Old Exam Questions – Old Course

Travel Graphs

(M1 Winter 2006)

3. At time $t = 0$, Car A, which is travelling at a constant speed of 20 ms^{-1} on a straight horizontal road, overtakes Car B travelling at a speed of 15 ms^{-1}. Car B immediately accelerates uniformly and, T seconds later, it overtakes Car A, which has kept its speed at 20 ms^{-1}. The distance travelled by each car in time T is 600 m.

(a) Show that $T = 30$. [1]

(b) Calculate the magnitude of the acceleration of car B. [3]

(c) Find the speed of car B at the moment it overtakes car A. [3]

(d) On the same diagram, draw velocity-time graphs for A and B. Find the time when the speeds of cars A and B are equal. [4]

(M1 Summer 2006)

2. A train, starting from rest from station A, travels along a straight horizontal track until it stops at station B, which is 2400 m from A. Initially, the train accelerates at a uniform rate of 0·4 ms^{-2} until it reaches a speed of 16 ms^{-1}. It then maintains this speed of 16 ms^{-1} for T s, before decelerating uniformly to rest in 20 s.

(a) Calculate the time taken for accelerating. [2]

(b) Draw a sketch of the v-t graph for the journey from A to B. [4]

(c) Find the value of T. [4]

(M1 Winter 2007)

3. The mass of a lift is 5600 kg. The lift starts from rest and descends with uniform acceleration for 8 s until it reaches a speed of V ms^{-1}. The tension in the lift cable is 50 400 N.

(a) Show that the magnitude of the acceleration of the lift is 0·8 ms^{-2}. [2]

(b) Find the value of V. [2]

The lift maintains this constant speed of V ms^{-1} for 25 s before decelerating uniformly to rest. The **total** time for descent is 40 s.

(c) Draw a sketch of the velocity-time graph of the motion. [3]

(d) Calculate the total distance that the lift descends. [3]

(e) Find the maximum tension in the lift cable during the motion. [3]

(M1 Summer 2007)

1. A train is travelling along a straight horizontal track and its speed as it passes a signal box A is $5\,\text{ms}^{-1}$. Immediately after passing A the train accelerates at a rate of $0{\cdot}6\,\text{ms}^{-2}$ for 25 s; it then travels at a constant speed of $V\,\text{ms}^{-1}$ before it finally decelerates uniformly for 30 s, coming to rest at station B. The total time taken by the train to travel from A to B is 12 minutes.

(a) Calculate the value of V. [3]

(b) Sketch a velocity-time graph for the journey from A to B. [3]

(c) Determine the magnitude of the deceleration of the train in the last 30 s of the journey. [2]

(d) Find the distance between A and B. [3]

(M1 Winter 2008)

1. A vehicle, moving with uniform acceleration along a straight horizontal road, has its speed measured at points A and B on the road. At point A, its speed is $12\,\text{ms}^{-1}$ and at point B, its speed is $20\,\text{ms}^{-1}$. The distance AB is 1000 m.

(a) Show that the acceleration of the vehicle is $0{\cdot}128\,\text{ms}^{-2}$. [3]

(b) Find the time taken for the vehicle to move from A to B. [3]

(c) Find the speed of the vehicle 25 s after passing A. [3]

(d) Calculate the distance from A of the vehicle 30 s after it passes A. [3]

(e) Sketch a velocity-time graph for the journey from A to B. [2]

(M1 Summer 2008)

1. A train is travelling along a straight horizontal track. As the train passes point A, its speed is $18\,\text{ms}^{-1}$ and immediately after passing point A, it decelerates uniformly for 9 s until its speed is $12\,\text{ms}^{-1}$. The train then accelerates at $0{\cdot}5\,\text{ms}^{-2}$ until it reaches a speed of $22\,\text{ms}^{-1}$. The train maintains the speed of $22\,\text{ms}^{-1}$ for the next 31 s at which time it passes the point B.

(a) Find the time taken for the acceleration. [2]

(b) Draw a sketch of the velocity-time graph for the journey between A and B. [4]

(M1 Winter 2009)

2. A paratrooper jumps out of a stationary helicopter so that his initial velocity is $2\,\text{ms}^{-1}$ vertically downwards. He falls freely under gravity for 1·5 s, then his parachute opens and he descends vertically with uniform retardation for a further 22·5 s. His speed is zero as he reaches the ground.

