1. A resistance of 2 W is connected across one gap of a meter-bridge (the length of the wire is 100 cm) and an unknown resistance, greater than 2W, is connected across the other gap. When the resistances are interchanged, the balance point shifts by 20 cm. neglecting any corrections, the unknown resistance is

(A) 3Ω

(b) 4Ω

(C) 5Ω

(D) 6Ω

2. In an experiment to determine the focal length (f) of a concave mirror by the n-v method, a student places the object pin A or the principal axis at a distance x from the pole P. The student looks at the pin and its inverted image from a distance keeping his/her eye in line with PA. When the student shifts his/her eye towards left, the image appears to the right of the object pin. Then,

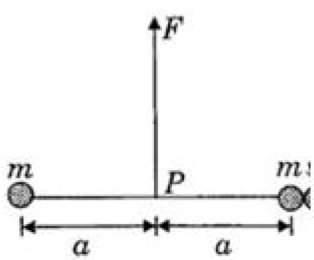
(A) $x < f$

(B) $f < x < 2f$

(C) $x = 2f$

(D) $x > 2f$

3. Two particles of mass m each are tied at the ends of a light string of length 2a. The whole system is kept on a frictionless horizontal surface with the string held tight so that each mass is at a distance 'a' from the center P (as shown in the figure). Now, the mid-point of the string is pulled vertically upwards with a small but constant for F. As a result, the particles move towards each other on the surface. The magnitudes of acceleration, when the separation between them becomes 2x, is



(A) $F/2m \; a/\sqrt{(a^2 - x^2)}$

(B) $F/2m \; x/\sqrt{(a^2 - x^2)}$

(C) $F/2m \; x/a$

(D) $F/2m \sqrt{(a^2 - x^2)}/x$

4. A long, hollow conducting cylinder is kept coaxially inside another long, hollow conducting cylinder of larger radius. Both the cylinders are initially electrically neutral.

(A) A potential difference appears between the two cylinders when a charge density is given to the inner cylinder.

(B) A potential difference appears between the two cylinders when a charge density is given to the outer cylinder

(C) No potential difference appears between the two cylinders when a uniform line charge is kept along the axis of the cylinders

(D) No potential difference appears between the two cylinders when a same charge density is given to both the cylinders

5. Consider a neutral conducting sphere. A positive point charge is placed outside the sphere. The net charge on the sphere is then,

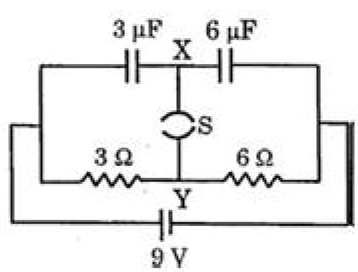
(A) negative and distributed uniformly over the surface of the sphere

(B) negative and appears only at the point on the sphere closest to the point charge

(C) negative and distributed non-uniformly over the entire surface of the sphere

(D) zero

6. A circuit is connected as shown in the figure with the switch S open. When the switch is closed, the total amount of charge that flows from Y to X is



(A) 0

(B) 54 μC

(C) 27 μC

(D) 81 μC

7. A ray of light traveling in water is incident on its surface open to air. The angle of incidence is, which is less than the critical angle. Then there will be

(A) only a reflected ray and no refracted ray

(B) only a refracted ray and no reflected ray

(C) a reflected ray and a refracted ray and the angle between them would be less than 180^o - 2θ

(D) a reflected ray and a refracted ray and the angle between them would be greater than 180^o - 2θ

8. In the options given below, let E denote the rest mass energy of a nucleus and n a neutron. The correct option is

(A) $E({}^{236}U_{92}) > E({}^{137}I_{53}) + E({}^{97}Y_{39}) + 2E(n)$

(B) $E({}^{236}U_{92}) < E({}^{137}I_{53}) + E({}^{97}Y_{39}) + 2E(n)$

(C) $E({}^{236}U_{92}) < E({}^{140}Ba_{56}) + E({}^{94}Kr_{36}) + 2E(n)$

(D) $E({}^{236}U_{92}) = E({}^{140}Ba_{56}) + E({}^{94}Kr_{36}) + 2E(n)$

9. The largest wavelength in the ultraviolet region of the hydrogen spectrum is 122 nm. The smallest wavelength in the infrared region of the hydrogen spectrum to the nearest integer) is

(A) 802 nm

(B) 823 nm

(C) 1882 nm

(D) 1648 nm

10. A block of mass m starts moving on a rough horizontal surface with a velocity v. It stops due to friction between the block and the surface after moving through a certain distance. The surface is now titled to an angle of 30o with the horizontal and the same block is made to go up on the surface with the same initial velocity v. The decrease in the mechanical energy in the second situation is smaller than that in the first situation.

Because

STATEMENT-2

The coefficient of friction between the block and the surface decreases with the increase in the angle of inclination.

(A) Statement-1 is True, Staement-2 is True, Statement-2 is a correct explanation for statement-1.

(B) Statement-1 is True, Staement-2 is True, Statement-2 is not a correct explanation for statement-1.

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

11. STATEMENT-1

In an elastic collision between two bodies, the relative speed of the bodies after collision is equal to the relative speed before the collision.

Because

STATEMENT-2

In an elastic collision, the linear momentum of the system is conserved.

(A) Statement-1 is True, Staement-2 is True, Statement-2 is a correct explanation for statement-1.

(B) Statement-1 is True, Staement-2 is True, Statement-2 is not a correct explanation for statement-1.

