21. (3) Acceleration $= \frac{d^2x}{dt^2} = 2a_2$

22. (1) $S = \int_0^3 v\,dt = \int_0^3 kt\,dt = \left[\frac{1}{2}kt^2\right]_0^3 = \frac{1}{2}\times 2\times 9 = 9m$

23. (1) Distance travelled in n^{th} second $= u + \frac{a}{2}(2n-1)$

Distance travelled in 5^{th} second $= 0 + \frac{8}{2}(2\times 5 - 1) = 36$ m

24. (1) $S \propto u^2 \ \therefore \ \frac{S_1}{S_2} = \left(\frac{u_1}{u_2}\right)^2 \Rightarrow \frac{2}{S_2} = \frac{1}{4} \Rightarrow S_2 = 8$ m

25. (3) $\frac{dx}{dt} = 2at - 3bt^2 \Rightarrow \frac{d^2x}{dt^2} = 2a - 6bt = 0 \Rightarrow t = \frac{a}{3b}$

26. (3) $h = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{2h/g}$; $t_a = \sqrt{\frac{2a}{g}}$ and $t_b = \sqrt{\frac{2b}{g}} \Rightarrow \frac{t_a}{t_b} = \sqrt{\frac{a}{b}}$

27. (2) Let the initial velocity of ball be u

Time of rise $t_1 = \frac{u}{g+a}$ and height reached $= \frac{u^2}{2(g+a)}$ Time of fall t_2 is given by

$\frac{1}{2}(g-a)t_2^2 = \frac{u^2}{2(g+a)} \Rightarrow t_2 = \frac{u}{\sqrt{(g+a)(g-a)}} = \frac{u}{(g+a)}\sqrt{\frac{g+a}{g-a}} \ \therefore t_2 > t_1$ because $\frac{1}{g+a} < \frac{1}{g-a}$

28. (1) $h = \frac{1}{2}gt^2 = \frac{1}{2}\times 10\times (4)^2 = 80$ m

29. (2) $v^2 = u^2 + 2gh \ \Rightarrow (3u)^2 = (-u)^2 + 2gh \Rightarrow h = \frac{4u^2}{g}$

30. (1) $S_n = u + \frac{g}{2}(2n-1)$; when $u = 0$, $S_1 : S_2 : S_3 = 1:3:5$