Kinematics worksheet

Question 1. Start of the bus at station A from rest with uniform acceleration 2m/sec2. The bus is moving in a straight line and. Find the distance moved by bus in 10 seconds? B. At what time, the speed becomes 20m/sec? c. How long it will take to cover the distance of 1.6 km Solution Now the first step in trying such a question is to visualize the whole process. Here the bus moves in a straight line and with uniform acceleration Now what we have Starting Speed = 0 Acceleration = 2m/sec2 Now, since it is uniformly moving, we can use the formula to move in use $v = u + at $$s = ut + \frac {1}{2}at^2 $ $v^2 = u^2 + 2as $ a. Distance (s)= time(t)=10 sec So here is the most appropriate equation $s=ut+ \frac {1}{2}at^2$ Substituting given values $s=(0)10 + \frac {1}{2} 2(10)^2=100 m$b. Speed (v) =20 m/s time (t)=? So here the most appropriate equation is $v=u+at$ $20 = 0 + 2t $ or t = 10 sec c.distance(s)= 1.6km = 1600m t = ? So here the most appropriate equation is $s = ut + \frac {1}{2}at^2 $1600 = \frac {1}{2} (2)t^2 $ or t = 40 sec Question 2. The object is moving in a straight line. The motion of this object describes $x=at+bt^2 + ct^3$ where there are a,b,c constants, and x in meters, and t in sec. Find the offset at t=1 sec b. Find speed at t=0 and t=1 sec c. Find acceleration to t =0 and t=1 sec Solution Now the first step to try such a question is to visualize the whole process. Here the object moves in a straight line and its motion is described by a certain equation Now we are $x = on + bt ^2 + ct^3 $ Now, since its movement is described by a certain equation, the following formula will be useful in determining $x=\int vdt$ $v=\int adt$ $v= \frac {dx}{dt}$ $a=\frac {dv}{dt}= \frac {d^2x}{dt^dt^2}$$a=v \frac {dv} t=1sec Here we get the answer $x=a(1)+b(1)^2+c(1)^3$$x=a+b+c$ m b. v=? t=0.v=? t=1 Here we have a displacement equation, so first we need to find out the speed equation So here is the most appropriate formula $v= \frac {dx}{dt}$ or $v=\frac {d}{dt}(at+bt^2+ct^13)$ or $v=a+2bt+3ct^2$ Substituting t=0 we get $v=a$ m/s Substituting t=1 we get $v=a+2b+3c$ m/s c. =? t=0.a=? t=1 Now we have a speed equation, we need to find the acceleration equation first. Therefore, the most appropriate formula here is $a=\frac {dv}{dt}$ or $a=\frac {d}{dt}(a+2bt+3ct^2)$ $a=dt}(a+2bt+3ct^2)$ $a=d 2b+6ct $ Replacement t = 0 we get $a = 2b $ m / s2 Replacement t = 1 we get $a = 2b + 6c $ m / s2 Question 3. The object is thrown vertically upwards with a starting speed of 40m/s.Two seconds later another object is thrown upwards at the same speed. Find out a.At what height they encounter b.what is the time when they encounter c.what are the speeds of each object when they encounter Solution Let take origin at the initial position of the object and ascending direction as a positive wash. Let's also take the time when the time began when the first object was thrown upwards. Now, since the uniform movement we can use the given formula movements in use $v = u + at $ $s = ut + \frac $v^2=u^2+2as$ So, from the motion equation The first object $v_1=v_0 - gt$ and $y_1= v_0t- \frac {1}{2}(gt^2)$ ---(1) It is similar for another object. We write the equation at the same time t variable $v_2=v_0 - g(t-2)$ and $y_2= v_0(t-2)- \frac {1}{2}g(t-2)^2$ ---(2) Now that they meet, then $y_1= y_2$$v_0t- \frac {1}{2}(gt^2) = v_0(t-2)- \frac {1}{2}g(2) t-2)^2$ Resolution $t = \frac {v_0}{g}+1=5.09$sec Replacing that value in any equation above give height value $H = 40 \times 5.09- \frac {1}{2} (9.8 \times 5.09 \times 5.09) =76.6 m The corresponding speed can be found using the first set of each equation 1 and 2 For the first object $v_1 = v_0 - gt =40-(9.8 \times 5.09)=-$9,882 m/sec For another object $v_2=v_0 - g(t-2) =40-9.8(5.09-2)=9,718$m/sec Question 4. The particle moves along the x-axis according to the following equation $x=pt(1-qt)$ where p and q are constants and p > 0 , q>0. Let it also be as a unit vector over x-axis a. Find out the speed and vector of acceleration for particle b. At what time it will reach its starting point and what the total solution distance will be. The equation of motion is given by $x=pt(1-qt)$ Speed = $\frac {dx}{dt}$ So $v=p(1-2qt)$ Acceleration = $\frac {dv}{dt}$ So $a=-2pqt$ Therefore, Speed Vector= $p(1-2qt) \mathbf{i}$ Acceleration vector=$-2pqt \mathbf{i}$ b. Jednadžbu gibanja daje $x=pt(1-qt)$ na t=0,x=0 i $t= \frac {1}{q}$,x=0 Tako će na t=1/q , doći do nje početni položaj Jednadžba brzine $v=p(1-2qt)$ Iz jednadžbe možemo vidjeti da za $ t < \frac {1}{2q}$, $v>0$ tako speed = $ |v| = p (1-2qt)$ Na $t = \frac {1} {2q}$,$v = 0 $ za $t > \frac {1} {2q}$,$v < 0 $ tako speed = $ |v| = p 2qt-1)$ Prijeđena udaljenost od vremena t=0 do t=1/2q $s_1=\int_{0}^{\frac {1}{2q}} p(1-2qt)dt = \frac {p}{4q}$ Udaljenost prijeđena od vremena t=1/2q do t=1/q $s_2= \int_{\frac {1}{2q}}^{\frac {1}{q}} p(2qt -1)dt = \frac {p}{4q}$ Tako je ukupna prijeđena udaljenost=$ \frac {p}{4q} + \frac {p}{4q} =\frac {p{2q}. The balloon rises from rest on the ground vertically upwards with constant acceleration g/8.The object blows out of the balloon when it rises to a height of h.Find out the time the object took to get to the ground. Solution Because the balloon starts from rest, the balloon speed when raised to h height gives $v^2= u^2+2gH$ $v^2=0 + 2 \times \frac {g}{8} \times h$$v=\frac {1}{2} \sqrt {gh}$ When the object has fallen, it has the speed of that same speed in the ascending direction. Taking the ascending direction as positive, $-h = \sqrt {gh} t- \frac {1}{2} gt^2$ Where h is as negative as we took upwards as a positive wasg, t is the time that was taken to get to the ground and acceleration is -g as gravity is active down Equation can be written in the format $gt^2-\sqrt {gh} t-2h=0$ Solving this equation and taking a positive root $t=2 \sqrt {\frac {h}{g}}$ Question 6. A police motorcycle moves along the highway at $v.m$300 fired a bullet at a motorcycle thief speeding in. same direction as $v_t (v_t > v_m)$. If the muzzle speed is $v_b(v_b > v_t - v_m)$ find out the following a. What is the speed of the bullet relative to the observer sitting on the ground? B. At what speed will the bullet hit the thief c. What will be the speed of the bullet compared to another police motorcycle moving in the same direction at speed v Solution Speed of the Police Motorcycle w.r.t ground = v_m Bullet speed w.r.t to Motorcycle or Muzzle= v_b Bullet speed w.r.t ground=Bullet speed w.r.t to motorcycle + motorcycle speed w.r.t to ground So bullet speed w.r.r.t to ground= $v_b + v_m$ Speed with a bullet hit the thief=Bullet speed w.r.t to the ground - Speed thief w.r t ground = $v_b + v_m- v_t$ Bullet speed w.r t another motorcycle=Bullet speed w.r.ground ground t - Motorcycle speed = $v_b + v_m - v$ Question 7. The nut comes loose from the screw at the bottom of the elevator as the elevator moves along the shaft at 3 m/s. The nut hits the bottom of the axle in 2 sec Find out the following a. How far from the bottom of the shaft was the elevator when the queen fell off? B. How much above the bottom of the pane was a .25 sec nut after the fall.? c. How far above the bottom of the shaft was the elevator when the nut fell to the ground? d. At what height above the bottom of the axle, the nut has zero speed after the fall? e. what is the total