NEET MOCK TEST 2- PHYSICS

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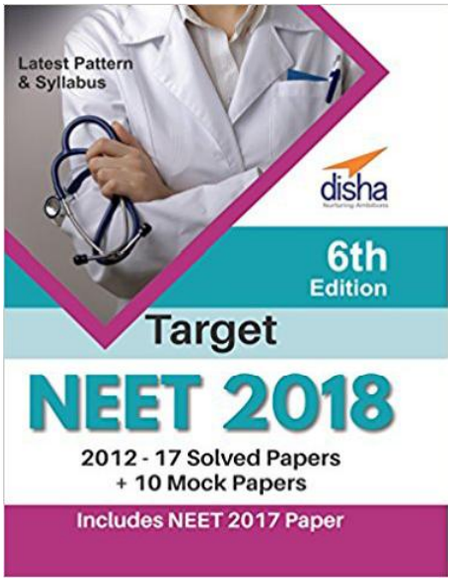

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Product Name : Target NEET 2018 (2012-17 Solved Papers + 10 Mock Papers)

Product Description : Table of Contents:

NEET 2017 Solved Paper

NEET 2016 Solved Paper

AIPMT 2015 Retest Solved Paper

AIPMT 2015 Solved Paper

AIPMT 2014 Solved Paper

NEET 2013 Solved Paper

NEET Karnataka 2013 Solved Paper

AIPMT 2012 Solved Paper (Screening + Mains) with Solutions

Practice Mock Tests

Full Test -1 Full Test -2 Full Test - 3 Full Test - 4 Full Test - 5 Full Test - 6 Full Test - 7

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Solutions to Mock Tests 1 to 10

PART A – PHYSICS

DIRECTIONS : There are 45 multiple choice questions numbered 1 to 45. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE is correct.

1. Two concentric shells having radii R and $2R$, charges q_1 and q_2 and potentials 3 V and V respectively. Now outer shell is earthed, then

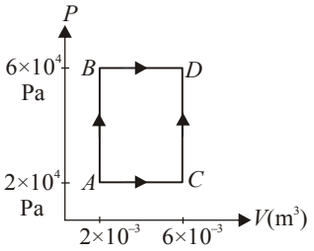
(1) Potential difference between shell increases

(2) Potential difference between shell decreases

(3) Potential of inner shell will become 2 V

(4) Potential of common centre will become 2.5 V

2. A thermodynamic process is shown in the figure. In the process AB 500 J of heat are added and in process BD, 150 J of heat are added. The change in the internal energy in the process ABD is :



(1) 890 J (2) 410 J (3) 650 J (4) 240 J

3. The density of a material in CGS system is 4g/cm^3. In a system of units in which unit of length is 10 cm and unit of mass is 100 g, the value of density of material will be

(1) 0.4 (2) 40 (3) 400 (4) 0.04

4. At what altitude will the value of the acceleration due to gravity be half of its value at the surface of the earth? (R = radius of earth)

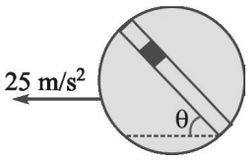
(1) $\frac{R}{2}$ (2) $\frac{R}{\sqrt{2}}$

(3) $(\sqrt{2}+1)R$ (4) $(\sqrt{2}-1)R$

5. Water falls from a height of 60 m at the rate of 15 kg/s to operate a turbine. The losses due to frictional force are 10% of energy. How much power is generated by the turbine?(g = 10 m/s^2)

(1) 8.1 kW (2) 10.2 kW (3) 12.3 kW (4) 7.0 kW

6. A circular disc with a groove along its diameter is placed horizontally. A block of mass 1 kg is placed as shown. The coefficient of friction between the block and all the surfaces of groove in contact is $\mu = 2/5$. The disc has an acceleration of 25 m/s^2. The acceleration of the block with respect to disc is $\left(\cos\theta = \frac{4}{5}\right), \left(\sin\theta = \frac{3}{5}\right)$



(1) 10 m /s^2 (2) 8 m/s^2 (3) 5 m/s^2 (4) zero

7. In a photo-emissive cell, with exciting wavelength λ, the fastest electron has speed v. If the exciting wavelength is changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted electron will be

(1) $(3/4)^{1/2}$. v (2) $(4/3)^{1/2}$. v

(3) less than $(4/3)^{1/2}$.v (4) greater than $(4/3)^{1/2}$. v

8. Three bulbs of 40 W, 60 W and 100 W are connected in series to a current source of 200 V. Which of the following statements is true ?

(1) 40 W bulb glows brightest

(2) 60 W bulb glows brightest

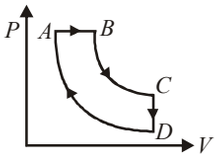
(3) 100 W bulb glows brightest

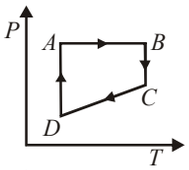
(4) All bulbs glow with same brightness

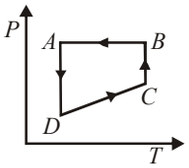
9. If the moment of inertia of a disc about an axis tangential and parallel to its surface be I, then what will be the moment of inertia about the axis tangential but perpendicular to the surface?

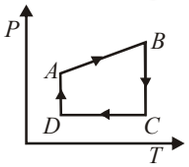
(1) $\frac{6}{5}I$ (2) $\frac{3}{4}I$ (3) $\frac{3}{2}I$ (4) $\frac{5}{4}I$

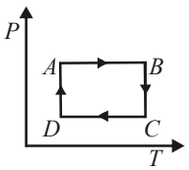
10. A cyclic process $ABCD$ is shown in the P-V diagram. Which of the following curves represent the same process?



