C-S, D-R D) None of these

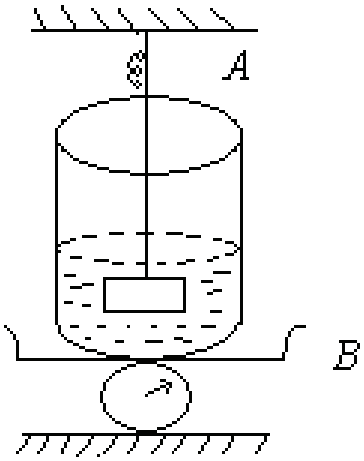
19. The cases in Column I match the velocity of efflux cross section of opening is very small in Column II

Column I		Column II	
A)	 Two immiscible liquids of density ρ & 2ρ	P)	$\sqrt{2gh}$
B)	 A perfectly fitting piston made of material of density ρ which can slide without friction	Q)	$\sqrt{2.5gh}$
C)	 A solid cylinder of half the cross section of tank Is just touching the water surface. Now it is pushed by a distance $\frac{h}{2}$ downward (An external agent holds cylinder, vessel is large).	R)	$\sqrt{3gh}$
D)	Arrangement is same as in option C but cylinder is pushed down by a distance h	S)	$\sqrt{3.5gh}$
		T)	$\sqrt{4gh}$

A) A-R, B-S, C-P, D-S B) A-P, B-Q, C-R, D-S

C) A-P, B-S, C-Q, D-S D) None of these

20. The spring balance a reads 2 kg with a block m suspended from it. A balance B reads 5 kg when a beaker with liquid is put on the pan of the balance. The two balances are now so arranged that the handing mass is inside the liquid in a beaker as shown in the figure. In this situation (g is acceleration due to gravity)



COLUMN-I		COLUMN-II	
A)	Readings of balance A	P)	more than 2 kg
B)	Reading of balance B	Q)	less then 5 kg
C)	$\frac{1}{g}$(Tension in the string connecting balancing A And the block)	R)	less than 2 kg
D)	$\frac{1}{g}$(Normal reaction of the pan of balance B on the Beaker)	S)	more than 5 kg

A) A-R, B-S, C-P, D-S

B) A-Q, B-Q, C-R, D-T

C) A-Q, B-R, C-Q, D-S

D) None of these

Sri Chaitanya IIT Academy., India.

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

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Sec: Jr.Super60 | **JEE ADVANCED** | **DATE : 19-09-16**

TIME : 07:30 AM to 10:30 AM | **WTA-20** | **MAX MARKS : 180**

KEY & SOLUTIONS

PHYSICS

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

CHEMISTRY

21	**C**	22	**A**	23	**A**	24	**C**	25	**C**	26	**B**
27	**C**	28	**D**	29	**B**	30	**D**	31	**C**	32	**A**
33	**B**	34	**D**	35	**A**	36	**A**	37	**B**	38	**B**
39	**B**	40	**C**								

MATHS

41	**A**	42	**C**	43	**A**	44	**C**	45	**B**	46	**C**
47	**A**	48	**D**	49	**D**	50	**B**	51	**B**	52	**C**
53	**D**	54	**A**	55	**A**	56	**B**	57	**C**	58	**A**
59	**C**	60	**D**								

SOLUTIONS:

PHYSICS:

1. $\alpha = a\sqrt{2gh}$
2. When the ball has moved through a distance 'vt'. it can be considered to have changed places with a 'honey ball' of identical volume
3. As A tends to infinity velocity V tends to constant.
4. $g_{eff} = 0 \,\&\, dP = 0$
5. $W = K_f - K_i$
6. $$\rho_2 g h_2 + \rho_1 g h_1 = \frac{1}{2}P_1 V^2$$

   $$\Rightarrow \quad V^2 = \frac{2g(\rho_1 h_1 + \rho_2 h_2)}{\rho_1} \Rightarrow V = \sqrt{2g\left(h_1 + \frac{\rho_2}{\rho_1}h_2\right)}$$
7. Weight is same on right increases on left
8. $v^2 - u^2 = 2gh$

   $$h_{max} = \frac{v^2}{2gh}$$
9. $dp = 2.dmv \qquad dk = 0$
10. $p_1 v_1 = p_2 v_2$

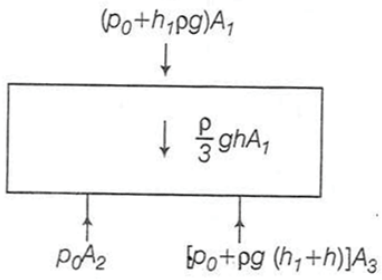
    $\therefore \quad p_2 = p_0$

    $\therefore v = \sqrt{2gh}$
11. (c) Let A_1 = Area of cross-section of cylinder = $4\pi r^2$

    A_2 = Area of base of cylinder in air = πr^2

    and A_3 = Area of base of cylinder in water = $A_1 - A_2 = 3\pi r^2$

    The free body diagram of cylinder

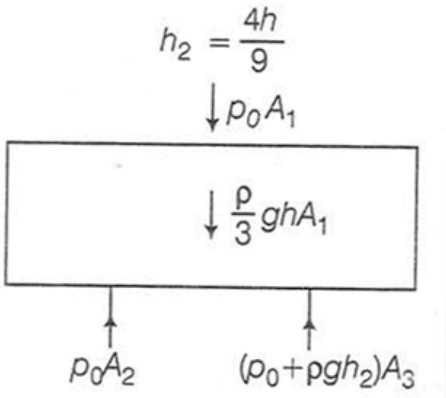
    

    Equating the net downward forces and net upward forces, we get,

    $h_1 = \frac{5}{3}h.$

12.

(a) Again equating the forces, we get



13. $E = \frac{4}{3}\pi G\rho\left(\frac{R}{2}\right) = Acceleration$

14. $E = \frac{4}{3}\pi G\rho\left(\frac{R}{2}\right) = Acceleration$

15. $A_1V_1 = A_2V_2$

16. W = Increase in Gravitational Potential Energy of water and piston + Increase in Kinetic Energy of Water

17. A - R, B - P, C - S, D - Q.

Take the container as reference.

Consider a liquid element in the container and draw its FBD wrt the container. Free surface must be normal to the resultant force in that refernce.

18. Conceptual

19. Conceptual

20. Conceptual

FINAL KEY

S.NO	SUB	Q.NO	GIVEN KEY	FINALIZED KEY	EXPLANATION
1	PHY	12	A	Delete	H_2 is not shown in the diagram
2	PHY	19	B	D	Other diagram sets are not matched
3	PHY	20	A	D	Other sets are not matching

Question Paper setter is **total responsible** for the Key finalization:

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