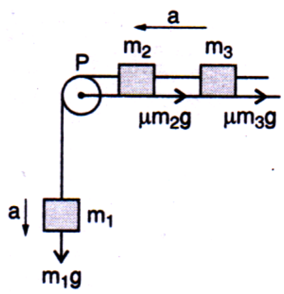
WEEKLY TEST TYJ -1 TEST - 18 Rajpur Road
SOLUTION Date 25-08-2019

[PHYSICS]

1. Force of friction on mass $m_2 = \mu m_2 g$

Force of friction on mass $m_3 = \mu m_3 g$

Let a be common acceleration of the system



$$\therefore \quad a = \frac{m_1 g - m_2 g - \mu m_3 g}{m_1 + m_2 + m_3}$$

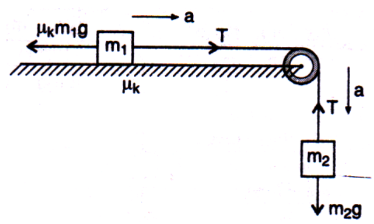
Here, $m_1 = m_2 = m_3 = m$

$$\therefore \quad a = \frac{mg - \mu mg - \mu mg}{m + m + m}$$

$$= \frac{mg - 2\mu mg}{3m}$$

$$= \frac{g(1-2\mu)}{3}$$

2. For motion of mass m_1,



$T - \mu_k m_1 g = m_1 a$ ......(i)

$m_2 g - T = m_2 a$ ....(ii)

Adding eqns. (i) and (ii), we get

$$a = \frac{m_2 g - \mu_k m_1 g}{m_1 + m_2} \quad ....(iii)$$

Putting eqn. (iii), in eqn. (ii), we get

$$m_2 g - T = m_2 \left[\frac{m_2 g - \mu_k m_1 g}{m_1 + m_2}\right]$$

or $$T = \left[\frac{m_1 m_2 g(1+\mu_k)}{m_1 + m_2}\right]$$

3. Force of friction, $f = \mu mg$

$$\therefore \quad a = \frac{f}{m} = \frac{\mu mg}{m} = \mu g = 0.5 \times 10 = 5\,ms^{-2}$$

Using, $v^2 - u^2 = 2aS$

$0^2 - 2^2 = 2(-5) \times S$

$S = 0.4$ m

4. $R = mg\cos\alpha$

Force of friction $= \mu R = \mu mg\cos\alpha$

Force on the body along the direction of motion

$= mg\sin\alpha - \mu mg\cos\alpha$

$$\therefore \quad a = \frac{\text{force}}{\text{mass}} = g(\sin\alpha - \mu\cos\alpha)$$

5. Ball bearing are helpful in converting the sliding friction into rolling friction. Remember rolling friction is negligble as compared to sliding friction.

6. When the cube is to be moved up, the minimum force needed is given by :
F = mg sinθ + μR = mgsinθ + μmgcosθ

$$= 10\sin\theta + 0.6 \times 10\cos\theta = 10 \times \frac{3}{5} + 0.6 \times 10 \times \frac{4}{5}$$

= 10.8 N

7. $\mu_s > \mu_k > \mu_r$. Rolling friction is always less than sliding friction, that is why it is easy to move heavy load from one place to another by rolling it over the surface instead of sliding it over the same surface. Moreover, it is quite obvious that static friction is always greater than kinetic friction

8. Given u = V, final velocity = 0
Using v = u + at

$\therefore$ 0 = V – at or $-a = \frac{0-V}{t} = -\frac{V}{t}$

f = μR = μmg (f is the force of friction)

$\therefore$ Retardation, a = μg

$$\therefore \quad t = \frac{V}{a} = \frac{V}{\mu g}$$

10. $x = 3t - 4t^2 + t^3$

$$\frac{dx}{dt} = 3 - 8t + 3t^2 \text{ and } a = \frac{d^2x}{dt^2} = -8 + 6t$$

Now, $W = \int F dx \int ma dx = \int ma \frac{dx}{dt} dt$

$$= \int_0^4 \frac{3}{1000} \times (-8 + 6t)(3 - 8t + 3t^2)dt$$

On integrating, we get W = 530 mJ

11. When the body is rest, force of friction between the body and the floor = applied force = 2.8 N.

12. Kinetic friction is constant, hence frictional force will remain same = (10 N)

13. Given that; $a = 70\text{km/h} = 70 \times \frac{5}{18} = \frac{175}{9}\text{m/s}$

Final velocity = 0

Now, $\mu = \frac{F}{R} = \frac{(m-a)}{mg} = -\frac{a}{g}$ or $-a = \mu g$

$\therefore$ Retardation = 0.2 × 9.8 = 1.96 m/s^2
Using, $v^2 = u^2 + 2as$, we get

$$0 = \left(\frac{175}{9}\right)^2 + 2(-1.96)s$$

Solving, we get; s = 96.45 m

14.

[CHEMISTRY]

26. (c) Boyle's law is $V \propto \frac{1}{P}$ at constant T

27. (d) According to Boyle's law $V \propto \frac{1}{P}$

$V = \frac{\text{Constant}}{P}$ **;** VP = Constant.

28. (a) At constant $T, P_1V_1 = P_2V_2$

$$1 \times 20 = P_2 \times 50 \textbf{ ; } P_2 = \frac{20}{50} \times 1$$

29. (b,c)According to Boyle's Law PV = constant, at constant temperature either P increases or V increases both (b) & (c) may be correct.