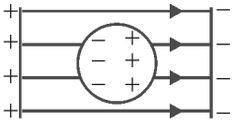
(1) 

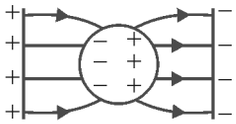
(2) 

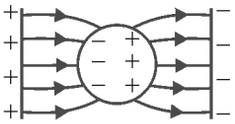
(3) 

(4) 

11. An uncharged metal ball is placed in the uniform electric field of a plane capacitor. Which of following correctly represents the field lines on the ball ?

(1) 

(2) 

(3) 

(4) None of these

12. A 12.5 eV electron beam is used to bombard gaseous hydrogen at room temperature. It will emit :

(1) 2 lines in the Lyman series and 1 line in the Balmar series

(2) 3 lines in the Lyman series

(3) 1 line in the Lyman series and 2 lines in the Balmar series

(4) 3 lines in the Balmer series

13. A boat takes two hous to travel 8 km and back in still water. If the velocity of water is 4 km/h, the time taken for going upstream 8 km and coming back is

(1) 2 hr (2) 2hr 40 min

(3) 1hr 20 min (4) 2 hr 30 min

14. If an ideal junction diode is connected as shown, then the value of the current I is

(1) 0.013 A

(2) 0.02 A

(3) 0.01 A

(4) 0.1 A

15. If the time period t of a drop of liquid of density d, radius r, vibrating under surface tension s is given by the formula $t = \sqrt{d^a r^b s^c}$ and if a = 1, c = –1, then b is

(1) 1 (2) 2 (3) 3 (4) 4

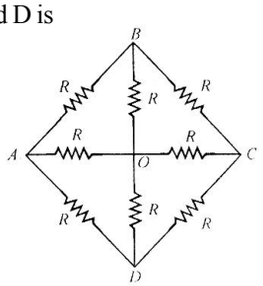
16. A simple pendulum attached to the ceiling of a stationary lift has a time period T. The distance y covered by the lift moving upwards varies with time t as $y = t^2$ where y is in metres and t in seconds. If g = 10 m/s^2, the time period of pendulum will be

(1) $\sqrt{\frac{4}{5}}T$ (2) $\sqrt{\frac{5}{6}}T$ (3) $\sqrt{\frac{5}{4}}T$ (4) $\sqrt{\frac{6}{5}}T$

17. A paper, with two marks having separation d, is held normal to the line of sight of an observer at a distance of 50m. The diameter of the eye-lens of the observer is 2 mm. Which of the following is the least value of d, so that the marks can be seen as separate ? (The mean wavelength of visible light may be taken as 5000 Å)

(1) 1.25 m (2) 12.5 cm (3) 1.25 cm (4) 2.5 mm

18. In the network shown, each resistance is equal to R. The equivalent resistance between A and D is



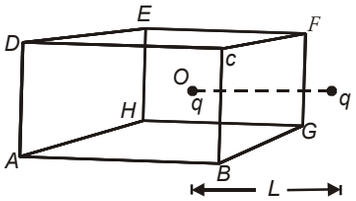
(1) R

(2) $\frac{2}{3}$R

(3) $\frac{3}{7}$R

(4) $\frac{8}{15}$R

19. A charged particle q is placed at the centre O of a cube of length L ($A\,B\,C\,D\,E\,F\,G\,H$). Another same charge q is placed at a distance L from O. Then the electric flux through $ABCD$ is



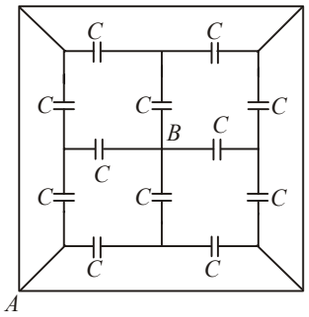
(1) $q/4\pi\in_0 L$ (2) zero

(3) $q/2\ \pi\in_0 L$ (4) $q/3\pi\in_0 L$

20. Four mole of hydrogen, two mole of helium and one mole of water vapour form an ideal gas mixture. What is the molar specific heat at constant pressure of mixture?

(1) $\frac{16}{7}$R (2) $\frac{7}{16}$R (3) R (4) $\frac{23}{7}$R

21. The equivalent capacitance between A and B is



(1) $\frac{4C}{3}$ (2) $\frac{8C}{3}$ (3) 12 C (4) $\frac{5C}{12}$

22. A mass of M kg is suspended by a weightless string. The horizontal force that is required to displace it until the string makes an angle of 45° with the initial vertical direction is

(1) $Mg(\sqrt{2}+1)$ (2) $Mg\sqrt{2}$

(3) $\frac{Mg}{\sqrt{2}}$ (4) $Mg(\sqrt{2}-1)$

23. The primary winding of a transformer has 100 turns and its secondary winding has 200 turns. The primary is connected to an A.C. supply of 120 V and the current flowing in it is 10 A. The voltage and the current in the secondary winding are

(1) 240 V, 5 A (2) 240 V, 10 A

(3) 60 V, 20 A (4) 120 V, 20 A

24. A projectile is fired vertically from the Earth with a velocity kv_e where v_e is the escape velocity and k is a constant less than unity. The maximum height to which projectile rises, as measured from the centre of Earth, is