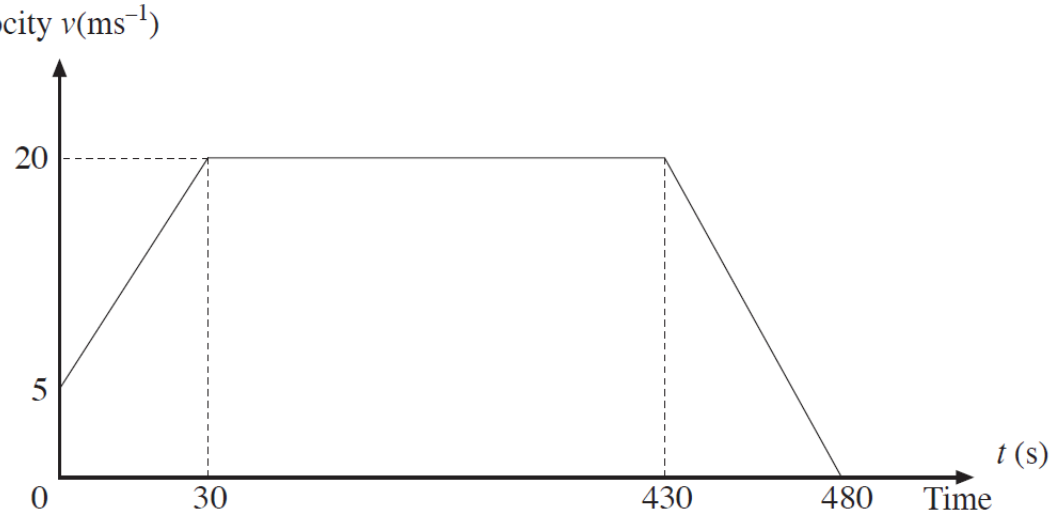
(a) Calculate the speed of the paratrooper just before his parachute opens. [3]

(b) Draw a sketch of the velocity-time graph for the paratrooper's descent. [3]

(c) Calculate the height of the paratrooper above the ground when he jumped out of the helicopter. [3]

(M1 Summer 2009)

4.



The diagram, which is not drawn to scale, is a sketch of the velocity-time graph of a train over a period of 480 s.

(a) Find the acceleration of the train at $t = 10$ and at $t = 420$. [3]

(b) Find the velocity of the train at $t = 20$. [2]

(c) Calculate the distance travelled from $t = 0$ to $t = 480$. [4]

(M1 Winter 2010)

5. A car travels along a straight road. The car starts at rest from the point A and accelerates for 30 s at a constant rate until it reaches a speed of $25\,\text{ms}^{-1}$. The car continues at $25\,\text{ms}^{-1}$ for T s until it approaches a built-up area when a constant retardation is applied for 10 s until the car slows to a speed of $15\,\text{ms}^{-1}$ as it passes the point B. The distance AB is 8 km.

(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]

(M1 Summer 2010)

2. An express lift in a skyscraper travels non-stop from the ground floor to the top floor. For the first 15 s of its journey, the lift accelerates uniformly from rest. It then travels at a constant speed of $2{\cdot}7\ \text{ms}^{-1}$ for 90 s before finally decelerating uniformly to rest. The total time for the journey is 2 minutes.

(a) Sketch a velocity-time graph for the motion of the lift. [3]

(b) Calculate the distance travelled by the lift. [3]

A woman, of mass 75 kg, is standing on the floor of the lift during its journey.

(c) Calculate the reaction exerted by the floor of the lift on the woman when the lift is accelerating. [4]

8. A car is travelling along a straight road ABC with uniform acceleration $a\ \text{ms}^{-2}$. The distance AB is 95 m. The time taken by the car to travel from A to B is 5 s and the time taken to travel from B to C is 2 s. At A the speed of the car is $u\ \text{ms}^{-1}$ and at C, its speed is $29{\cdot}8\ \text{ms}^{-1}$. Find the value of a and the value of u. [7]

(M1 Winter 2011)

1. 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 60 s until it reaches a speed of $30\ \text{ms}^{-1}$ at point X. The train then continues at $30\ \text{ms}^{-1}$ to a point Y when a constant deceleration is applied for 40 s, so that the speed of the train as it passes station B is $15\ \text{ms}^{-1}$. The distance between stations A and B is 24 km.