[MATHEMATICS]

31. (b) Three letters can be posted in 4 letter boxes in $4^3 = 64$ ways but it consists the 4 ways that all letters may be posted in same box. Hence required ways = 60.

32. (b) At first we have to accommodate those 5 animals in cages which can not enter in 4 small cages, therefore number of ways are ${}^6P_5$. Now after accommodating 5 animals we left with 5 cages and 5 animals, therefore number of ways are $5!$. Hence required number of ways = ${}^6P_5 \times 5! = 86400$.

33. (a) Number of words in which all the 5 letters are repeated $= 10^5 = 100000$ and the number of words in which no letter is repeated are ${}^{10}P_5 = 30240$.

Hence the required number of ways are
$100000 - 30240 = 69760$.

34. (b) The word ARRANGE, has AA, RR, NGE letters, that is two A' s, two R's and N, G, E one each.

$\therefore$ The total number of arrangements

$$= \frac{7!}{2!2!1!1!1!} = 1260$$

But, the number of arrangements in which both RR are together as one unit = $\dfrac{6!}{2!1!1!1!1!} = 360$

$\therefore$ The number of arrangements in which both RR do not come together $= 1260 - 360 = 900$.

35. (b) The number of ways can be deduce as follows :

1 woman and 4 men $= {}^4C_1 \times {}^6C_4 = 60$

2 women and 3 men $= {}^4C_2 \times {}^6C_3 = 120$

3 women and 2 men $= {}^4C_3 \times {}^6C_2 = 60$

4 women and 1 man $= {}^4C_4 \times {}^6C_1 = 6$

Required number of ways $= 60 + 120 + 60 + 6 = 246$.

36. (b) Since 2 persons can drive the car, therefore we have to select 1 from these two. This can be done in ${}^2C_1$ ways. Now from the remaining 5 persons we have to select 2 which can be done in ${}^5C_2$ ways.

Therefore the required number of ways in which the car can be filled is ${}^5C_2 \times {}^2C_1 = 20$.

37. (c) We have got $2P^s, 2R^s, 3O^s, 1I, 1T, 1N$ *i.e.* 6 types of letters. We have to form words of 4 letters. We consider four cases

(i) All 4 different : Selection ${}^6C_4 = 15$

Arrangement $= 15 \,.\, 4\,! = 15 \times 25 = 360$

(ii) Two different and two alike :

P^s, R^s and O^s in ${}^3C_1 = 3$ ways. Having chosen one pair we have to choose 2 different letters out of the remaining 5 different letters in ${}^5C_2 = 10$ ways. Hence the number of selections is $10 \times 3 = 30$. Each of the above 30 selections has 4 letters out of which 2 are alike and they can be arranged in $\frac{4\,!}{2\,!} = 12$ ways.

Hence number of arrangements is $12 \times 30 = 360$.

(iii) 2 like of one kind and 2 of other :

Out of these sets of three like letters we can choose 2 sets in ${}^3C_2 = 3$ ways. Each such selection will consist of 4 letters out of which 2 are alike of one kind, 2 of the other. They can be arranged in $\frac{4\,!}{2\,!\,2\,!} = 6$ ways.

Hence the number of arrangements is $3 \times 6 = 18$.

(iv) 3 alike and 1 different :

There is only one set consisting of 3 like letters and it can be chosen in 1 way. The remaining one letter can be chosen out of the remaining 5 types of letters in 5 ways.

Hence the number of selection $= 5 \times 1$. Each consists of 4 letters out of which 3 are alike and each of them can be arranged in $\frac{4\,!}{3\,!} = 4$ ways.

Hence the number of arrangements is $5 \times 4 = 20$.

From (i), (ii), (iii) and (iv), we get

Number of selections $= 15 + 30 + 3 + 5 = 53$

Number of arrangements

$= 360 + 360 + 18 + 20 = 758$.

38. (a) The number of words before the word CRICKET is
$4 \times 5! + 2 \times 4! + 2! = 530$.

39 $^{n+1}C_3 - {}^nC_3 = 21$
$\Rightarrow \frac{(n+1)(n)(n-1)}{6} - \frac{n(n-1)(n-2)}{6} = 21$
$\Rightarrow n(n-1) = 42 = 7 \times 6$ giving $n = 7$.

40. Two are already selected, so we have to select only
9. Four are excluded and two already selected, so we have to select out of $22 - 6 = 16$. The number of ways is $^{16}C_9$.

41. (a) $x = 6! \times 6! + 6! \times 6! = 2(6!)^2$ and $y = 5! \times 6!$
$\therefore \frac{x}{y} = 2 \times 6 \Rightarrow x = 12y$

42. (a) Excluding the two particular persons, the remaining five can be arranged at the round table in 4! ways. There are five gaps between them in every arrangement. Two particular persons can be arranged in these gaps in $^5P_2$ ways.
So, the required number of ways = $4! \times {}^5P_2 = 480$.

43. (c) Here, we have 1M, 41's,4 S's and P's
$\therefore$ Total number of selections

44. (a) Out of 9 men, 2 men can be chosen in $^9C_2$ ways.
But no husband and wife are to play in the same game.
$\therefore$ We have to select two women from the remaining 7 women. It can done in $^7C_2$ ways. Let M_1, M_2 and W_1, W_2 are chosen, then a team can be constituted in 4 ways viz. M_1, W_2; M_1, W_1; M_2, W_1, M_2, W2. *Thus* number of ways of arranging the game
$= {}^9C_2 \times {}^7C_2 \times 4$
$= 3024$.

45 (a) The required number of ways =
$(10 + 1)(9 + 1)(7 + 1) - 1 = 879$.