KINEMATICS

AS Unit 2: Applied Mathematics A

Section B: Mechanics

WJEC past paper questions: 2010 – 2017

Total marks available 112 (approximately 2 hours 15 minutes)

1. A car travels along a straight road. The car starts at rest from the point A and accelerates for 30s at a constant rate until it reaches a speed of $25ms^{-1}$. The car continues at $25ms^{-1}$ for Ts until it approaches a built up area when a constant retardation is applied for 10s until the car slows to a speed of $15ms^{-1}$ as it passes the point B. The distance AB is 8km.
   a) Sketch a velocity-time graph for the journey between A and B. (4)
   b) Find the total time of the journey from A to B. (5)
   (January 10)

2. A car is travelling along a straight road ABC with uniform acceleration $a ms^{-2}$. The distance AB is 95m. The time taken by the car to travel from A to B is 5s and the time taken to travel from B to C is 2s. At A the speed of the car is $u ms^{-1}$ and at C, its speed is $29.8ms^{-1}$. Find the value of a and the value of u. (7)
   (Summer 10)

3. A train, starting from rest at station A, travels on a straight horizontal track towards station B. On leaving station A, the train accelerates at a constant rate for 60s until it reaches a speed of $30ms^{-1}$ at a point X. The train then continues at $30ms^{-1}$ to a point Y when a constant deceleration is applied for 40s, so that the speed of the train as it passes station B is $15ms^{-1}$. The distance between stations A and B is 24km.
   a) Draw a sketch of the velocity-time graph showing the motion of the train between A and B. (4)
   b) Find the acceleration of the train and the distance travelled whilst the train was accelerating. (4)
   c) Find the total time for the train to travel from A to B. (4)
   (January 11)

4. The points A, B, and C lie, in that order, on a straight horizontal road. A car travels on the road with constant acceleration $a$ms^{-2}. When the car is at A, its speed is $u$ms^{-1}. The distance AB is 10m and the car takes 2s to travel from A to B. The car takes 7s to travel from A to C and its speed at C is 17ms^{-1}.
   a) Find the value of u and the value of a. (7)
   b) Draw a velocity-time graph for the motion of the car between A and C. (2)
   c) Calculate the distance AC. (2)

(Summer 11)

5. A car moves with constant acceleration along a straight horizontal road. It passes the point O with speed 12ms^{-1}. It then passes point A, 4 seconds later, with speed 32ms^{-1}.
   a) Show that the acceleration of the car is 5ms^{-2}. (3)
   b) Determine the distance OA. (3)
   c) The point M is the midpoint of OA. Calculate the speed of the car as it passes M. Give your answer correct to one decimal place. (3)

(January 13)

6. A vehicle moves along a straight horizontal road. At time t=0s, the vehicle passes a point A and is moving with speed 20ms^{-1}. It continues with this constant speed of 20ms^{-1} for 8s. The vehicle then slows down with uniform deceleration for 10s so that at time t=18s, the speed of the vehicle is 6ms^{-1}. This speed is maintained until the vehicle reaches the point B at time t=40s.
   a) Sketch a velocity-time graph for the motion of the vehicle between A and B. (3)
   b) Find the magnitude of the deceleration between t=8 and t=18. (3)
   c) Calculate the distance AB. (3)

(Summer 13)

7. A vehicle travels on a straight horizontal road. As it passes a point A at time t=0, it is moving with a constant velocity of 18ms^{-1}. It continues travelling at this velocity for 48 seconds. It then decelerates at a constant rate for the next 12s until it passes a point B with velocity 3ms^{-1}.
   a) Sketch a velocity-time graph for the motion of the vehicle between A and B. (2)
   b) Find the magnitude of the deceleration of the vehicle. (2)
   c) Determine the distance between A and B. (3)

(January 14)

8. A vehicle travels along a straight horizontal road. As it passes a point A with speed 10ms^{-1}, it accelerates at a constant rate for 21s until it reaches a speed of 24ms^{-1}. It then travels at this constant speed of 24ms^{-1} for Ts before decelerating at a uniform rate, coming to rest at a point B. The time taken to decelerate to rest is 16s.
   a) Calculate the magnitude of the acceleration of the vehicle. (3)
   b) Determine the distance taken for the vehicle to decelerate to rest. (3)
   c) Draw a sketch of the velocity-time graph for the motion of the vehicle between A and B. (4)
   d) Given that the distance between A and B is 15 000m, find the value of T. (4)

(Summer 14)

9. A bus travels on a straight horizontal road. It leaves bus stop A starting from rest and accelerates at a constant rate for 10s until it reaches a speed of $20ms^{-1}$. It then continues to travel at this constant speed and, *T* seconds after it stops accelerating, it passes a point B.
   a) Sketch a velocity-time graph for the motion of the bus between A and B. (3)
   b) Find the acceleration of the bus. (2)
   c) Determine an expression for the distance between A and B in terms of *T*. (3)
   d) A car leaves A 5 seconds after the bus has left. It starts from rest and travels with a constant acceleration of magnitude $2ms^{-2}$. Given that the car overtakes the bus at the point B, find the distance between A and B. (5)

   (Summer 15)

10. A man drives a car along a straight road. As he passes the point A, the car is travelling at a constant speed of $30ms^{-1}$. He continues at the speed of $30ms^{-1}$ for 5 minutes until he approaches a built up area, when he applies a constant deceleration for 20 seconds until the car slows down to a speed of $16ms^{-1}$. On reaching the speed of $16ms^{-1}$, he sees his destination point B and applies a constant deceleration for 8s until the car stops at B.
    a) Sketch a velocity-time graph for the journey between A and B. (4)
    b) Find the distance between A and B. (4)

    (Summer 16)

11. A car of mass 800kg is travelling on a horizontal road. It experiences a resistance to motion which is constant throughout the journey. The car accelerates from rest under a constant tractive force of 300N exerted by its engine. After 50 seconds, the car reaches a speed of $15ms^{-1}$.
    a) Determine the magnitude of the acceleration of the car. (3)
    b) Calculate the magnitude of the constant resistance to motion. (3)
    c) When the car reaches the speed of $15ms^{-1}$, the engine is switched off and the car is brought to rest by a constant breaking force. The total distance covered by the car for the **whole** journey is 500m. Find the constant force exerted by the brakes. (7)

    (Summer 17)