(1) $\frac{R}{k}$ (2) $\frac{R}{k-1}$ (3) $\frac{R}{1-k^2}$ (4) $\frac{R}{1+k^2}$

25. Water rises to a height 'h' in a capillary tube. If the length of capaillary tube above the surface of water is made less than 'h' then :

(1) water rises upto the top of capillary tube and stays there without overflowing

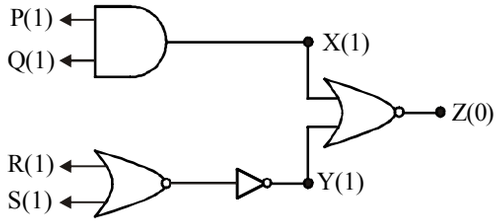
(2) water rises upto a point a little below the top and stays there

(3) water does not rise at all.

(4) water rises upto the tip of capillary tube and then starts overflowing like fountain.

SPACE FOR ROUGH WORK

26. The circuit diagram shows a logic combination with the states of outputs X, Y and Z given for inputs P, Q, R and S all at state 1. When inputs P and R change to state 0 with inputs Q and S still at 1, the states of outputs X, Y and Z change to



(1) 1, 0, 0 (2) 1, 1, 1 (3) 0, 1, 0 (4) 0, 0, 1

27. The self inductance of a long solenoid cannot be increased by

(1) increasing its area of cross section
(2) increasing its length
(3) changing the medium with greater permeability
(4) increasing the current through it

28. A car moving on a horizontal road may be thrown out of the road in taking a turn

(1) by the gravitational force
(2) due to the lack of proper centripetal force
(3) due to the rolling frictional force between the tyre and road
(4) due to the reaction of the ground

29. If T_1 and T_2 are the time-periods of oscillation of a simple pendulum on the surface of earth (of radius R) and at a depth d, then d is equal to

(1) $\left(1-\frac{T_1^2}{T_2^2}\right)R$ (2) $\left(1-\frac{T_2^2}{T_1^2}\right)R$

(3) $\left(1-\frac{T_1}{T_2}\right)R$ (4) $\left(1-\frac{T_2}{T_1}\right)R$

30. Which of the following is more close to a black body?

(1) black board paint (2) green leaves
(3) black holes (4) red roses

31. A circular coil of radius 6 cm and 20 turns rotates about its vertical diameter with an angular speed of 40 rad s^{-1} in a uniform horizontal magnetic field of magnitude 2×10^{-2} T. If the coil form a closed loop of resistance 8Ω, then the average power loss is

(1) 2.07×10^{-3} W (2) 1.23×10^{-3} W
(3) 3.14×10^{-3} W (4) 1.80×10^{-3} W

32. For an angle of incidence θ on an equilateral prism of refractive index $\sqrt{3}$, the ray refracted is parallel to the base inside the prism. The value of θ is

(1) 30° (2) 45° (3) 60° (4) 75°

33. A closely wound solenoid of 2000 turns and area of cross-section 1.5×10^{-4} m^2 carries a current of 2.0 A. It suspended through its centre and perpendicular to its length, allowing it to turn in a horizontal plane in a uniform magnetic field 5×10^{-2} tesla making an angle of 30° with the axis of the solenoid. The torque on the solenoid will be:

(1) 3×10^{-2} N-m (2) 3×10^{-3} N-m
(3) 1.5×10^{-3} N-m (4) 1.5×10^{-2} N-m

34. A body weighs 72 N on the surface of the earth. What is the gravitational force on it due to earth at a height equal to half the radius of the earth from the surface?

(1) 32 N (2) 28 N (3) 16 N (4) 72 N

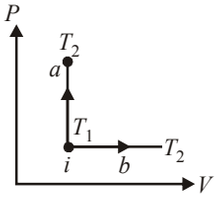
35. The length of a metal is ℓ_1 when the tension in it is T_1 and is ℓ_2 when the tension is T_2. The original length of the wire is

(1) $\frac{\ell_1+\ell_2}{2}$ (2) $\frac{\ell_1 T_2+\ell_2 T_1}{T_1+T_2}$

(3) $\frac{\ell_1 T_2-\ell_2 T_1}{T_2-T_1}$ (4) $\sqrt{T_1 T_2 \ell_1 \ell_2}$

SPACE FOR ROUGH WORK

36. An ideal gas has temperature T_1 at the initial state *i* shown in the *P*-*V* diagram. The gas has a higher temperature T_2 at the final states *a* and *b*, which it can reach the paths shown. The change in entropy is



(1) greatest in *a* (2) greatest in *b*

(3) same in *a* and *b* (4) cannot be said

37. A proton carrying 1 MeV kinetic energy is moving in a circular path of radius *R* in uniform magnetic field. What should be the energy of an α-particle to describe a circle of same radius in the same field?