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

12. STATEMENT-1

The formulae connecting u, v and f for a spherical mirror is valid only for mirrors whose sizes are very small compared to their radii of curvature.

Because

STATEMENT-2

Laws of reflection are strictly valid for plane surfaces, but not for large spherical surfaces

(A) Statement-1 is True, Staement-2 is True, Statement-2 is a correct explanation for statement-1.

(B) Statement-1 is True, Staement-2 is True, Statement-2 is not a correct explanation for statement-1.

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

13. STATEMENT-1

If the accelerating potential in an X-ray tube is increased, the wavelengths of the characteristic X-rays do not change.

Because

STATEMENT-2

When an electron beam strikes the target in an X-ray tube, part of the kinetic energy is converted into X-ray energy.

(A) Statement-1 is True, Staement-2 is True, Statement-2 is a correct explanation for statement-1.

(B) Statement-1 is True, Staement-2 is True, Statement-2 is not a correct explanation for statement-1.

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

14. The ratio x_1/x_2 is

(A) 2

(B) 1/2

(C) $\sqrt{2}$

(D) $1/\sqrt{2}$

15. When disc B is brought in contact with disc A, they acquire a common angular velocity in time t. The average frictional torque on one disc by the other during this period is

(A) $2I\omega/3t$

(B) $9I\omega/2t$

(C) $9I\omega/4t$

(D) $3I\omega/2t$

16. The loss of kinetic energy during the above process is

(A) $(I\omega^2)/2$

(B) $(I\omega^2)/3$

(C) $(I\omega^2)/4$

(D) $(I\omega^2)/6$

17. The piston is now pulled out slowly and held at a distance 2L from the top. The pressure in the cylinder between its top and the piston will then be

(A) P_0

(B) $P_0/2$

(C) $P_0/2 + Mg/(\pi R_2)$

(D) $P_0/2 - Mg/(\pi R_2)$

18. While the piston is at a distance 2L from the top, the hole at the top is sealed. The piston is then released, to a piston where it can stay in equilibrium. In this condition, the distance of the piston from the top is

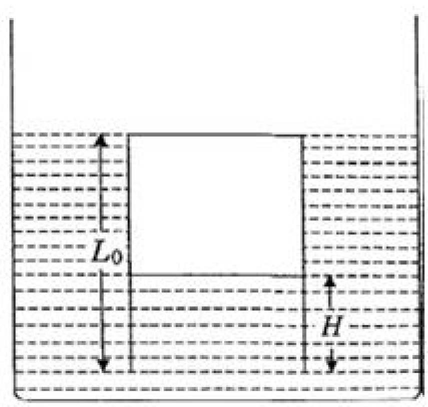
(A) $((2P_0 \pi R^2)/(\pi R^2 P_0 + Mg))(2L)$

(B) $((P_0 \pi R^2 - Mg)/(\pi R^2 P_0))(2L)$

(C) $((P_0 \pi R^2 + Mg)/(\pi R^2 P_0))(2L)$

(D) $((P_0 \pi R^2)/(\pi R^2 P_0 - Mg))(2L)$

19. The piston is taken completely out of the cylinder. The hole at the top is sealed. A water tank is brought below the cylinder and put in a position so that the water surface in the tank is at the same level as the top of the cylinder as shown in the figure. The density of the water is r. In equilibrium, the height H of the water column in the cylinder satisfies



(A) $rg(L_0 - H)^2 + P_0(L_0 - H) + L_0P_0 = 0$

(B) $rg(L_0 - H)^2 - P_0(L_0 - H) - L_0P_0 = 0$

(C) $rg(L_0 - H)^2 + P_0(L_0 - H) - L_0P_0 = 0$

(D) $rg(L_0 - H)^2 - P_0(L_0 - H) + L_0P_0 = 0$

20. Some physical quantities are given in Column I and some possible. SI units in which these quantities may be expressed are given in Column II. Match the physical quantities in Column I with the units in Column II.

Column I		Column II	
(A)	GM_eM_s G-universal gravitational constant M_e-mass of the earth M_s-mass of the Sun	(p)	(volt) (coloumb) (metre)
(B)	R-universal gas constant	(q)	(kilogram)(metre)^3(second)$^{-2}$

	T-absolute temperature M-molar mass		
(C)	F-force q-charge B-magnetic field	(r)	$(metre)^2$ $(second)^2$
(D)	G-universal gravitational constant M_e-mass of the earth R_e-radius of the earth	(s)	(farad) $(volt)^2$ $(kg)^{-1}$

21. Column I gives certain situations in which a straight metallic wire of resistance R is used and Column II gives some resulting effects. Match the statements in Column I with the statements in Column II.

Column I		**Column II**	
(A)	A charged capacitor is connected to the ends of the wire	(p)	A constant current flows through the wire
(B)	The wire is moved perpendicular to its length with a constant velocity in a uniform magnetic field perpendicular to the plane of motion.	(q)	Thermal energy is generated in the wire
(C)	The wire placed of constant emf is connected to the ends of the wire	(r)	A constant potential difference develops between the ends of the wire
(D)	A battery of constant emf is connected to the ends of the wire	(s)	Charges of constant magnitude appear at the ends of the wire

22. Some laws/processes are given in Column I. Match these with the physical phenomena given in Column II.

Column I		**Column II**	
(A)	Transition between two atomic energy levels	(p)	Characteristic X-rays
(B)	Electron emission from a material	(q)	Photoelectric effect
(C)	Mosley's law	(r)	Hydrogen spectrum
(D)	Change of photon energy into kinetic energy of electrons	(s)	b-decay