Godalming College

Mechanics 2 – "suvat" Equations

Please **complete** this homework by _____. Start it early. If you can't do a question you will then have time to ask your teacher for help or go to a drop in session.

Section 1 – Review of previous topics. Please complete all questions.

A train is travelling at a steady speed of $30ms^{-1}$ along a straight track. As it passes a signal box, it begins to decelerate steadily, coming to rest at a station in 20 seconds. The train remains stationary for 20 seconds, then sets off back in the opposite direction with an acceleration of $0.375ms^{-2}$. It reaches a speed of $15ms^{-1}$ as it passes the signal box.

a) Draw a velocity-time graph to show the motion of the train after it first passes the signal box.
b) Find the train's deceleration as it comes into the station.
c) Find the distance between the signal box and the station.
d) Find the time it takes to return to the signal box.

Section 2 – Consolidation of this week's topic. Please complete all questions.

1) State, giving a reason, which of the five variables used in the "suvat" equations is not a vector. **(2 marks)**

2) Use the appropriate "suvat" equations to find
   a) s, given $u = 70ms^{-1}$, $a = -3ms^{-2}$, $t = 10s$
   b) s, given $u = 15ms^{-1}$, $v = 29ms^{-1}$, $t = 9s$
   c) a, given $u = 3ms^{-1}$, $v = 38ms^{-1}$, $t = 7s$
   d) s, given $u = 22ms^{-1}$, $a = 6ms^{-2}$, $v = 28ms^{-1}$
   e) t, given $v = -28ms^{-1}$, $a = -7ms^{-2}$, $s = 0m$ **(10 marks)**

3) A particle has an initial velocity of $24ms^{-1}$ and a constant acceleration of $5ms^{-2}$.
   a) Find its velocity after it has travelled 10m.
   b) Find the time taken to travel 10m. **(4 marks)**

4) A particle has an initial velocity of $60ms^{-1}$ and a constant deceleration of $8ms^{-2}$.
   a) Find its velocity after 10 seconds.
   b) Find the time at which it is at instantaneous rest. **(4 marks)**

5) Starting from rest, a cyclist wins a sprint race in 40 seconds. If she has a constant acceleration of $0.5ms^{-2}$,
   a) How fast was she travelling when she crossed the finishing line?
   b) What distance was the race? **(4 marks)**

6) A particle with an initial velocity of $5ms^{-1}$ and a constant acceleration of $3ms^{-2}$ takes T seconds to travel 84m. Show that $3T^2 + 10T - 168 = 0$ and hence find the value of T.

(3 marks)

7) A car accelerates uniformly from rest to $60kmh^{-1}$ in 8 seconds, then maintains a steady speed.
   a) How long does it take to travel 200m?
   b) How long does it take to travel 1km? **(4 marks)**

8) Particles A and B are at rest at either end of a 100m track. They set off instantaneously towards each other with constant accelerations of $6ms^{-2}$ and $2ms^{-2}$ respectively.
   a) How far has A travelled when they meet?
   b) After what time do they meet?
   c) At what speed is each particle travelling when they meet? **(6 marks)**

9) A ball is launched along a straight line with an initial velocity of $13ms^{-1}$ and a constant acceleration of $-2ms^{-2}$. At what times is the ball 30m from its starting point? **(5 marks)**

Total for section 2: 42 marks

Section 3 – Extension question. If you are aiming for a top grade, you should attempt this question.

A cyclist passes a garage, a restaurant and a library, in that order, along a straight road, maintaining a constant acceleration of $0.15ms^{-2}$ throughout and passing the library at $9ms^{-1}$. The library is 240m from the restaurant. The cyclist takes twice as long to cycle from the restaurant to the library as she does to cycle from the garage to the restaurant. How far is the library from the garage? (NB You are not told that the cyclist starts from rest.)