(1) 2 MeV (2) 1 MeV

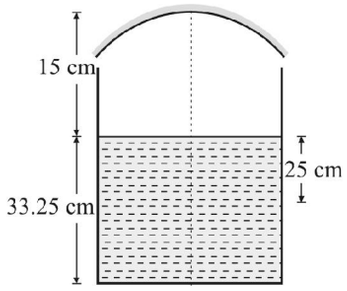
(3) 0.5 MeV (4) 4 MeV

38. The rate of steady volume flow of water through a capillary tube of length 'l' and radius 'r' under a pressure difference of P is V. This tube is connected with another tube of the same length but half the radius, in series. Then the rate of steady volume flow through them is (The pressure difference across the combination is P)

(1) $\frac{V}{16}$ (2) $\frac{V}{17}$

(3) $\frac{16V}{17}$ (4) $\frac{17V}{16}$

39. A container is filled with water ($\mu = 1.33$) upto a height of 33.25 cm. A concave mirror is placed 15 cm above the water level and the image of an object placed at the bottom is formed 25 cm below the water level. The focal length of the mirror is



(1) 10 cm (2) 15 cm

(3) 18.30 cm (4) 25 cm

40. A solid cube and a solid sphere of the same material have equal surface area. Both are at the same temperture 120°C , then

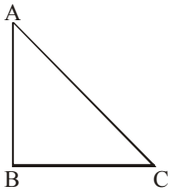
(1) both the cube and the sphere cool down at the same rate

(2) the cube cools down faster than the sphere

(3) the sphere cools down faster than the cube

(4) whichever is having more mass will cool down faster

41. A current carrying loop in the form of a right angle isosceles triangle ABC is placed in a uniform magnetic field acting along AB. If the magnetic force on the arm BC is F, what is the force on the arm AC?



(1) $-\sqrt{2}\,\vec{F}$ (2) $-\vec{F}$ (3) $\vec{F}$ (4) $\sqrt{2}\,\vec{F}$

42. A radioactive element forms its own isotope after 3 consecutive disintegrations. The particles emitted are

(1) 3 β–particles

(2) 2 β–particles and 1 α–particle

(3) 3 β–particles and 1 α–particle

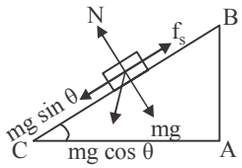
(4) 2 α–particles and 1 β–particle.

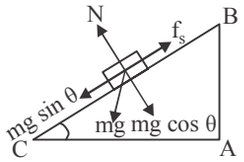
SPACE FOR ROUGH WORK

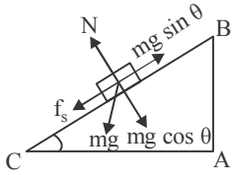
43. The fundamental frequency of a closed organ pipe of length 20 cm is equal to the second overtone of an organ pipe open at both the ends. The length of organ pipe open at both the ends is

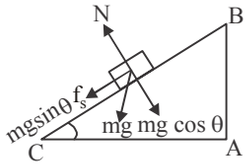
(1) 100 cm (2) 120 cm (3) 140 cm (4) 80 cm

44. Which figure shows the correct force acting on the body sliding down an inclined plane? ($m \rightarrow$ mass, $f_s \rightarrow$ force of friction)

(1) 

(2) 

(3) 

(4) 

45. Forward biasing is that in which applied voltage

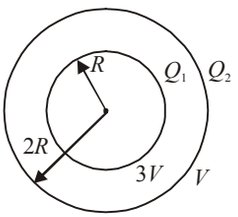
(1) increases potential barrier
(2) cancels the potential barrier
(3) is equal to 1.5 volt
(4) decreases potential barrier

SPACE FOR ROUGH WORK

NEET TEST SERIES
SOLUTIONS FULL TEST-2

PART A – PHYSICS

1. (3) Previously, if V_1 and V_2 are the potentials of inner and outer shells due to own charge respectively, then



$V_1 + V_2 = 3V$

$\therefore\ V_1 + V = 3V$ or $V_1 = 2V$

When outer shell is earthed, its potential becomes zero, and so potential of inner shell becomes

$V_1' = 2V + 0 = 2V$

2. (2) $W_{ABD} = W_{AB} + W_{BD}$

$= 0 + 6 \times 10^4 \times 4 \times 10^{-3}$

$= 240\,\text{J}.$

Now, $Q = \Delta U + W$

or $500 + 150 = \Delta U + 240$

$\therefore\ \Delta U = 410\,\text{J}.$

3. (2) In CGS system,

$$d = 4\frac{\text{g}}{\text{cm}^3}$$

The unit of mass is 100g and unit of length is 10 cm, so

$$\text{density} = \frac{4\left(\frac{100\text{g}}{100}\right)}{\left(\frac{10}{10}\text{cm}\right)^3}$$

$$= \frac{\left(\frac{4}{100}\right)}{\left(\frac{1}{10}\right)^3}\frac{(100\text{g})}{(10\text{cm})^3}$$

$$= \frac{4}{100} \times (10)^3 \cdot \frac{100\text{g}}{(10\text{cm})^3}$$

$= 40$ unit

4. (4) $\text{g} = \frac{\text{GM}}{\text{R}}$ and $\text{g}' = \frac{\text{GM}}{(\text{R}+\text{h})^2}$

$$\Rightarrow \frac{\text{g}'}{\text{g}} = \left(\frac{\text{R}}{\text{R}+\text{h}}\right)^2$$

$$\therefore\ \text{g}' = \text{g}\left(\frac{\text{R}}{\text{R}+\text{h}}\right)^2$$

$$\Rightarrow \frac{\text{g}}{2} = \text{g}\left(\frac{\text{R}}{\text{R}+\text{h}}\right)^2 \Rightarrow \frac{1}{\sqrt{2}} = \frac{\text{R}}{\text{R}+\text{h}}$$

$\Rightarrow \text{R} + \text{h} = \sqrt{2}\,\text{R}$ or $\text{h} = (\sqrt{2} - 1)\text{R}$

5. (1) Given, $\text{h} = 60\text{m}$, $\text{g} = 10\ \text{ms}^{-2}$,

Rate of flow of water = 15 kg/s

$\therefore$ Power of the falling water

$= 15\ \text{kgs}^{-1} \times 10\ \text{ms}^{-2} \times 60\ \text{m} = 900$ watt.

