ASSIGNMENT TEST 6.

1. A car of mass 1000 kg is moving along a straight horizontal road. The resistance to motion is modelled as a constant force of magnitude R newtons. The engine of the car is working at a constant rate of 12 kW. When the car is moving with speed $15\,\text{m s}^{-1}$, the acceleration of the car is $0.2\,\text{m s}^{-2}$.

a Show that $R = 600$. **(4)**

The car now moves with constant speed $U\,\text{m s}^{-1}$ downhill on a straight road inclined at θ to the horizontal, where $\sin\theta = \frac{1}{40}$. The engine of the car is now working at a rate of 7 kW. The resistance to motion from non-gravitational forces remains of magnitude R newtons.

b Calculate the value of U. **(5)**

2. A motorcycle of mass 600 kg moves along a straight road at a speed of $v\,\text{m s}^{-1}$. The total resistances to motion of the motorcycle are modelled as a variable force of magnitude $(500 + 2v^2)$ N.

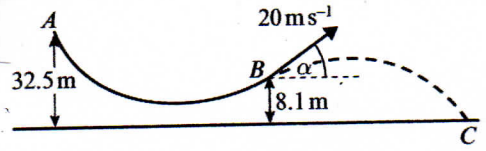
Calculate the power that must be generated by the motorcycle engine to maintain a constant speed of $15\,\text{m s}^{-1}$

a when the road is horizontal **(4)**

b when the road slopes downhill at an angle of 5° to the horizontal. **(5)**

TOTAL 34 MARKS

3.



In a ski jumping competition, a skier of mass 80 kg moves from rest at a point A on a ski slope. The skier's path is an arc AB. The starting point A of the slope is 32.5 m above horizontal ground. The end B of the slope is 8.1 m above the ground. When the skier reaches B she is travelling at $20\,\text{m s}^{-1}$ and moving upwards at an angle α to the horizontal, where $\tan\alpha = \frac{3}{4}$, as shown in the figure. The distance along the slope from A to B is 60 m. The resistance to motion while she is on the slope is modelled as a force of constant magnitude R newtons.

a By using the work–energy principle, find the value of R. **(5)**

On reaching B, the skier then moves through the air and reaches the ground at the point C. The motion of the skier in moving from B to C is modelled as that of a particle moving freely under gravity.

b Find the time the skier takes to move from B to C. **(5)**

c Find the horizontal distance from B to C. **(2)**

d Find the speed of the skier immediately before she reaches C. **(4)**