(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]

(M1 Summer 2011)

3. The points A, B and C lie, in that order, on a straight horizontal road. A car travels on the road with constant acceleration $a\ \text{ms}^{-2}$. When the car is at A, its speed is $u\ \text{ms}^{-1}$. The distance AB is 10 m and the car takes 2 s to travel from A to B. The car takes 7 s to travel from A to C and its speed at C is $17\ \text{ms}^{-1}$.

(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]

(M1 Winter 2012)

1. A lift is moving upwards. It accelerates from rest with uniform acceleration $0{\cdot}4\,\text{ms}^{-2}$ until it reaches a speed of $2\,\text{ms}^{-1}$. It then travels at this constant speed of $2\,\text{ms}^{-1}$ for 17 s before decelerating uniformly to rest in 8 s.

(a) Calculate the time taken for the lift to reach the speed of $2\,\text{ms}^{-1}$. [3]

(b) Sketch a velocity-time graph for the lift's journey. [3]

(c) Find the distance travelled by the lift during the journey. [3]

(d) A man, of mass 70 kg, is standing in the lift during its journey.
Calculate the greatest value of the reaction exerted by the floor of the lift on the man during the journey. [4]

(M1 Summer 2012)

7. A skydiver drops from rest from a hot air balloon and falls vertically under gravity for 5 s before his parachute opens. After the parachute has opened, his speed of descent reduces with uniform retardation for a further 10 s until his speed is $4\,\text{ms}^{-1}$. He then continues to travel at a constant speed of $4\,\text{ms}^{-1}$ until he reaches the ground 2 minutes after he left the hot air balloon.

(a) Calculate the speed of the skydiver just before his parachute opens. [3]

(b) Draw a sketch of the velocity-time graph for the skydiver's descent. [4]

(c) Determine the height of the skydiver above the ground when he drops from the hot air balloon. [3]

(M1 Summer 2013)

1. A vehicle moves along a straight horizontal road. At time $t = 0$ s, the vehicle passes a point A and is moving with a speed of $20\,\text{ms}^{-1}$. It continues with this constant speed of $20\,\text{ms}^{-1}$ for 8 s. The vehicle then slows down with uniform deceleration for 10 s so that at time $t = 18$ s, the speed of the vehicle is $6\,\text{ms}^{-1}$. This speed is maintained until the vehicle reaches the point B at time $t = 40$ s.

(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]

(M1 Winter 2014)

1. 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 $18\,\text{ms}^{-1}$. It continues travelling at this velocity for 48 seconds. It then decelerates at a constant rate for the next 12 s until it passes a point B with velocity $3\,\text{ms}^{-1}$.

(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]

(M1 Summer 2014)

2. A vehicle travels along a straight horizontal road. As it passes point *A* with speed $10\,\text{ms}^{-1}$, it accelerates at a constant rate for 21 s until it reaches a speed of $24\,\text{ms}^{-1}$. It then travels at this constant speed of $24\,\text{ms}^{-1}$ for T s before decelerating at a uniform rate, coming to rest at a point *B*. The time taken to decelerate to rest is 16 s.

(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 15 000 m, find the value of T. [4]

(M1 Summer 2015)

6. A bus travels on a straight horizontal road. It leaves bus stop *A* starting from rest and accelerates at a constant rate for 10 s until it reaches a speed of $20\,\text{ms}^{-1}$. 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 $2\,\text{ms}^{-2}$. Given that the car overtakes the bus at the point *B*, find the distance between *A* and *B*. [5]

(M1 Summer 2016)

4. A man drives a car along a straight road. As he passes the point *A*, the car is travelling at a constant speed of $30\,\text{ms}^{-1}$. He continues at the speed of $30\,\text{ms}^{-1}$ 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 $16\,\text{ms}^{-1}$. On reaching the speed of $16\,\text{ms}^{-1}$, he sees his destination point *B* and applies a constant deceleration for 8 s 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]