Loss in energy due to friction

$$= 9000 \times \frac{10}{100} = 900 \text{ watt.}$$

$\therefore$ Power generated by the turbine

$= (9000 - 900)$ watt $= 8100$ watt $= 8.1$ kW

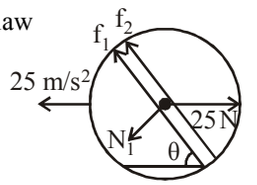
6. (1) $N_1 = 25 \sin\theta,$

$\therefore\quad f_1 = \mu N_1 = \frac{2}{5} \times 25 \times \frac{3}{5} = 6N.$

$f_2 = \mu N_2 = \frac{2}{5} mg = \frac{2}{5} \times 1 \times 10$

$= 4\text{N}.$

Now from Newton's second law



$25\cos\theta - (f_1 + f_2) = ma$

or $25 \times \frac{4}{5} - (6 + 4) = 1\,a$

$\therefore\quad a = 10\ \text{m/s}^2.$

7. (4) $\frac{1}{2}mv^2 = \frac{hc}{\lambda} - W_0$ or $\frac{hc}{\lambda} = \frac{1}{2}mv^2 + W_0$ and

$$\frac{1}{2}mv_1^2 = \frac{hc}{(3\lambda/4)} - W_0$$

$$= \frac{4}{3}\left(\frac{1}{2}mv^2 + W_0\right) - W_0$$

So, v_1 is greater than $v\left(\frac{4}{3}\right)^{1/2}$.

8. (1) Current through each bulb is same because these are connected in series.

since $\left(\text{R} = \frac{\text{V}^2}{\text{P}}\right)$, resistance of 40 W bulb is more, hence greater heat is produced in the 40 W bulb, it glows brightest

$\text{H} = \text{I}^2\,\text{R}\,\text{t}$

9. **(1)** M.I. of disc about tangent in a plane $= \frac{5}{4}mR^2 = I$

$\therefore\ mR^2 = \frac{4}{5}I$ ...(i)

M.I. of disc about tangent $\perp$ to plane $I' = \frac{3}{2}mR^2$

Substituting the value of mR^2 from equation (i) we get

$$I' = \frac{3}{2}\left(\frac{4}{5}I\right) = \frac{6}{5}I$$

10. **(1)** Process *AB* is isobasic and *BC* is isothermal, *CD* isochoric and *DA* isothermic compression.

11. **(3)** Electric field lines at each point of the ball must crosses normally.

12. **(1)** $E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E} = \frac{6.62\times10^{-34}\times3\times10^{8}}{12.5\times1.6\times10^{-19}}$

$= 993\,A^{\circ}$

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

(where Rydberg constant , $R = 1.097 \times 10^7$)

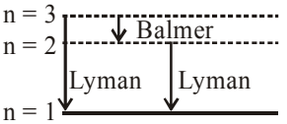
or, $\frac{1}{993\times10^{-10}} = 1.097\times10^{7}\left(\frac{1}{1^2} - \frac{1}{n_2^2}\right)$

Solving we get $n_2 = 3$

Spectral lines

Total number of spectral lines = 3

Two lines in Lyman series for $n_1 = 1, n_2 = 2$ and $n_1 = 1$, $n_2 = 3$ and one in Balmer series for $n_1 = 2$, $n_2 = 3$



13. **(2)** Boat covers distance of 16km in a still water in 2 hours.

i.e. $v_B = \frac{16}{2}$ km/hr

Now velocity of water $\Rightarrow$ $v_w = 4$km/hr

Time taken for going upstream

$$t_1 = \frac{8}{v_B - v_w} = \frac{8}{8-4} = 2\text{hr}$$

(As water current oppose the motion of boat)

Time taken for going down stream

$$t_2 = \frac{8}{v_B + v_w} = \frac{8}{8+4} = \frac{8}{12}\text{hr}$$

(As water current helps the motion of boat)

$\therefore$ Total time $= t_1 + t_2 = \left(2 + \frac{8}{12}\right)$hr or 2 hr 40 min.

14. **(3)** Current in circuit $= \frac{(3-1)\text{V}}{200\Omega} = \frac{2}{200} = 0.01$ A.

15. **(3)** Given $t = d^{a/2}, r^{b/2}, s^{c/2}$. Substituting dimensions, we have

$(T) = (ML^{-3})^{a/2}(L)^{b/2}(MT^{-2})^{c/2}$

$= M^{(a+c)/2}.L^{(-3a/2\ +\ b/2)}\ T^{-c}$

Equating powers of L, we have,

$$-\frac{3}{2}a + \frac{b}{2} = 0. \qquad \text{Given a = 1.}$$

$\therefore\ -\frac{3}{2} + \frac{b}{2} = 0$ or $b = 3$

16. **(2)** Distance covered by lift is given by

$y = t^2$

$\therefore$ Acceleration of lift upwards

$$= \frac{d^2y}{dt^2} = \frac{d}{dt}(2t) = 2\ \text{m/s}^2 = \frac{g}{5}$$

Now, $T = 2\pi\sqrt{\frac{\ell}{g}}$

$$T' = 2\pi\sqrt{\frac{\ell}{g + \frac{g}{5}}} = 2\pi\sqrt{\frac{\ell}{\frac{6}{5}g}} = \sqrt{\frac{5}{6}}T.$$

17. **(3)** Angular limit of resolution of eye, $\theta = \frac{\lambda}{d}$, where, d is diameter of eye lens.

