**1** A car is initially travelling with a constant velocity of 15 m s−1 for *T* s. It then decelerates at a constant rate fors, reaching a velocity of 10 m s−1. It then immediately accelerates at a constant rate fors reaching a velocity of 20 m s−1.

**a** Sketch a velocity–time graph to illustrate the motion. **(3 marks)**

**b** Given that the car travels a total distance of 1312.5 m over the journey described, find the value of *T*. **(4 marks)**

**2** A racing car starts from rest at the point *A* and moves with constant acceleration.of 11 m s−2 for 8 s. The velocity it has reached after 8 s is then maintained for *T*s. The racing car then decelerates from this velocity to 40 m s−1 in a further 2 s, reaching point *B*.

**a** Sketch a velocity–time graph to illustrate the motion of the racing car. Include the top speed of the racing car in your sketch. **(5 marks)**

**b** Given that the distance between *A* and *B* is 1404 m, find the value of *T*. **(3 marks)**

**3** A cyclist is descending down a mountain with constant acceleration. She passes through three checkpoints, *P*, *Q* and *R*, with velocity 6 m s−1, *x* m s−1, and 20 m s−1 repsectively. The time to taken to travel from *P* to *R* is 35 s.

**a** Find the acceleration of the cyclist. **(2 marks)**

Given that , where *t*1 s is the time taken to travel from *P* to *Q* and *t*2 s is the time taken to travel from *Q* to *R*.

**b** Find the value of *x*. **(5 marks)**

**c** Find the distance between *P* and *R*. **(2 marks)**

**4** A particle *P* passes through point *A* with velocity 2.8 m s−1 and constant acceleration 0.12 m s−2. Three seconds later a second particle *Q* passes through *A* with velocity 2.4 m s−1 and constant acceleration 0.2 m s−2.

**a** Write down expressions for the displacements of *P* and *Q* from *A*, in terms of *t*, where *t* s is the time after *P* passed through *A*, **(4 marks)**

**b** Show that, when the particles meet,  **(3 marks)**

**c** Find the distance from *A* when the two particles meet. **(5 marks)**

**5** A ball is thrown vertically upwards with a speed of 16 m s−1 from a point 80 m above the ground.

**a** Find the speed with which the ball strikes the ground. **(4 marks)**

**b** Find the total time that the ball is more than 85 m above the ground. **(6 marks)**

When the ball strikes the ground it rebounds with of the speed with which it strikes the ground.

**c** Find the greatest height reached by the ball when it rebounds from the floor. **(4 marks)**