distance that the nut in it was traveled after it fell off? Given g=9.8 m/s2 Solution a. Here the queen initially has the speed of the elevator when it fell off. Let's take the upward course as a positive direction Then $v_0=3 $m/s to t=0 and $a=-g=-9.8$ m/s2 Now it's time to hit the ground t=2 So $H= v_0t+ \frac v_0t {1}{2}gt^2$$H=3 \times 2 + \frac {1}{2} \times (-9.8) \times 2 \times 2 =-13.6$ m So the bottom of the shaft was 13.6 m below when the nut fell out of the elevator. The elevator was 13.6 m above the pane when the nut fell off b. Now let's calculate the nut shift to t = .25 $H = v_0t + \frac {1}{2}gt^2 $ Replace the values as the same above H = 44m So the nut was above its starting point. That makes sense if we remember the initial speed as upwards. Thus, the total height above the bottom will be =.44+13.6=14 m c. Now the elevator's perspective v = 3m/sec up So it will move 6m upwards in 2 sec. Thus, the total height above the ground will be =6+13.6 =19.6 m d. $v^2=u^2+2ah$ From a walnut perspective u=3m/sec a=-g=-9.8m/s2 to v=0 $u^2=2gH$ or H=3*3/2*9.8 =.45m So Total height above the bottom of the axle=13.6+.45=14.1m e. Total distance traveled by nut=.45+.45+13.6=14.5m Question 8. The displacement of the body x(in meters) varies over time t (in sec) as $x =- \frac {2}{3}t^2 +16t+2$ found after a. What is the speed at t =0.t=1 b. What is acceleration to t =0 c. What is the shift to t = 0 d. What will the shift when it comes to rest e. How long does it take to rest. Solution with respect to $x=- \frac {2}{3}t^2 (1) Speed=$ \frac {dx}{dt}=\frac {-4}{3} t+16$ so speed at t=0 =16 and speeds at t=1 =$\frac {-4}{3} +1616=\frac {44}{3}$ Acceleration is given as =$ \frac {d^2x}{dt^2}=- \frac {4}{3}$ so that the acceleration is time independent and can be constantly shifted to t=0 can be found by simply replacing the t=0 value in equation (1) So Move to(t=0)=2 Now $v=- \frac {4}{3}t+16$ when v=0 then $t= \frac {4}{3}$ sec Shift can be found by replacing the value t=4/3 in equation (1) $=- \frac {32}{27} + \frac {64}{3} +2$ $= \frac {(-32+576+54)}{27}=\frac {598}{27}$ m Question 9. The male runs at 4 m/s to overtake the standing bus. When it is 6 m behind the door on t = 0,the bus moves forward and continues with a constant acceleration of 1.2 m / s2 find the following a. How long does it take for a man to get gate b. if initially he's 10m behind the door,will running at the same speed ever catch up with the bus? Solution On t =0 let the position of man be the origin $x_{m0}=0$. The bus doors are then at $x{b0}=6$ m Motion equation for man and bus $x_m=x_{m0}+v_{m0}+ \frac {1}{2}a_m t^2$$x_b=x_ $x <6>{b0}+v_{b0}+\frac {1}{2}a_b t^2$ Now days are $v_{m0}=4$ m/s , $v_{b0}=0$, $a $x <0>_m=$0, $a_b=$1.2 m/s2 So $x_m=4t$$x_b=6+.6t^2$ When a man catches a bus $x_m=x_b $4t = 6 + 6t^2 $ or $3t^2-20t + 30 = 0 $ Solving square formula t = 2.3 and 4.4 s Here are two positive solutions . That can be explained as. The first time $t_1=$2.3 matches his first coming to the door. This is the right answer. However the equation we solved does not know that they will stop running and board the bus, the equation continues to work at a constant rate. He walks past the bus like that; but as the bus accelerates, it eventually builds a higher speed than a human and will catch it at 4.4 sec if the starting position of the bus is 10 m, and then $x_m=x_b $ gives $3t^2-20t +50=0$ which has only complex roots so that there are no real-time outputs where a man is co-reaching a bus connection to this page by copying the following textKinematics worksheet Also read class 11 Mathematics Class 11 Physics Class 11 Chemistry Class 11 Chemistry Class 11