Also, if *y* is the minimum separation between two objects at distance *D* from eye then

$$\theta = \frac{y}{D}$$

$$\Rightarrow\ \frac{y}{D} = \frac{\lambda}{d} \Rightarrow y = \frac{\lambda D}{d} \quad ...(1)$$

Here, wavelength $\lambda = 5000\text{Å} = 5\times10^{-7}$ m

$D = 50$ m

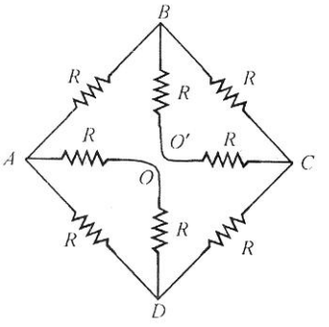
Diameter of eye lens $= 2$ mm $= 2\times10^{-3}$ m

From eq. (1), minimum separation is

$$y = \frac{5\times10^{-7}\times50}{2\times10^{-3}} = 12.5\times10^{-3}\ \text{m}$$

18. **(4)** The equivalent circuit is as shown in figure.

The resistance of arm AOD (= R + R) is in parallel to the resistance R of arm AD.



Their effective resistance $R_1 = \frac{2R \times R}{2R \times R} = \frac{2}{3}R$

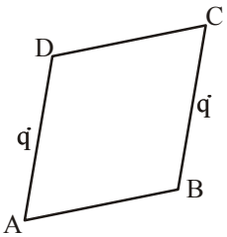
The resistance of arms AB, BC and CD is

$R_2 = R + \frac{2}{3}R + R = \frac{8}{3}R$

The resistance R_1 and R_2 are in parallel. The effective resistance between A and D is

$$R_3 = \frac{R_1 \times R_2}{R_1 + R_2} = \frac{\frac{2}{3}R \times \frac{8}{3}R}{\frac{2}{3}R + \frac{8}{3}R} = \frac{8}{15}R.$$

19. (2) Both the charges are identical and placed symmetrically about *ABCD*. The flux crossing *ABCD* due to each charge is $\frac{1}{6}\left[\frac{q}{\epsilon_0}\right]$ but in opposite directions. Therefore the resultant is zero.



20. (4) C_v for hydrogen $= \frac{5}{2}R$

C_v for helium $= \frac{3R}{2}$

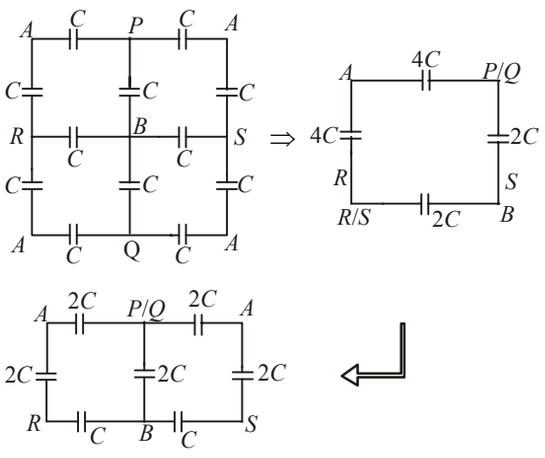
C_v for water vapour $= \frac{6R}{2} = 3R$

$$\therefore (C_v)_{mix} = \frac{4 \times \frac{5}{2}R + 2 \times \frac{3}{2}R + 1 \times 3R}{4 + 2 + 1} = \frac{16}{7}R$$

$\therefore C_p = C_v + R$

$C_p = \frac{16}{7}R + R$ or $C_p = \frac{23}{7}R$

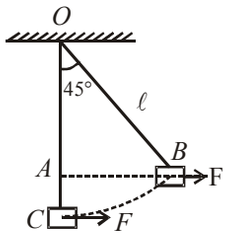
21. (2) The effective circuit is shown in the figure



Now $C_{AB} = 2 \times \frac{4C \times 2C}{4C + 2C} = \frac{8C}{3}$.

22. (4) Work done by tension + Work done by force (applied) + Work done by gravitational force = change in kinetic energy

Work done by tension is zero



$\Rightarrow 0 + F \times AB - Mg \times AC = 0$

$$\Rightarrow F = Mg\left(\frac{AC}{AB}\right) = Mg\left[\frac{1 - \frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{2}}}\right]$$

$$[\because AB = \ell \sin 45° = \frac{\ell}{\sqrt{2}} \text{ and}$$

$$AC = OC - OA = \ell - \ell \cos 45° = \ell\left(1 - \frac{1}{\sqrt{2}}\right)$$

where ℓ = length of the string.]

