Unit Review

Specification: AQA 7367: MC1, MC2, MC3, MC7 · Edexcel 9FM0: FM1 2.1 Work, energy and power

HOMEWORK Consolidation

1 A crate of mass 25 kg rests on a smooth horizontal floor. A force of 120 N, acting at $30°$ above the horizontal, pulls it 10 m from rest.
(a) Find the work done by the force.
(b) Find the speed of the crate.
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2 A bullet of mass 20 g moves horizontally at 400 m s^{-1} when it hits a fixed block of wood. It comes to rest after moving 15 cm into the block. Find the mean resistance of the wood.
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3 A ball is kicked from ground level with speed 18 m s^{-1} at $50°$ above the horizontal. Ignore air resistance. Take $g = 9.8$ m s^{-2}. Find the speed of the ball when it is 6 m above the ground.
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4 A pendulum bob on a light inextensible string of length 1.5 m passes through its lowest point with speed 4 m s^{-1}. Ignore air resistance. Take $g = 9.8$ m s^{-2}. Find the greatest angle that the string makes with the vertical.
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5 A block of mass 5 kg is released from rest on a rough plane inclined at $28°$ to the horizontal. It slides 4 m down the plane and reaches a speed of 4.2 m s^{-1}. Take $g = 9.8$ m s^{-2}. Find the coefficient of friction.
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6 A child of mass 30 kg slides from rest down a playground slide 4 m long. The bottom of the slide is 2.4 m below the top. A constant resistance of 35 N acts along the slide. Take $g = 9.8$ m s^{-2}. Find the speed of the child at the bottom.
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7 A train of mass 300 tonnes has a maximum speed of 40 m s^{-1} on a level track when its engine works at 1.2 MW. The resistance is constant.
(a) Find the resistance.
(b) Find the acceleration of the train when its speed is 25 m s^{-1}.
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8 A van of mass 1600 kg works at 24 kW on a level road. The resistance is $15v$ N when its speed is v m s^{-1}.
(a) Find the maximum speed of the van.
(b) Find its speed when its acceleration is 0.25 m s^{-2}.
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9 A lift of mass 600 kg carries four people of total mass 300 kg. It rises 24 m at a constant speed in 16 s. Ignore any resistance to motion. Take $g = 9.8$ m s^{-2}.
(a) Find the gain in gravitational potential energy.
(b) Find the power of the lift motor.
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10 A ball of mass 0.3 kg is thrown vertically upwards with speed 15 m s^{-1}. It rises 10 m before it stops. Take $g = 9.8$ m s^{-2}.
(a) Find the work done against air resistance on the way up.
(b) Assume the same amount of work is done against air resistance on the way down. Find the speed of the ball when it returns to its starting point.
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11 *AQA-style*. A car of mass 1100 kg moves up a straight hill inclined at $5°$ to the horizontal. Its engine works at a constant rate of 30 kW. The car passes the point A at 15 m s^{-1} and, 22 s later, passes the point B at 20 m s^{-1}. The distance AB is 400 m. Take $g = 9.8$ m s^{-2}.

(a) Find the work done by the engine between A and B. [1 mark]

(b) Find the gain in kinetic energy and the gain in gravitational potential energy between A and B. [3 marks]

(c) Find the mean resistance to the motion of the car between A and B. [3 marks]

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12 *Edexcel-style*. A particle P of mass 2 kg is projected with speed 7 m s^{-1} up a line of greatest slope of a rough plane inclined at an angle α to the horizontal, where $\tan\alpha = 3/4$. The coefficient of friction between P and the plane is 0.8. Take $g = 9.8$ m s^{-2}.

(a) Use the work–energy principle to find the distance P moves up the plane before it comes to rest. [4 marks]

(b) Determine whether P remains at rest. [2 marks]

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