$\Rightarrow F = Mg(\sqrt{2} - 1)$

23. (1) $\frac{E_s}{E_p} = \frac{n_s}{n_p}$ or $E_s = E_p \times \left(\frac{n_s}{n_p}\right)$

$$\therefore \quad E_s = 120 \times \left(\frac{200}{100}\right) = 240\,V$$

$$\frac{I_p}{I_s} = \frac{n_s}{n_p} \text{ or } I_s = I_p\left(\frac{n_p}{n_s}\right) \quad \therefore \; I_s = 10\left(\frac{100}{200}\right) = 5 \text{ amp}$$

24. (3) Applying conservation of energy principle, we get

$$\frac{1}{2}mk^2v_e^2 - \frac{GMm}{R} = -\frac{GMm}{r}$$

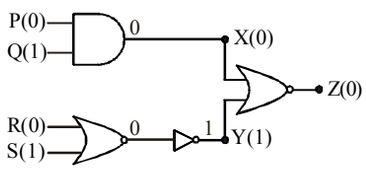
$$\Rightarrow \frac{1}{2}mk^2\frac{2GM}{R} - \frac{GMm}{R} = -\frac{GMm}{r}$$

$$\Rightarrow \frac{k^2}{R} - \frac{1}{R} = -\frac{1}{r} \Rightarrow \frac{1}{r} = \frac{1}{R} - \frac{k^2}{R}$$

$$\Rightarrow \frac{1}{r} = \frac{1}{R}(1 - k^2) \Rightarrow r = \frac{R}{1 - k^2}$$

25. (1) Water rises upto the top of capillary tube and stays there without overflowing.

26. (3)



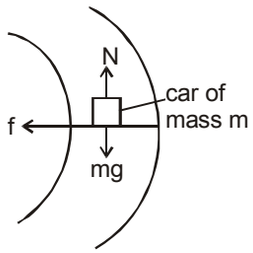
27. (4) The self inductance of a long solenoid is given by

$L = \mu_r \mu_0 n^2 A l$

Self inductance of a long solenoid is independent of the current flowing through it.

28. (2) It means that car which is moving on a horizontal road & the necessary centripetal force, which is provided by friction (between car & road) is not sufficient.

If μ is friction between car and road, then max speed of safely turn on horizontal road is determined from figure.



$N = mg$ ...(i)

$f = \frac{mv^2}{r}$ ...(ii)

Where f is frictional force between road & car, N is the normal reaction exerted by road on the car. We know that

$f = \mu_s N = \mu_s mg$ .....(iii)

where μ_s is static friction

so from eq (ii) & (iii) we have

$\frac{mv^2}{r} \le \mu_s mg \Rightarrow v^2 \le \mu_s rg$ or $v \le \sqrt{\mu_s rg}$

& $v_{max} = \sqrt{\mu_s rg}$

If the speed of car is greater than v_{max} at that road, then it will be thrown out from road i.e., skidding.

29. (1) Time period of simple pendulam is given by :

$T = 2\pi\sqrt{\frac{\ell}{g_{eff}}}$ or, $T = \frac{k}{\sqrt{g_{eff}}}$

Now, $T_1 = \frac{k}{\sqrt{g}}$ and $T_2 = \frac{k}{\sqrt{g\left(1-\frac{d}{R}\right)}}$

So, $\frac{T_1}{T_2} = \sqrt{1-\frac{d}{R}} = \left(\frac{T_1}{T_2}\right)^2 = 1-\frac{d}{R}$

$d = \left[1-\left(\frac{T_1}{T_2}\right)^2\right]R$

30. (1) Black board paint is quite approximately equal to black bodies.

31. (1) Here, $r = 6$ cm $= 6 \times 10^{-2}$ m, $N = 20$, $\omega = 40$ rads^{-1}
$B = 2 \times 10^{-2}$ T, $R = 8\Omega$
Maximum emf induced, $\varepsilon = NAB\omega$
$= N(\pi r^2)B\omega$
$= 20 \times \pi \times (6 \times 10^{-2})\ 2 \times 10^{-2} \times 40 = 0.18$ V

Average value of emf induced over a full cycle
$\varepsilon_{av} = 0$
Maximum value of current in the coil.

$I = \frac{\varepsilon I}{R} = \frac{0.18}{8} = 0.023$ A

Average power dissipated,

$P = \frac{\varepsilon I}{2} = \frac{0.18 \times 0.023}{2} = 2.07 \times 10^{-3}$ W

32. (3) Angle of prism A = 60°
By prism formula

$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

or $\sqrt{3} = \frac{\sin\left(\frac{60^\circ+\delta_m}{2}\right)}{\sin\left(\frac{60^\circ}{2}\right)}$

$\frac{\sqrt{3}}{2} = \sin\left(\frac{60^\circ+\delta_m}{2}\right)$

$\sin 60^\circ = \sin\left(\frac{60^\circ+\delta m}{2}\right)$

$60^\circ = \frac{60^\circ+\delta_m}{2} \Rightarrow \delta_m = 60^\circ$

As we know,
$\delta_m = 2\theta - A$

$\theta = \frac{\delta_m + A}{2} = \frac{60^\circ+60^\circ}{2} = 60^\circ$

33. (4) Torque on the solenoid is given by
$\tau = MB \sin\theta$
where θ is the angle between the magnetic field and the axis of solenoid.
$M = niA$
$\therefore\ \tau = niA\,B \sin 30^\circ$

$= 2000 \times 2 \times 1.5 \times 10^{-4} \times 5 \times 10^{-2} \times \frac{1}{2}$

$= 1.5 \times 10^{-2}\ N - m$

34. (1) $mg = 72$ N (body weight on the surface)

$g = \frac{GM}{R^2}$

At a height $H = \frac{R}{2}$,

$g' = \frac{GM}{\left(R+\frac{R}{2}\right)^2} = \frac{4\ GM}{9\ R^2}$

Body weight at height $H = \frac{R}{2}$,

$$mg' = m \times \frac{4}{9}\frac{GM}{R^2}$$

$$= m \times \frac{4}{9} \times g = \frac{4}{9}mg$$

$$= \frac{4}{9} \times 72 = 32\ \text{N}$$

35. (3) If ℓ is the original length of wire, then change in length of first wire, $\Delta\ell_1 = (\ell_1 - \ell)$

change in length of second wire, $\Delta\ell_2 = (\ell_2 - \ell)$

Now, $Y = \frac{T_1}{A} \times \frac{\ell}{\Delta\ell_1} = \frac{T_2}{A} \times \frac{\ell}{\Delta\ell_2}$

or $\frac{T_1}{\Delta\ell_1} = \frac{T_2}{\Delta\ell_2}$ or $\frac{T_1}{\ell_1 - \ell} = \frac{T_2}{\ell_2 - \ell}$

or $T_1\ell_2 - T_1\ell = T_2\ell_1 - \ell T_2$ or $\ell = \frac{T_2\ell_1 - T_1\ell_2}{T_2 - T_1}$

36. (2) $Q_a = \Delta U + 0 = \Delta U$

and $Q_b = \Delta U + P\Delta V$

As $Q_b > Q_a$, $\therefore$ Change in entropy is greater in case(2).

37. (2) According to the principal of circular motion in a magnetic field

$$F_c = F_m \Rightarrow \frac{mv^2}{R} = qVB$$

$$\Rightarrow R = \frac{mv}{qB} = \frac{P}{qB} = \frac{\sqrt{2m.k}}{qB}$$

$$R_\alpha = \frac{\sqrt{2(4m)K'}}{2qB}$$

$$\frac{R}{R_\alpha} = \sqrt{\frac{K}{K'}}$$

but $R = R_\alpha$ (given)

Thus $K = K' = 1$ MeV

38. (2) Rate of flow of liquid $V = \frac{P}{R}$

where liquid resistance $R = \frac{8\eta l}{\pi r^4}$

For another tube liquid resistance;

$$R' = \frac{8\eta l}{\pi\left(\frac{r}{2}\right)^4}.16 = 16R$$

For the series combination

$$V_{New} = \frac{P}{R + R'} = \frac{P}{R + 16R} = \frac{P}{17R} = \frac{V}{17}$$

39. (3) The distance of object from mirror

$$= 15 + \frac{33.25}{4} \times 3 = 39.93\ \text{cm}$$

Distance of image from mirror

$$= 15 + \frac{25 \times 3}{4} = 33.75\ \text{cm}$$

Using mirror formula,

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

or $\frac{1}{-33.93} + \frac{1}{-33.75} = \frac{1}{f}$

$\therefore \quad f = -18.3\ \text{cm}$

40. (2) Rate of cooling of a body $R = \frac{\Delta\theta}{t} = \frac{A\varepsilon\sigma(T^4 - T_0^4)}{mc}$

$\Rightarrow R \propto \frac{A}{m} \propto \frac{\text{Area}}{\text{Volume}}$ $[\text{m} = \rho \times \text{V}]$

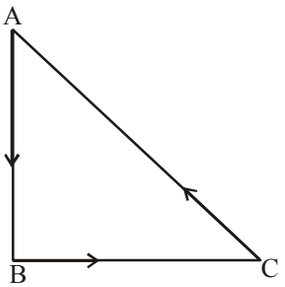
$\Rightarrow$ For the same surface area. $R \propto \frac{1}{\text{Volume}}$

$\because$ Volume of cube < Volume of sphere

$\Rightarrow R_{\text{cube}} > R_{\text{Sphere}}$ i.e., cube, cools down with faster rate.

41. (2) Let a current i be flowing in the loop ABC in the direction shown in the figure. If the length of each of the sides AB and BC be x then

$|\vec{F}| = \text{i x B}$



where B is the magnitude of the magnetic force.

The direction of $\vec{F}$ will be in the direction perpendicular to the plane of the paper and going into it.

By Pythagorus theorem,

$\text{AC} = \sqrt{\text{x}^2 + \text{x}^2} = \sqrt{2}\text{x}$

$\therefore$ Magnitude of force on AC

$= \text{i}\ \sqrt{2}\ \text{x}\ \text{B}\sin 45°$

$= \text{i}\sqrt{2}\ \text{x B} \times \frac{1}{\sqrt{2}}$

$= \text{ixB} = |\vec{F}|$

The direction of the force on AC is perpendicular to the plane of the paper and going out of it. Hence, force on

$\text{AC} = -\vec{F}$

42. (2) A nucleus is denoted by ${}_{Z}X^{A}$

An isotope should have same Z.

α–particle = ${}_{2}He^{4}$; β–particle = ${}_{-1}\beta^{0}$

The emission of one α particle and the emission of two β particles maintain the Z same.

Hence, for isotope formation 2β particles and one α particle are emitted.

43. (2) Fundamental frequency of closed organ pipe

$$V_c = \frac{V}{4l_c}$$

Fundamental frequency of open organ pipe

$$V_0 = \frac{V}{2l_0}$$

Second overtone frequency of open organ pipe = $\frac{3V}{2l_0}$

From question,

$$\frac{V}{4l_c} = \frac{3V}{2l_0}$$

$$\Rightarrow \quad l_0 = 6l_c = 6 \times 20 = 120 \text{ cm}$$

44. (2) If a body slides down, then the force of friction acts upwards along the plane weight(mg) act vertically downwards.

45. (2) Forward bias opposes the potential barrier and if the applied voltage is more than knee voltage it cancels the potential barrier.