WORK

1. Find the work done when a box is pushed 10 m across a floor with a constant speed against a frictional resistance of 24 N.

2. A force of 20 N acts on a 3 kg roller skate initially at rest on a frictionless table. The skate travels 5 m while the force acts.

    (a) How much work is done?
    (b) What is the final speed of the skate?

3. How much work is done when a 250 N force moves a mass of 12 kg a distance of 15 m in the direction of the force?

4. How much work is done in changing the velocity of a vehicle of mass 2 000 kg from 10 ms^{-1} to 40 ms^{-1} if the change occurs in 200 m?

5. How much work is done in stopping a vehicle of mass 5 000 kg in 100 m if the brakes apply a force of 1 000 N?

6. A body of mass 50 kg moving with a speed of 10 ms^{-1} is brought to rest by a constant force in a distance of 5.0 m. Calculate the work done by the force.

7. A force acts on a stationary vehicle of mass 3 000 kg for 20 seconds. In that time the vehicle moves 50 m and its velocity increases to 5 ms^{-1}.

    (a) What force acts on the vehicle?
    (b) How much work is done by the force?

8. How much work does a man who weighs 60 kg do against gravity when he climbs a 700 m hill?

9. How much work is done in pumping 4 000 litres of water from a depth of 15 m? The mass of a litre of water is 1 kg. (1 litre = 1 kg)

10. 100 J of energy are used to move a stationary box of mass 10 kg through a distance of 15 m in 5 seconds. Find the force used.

CHALLENGE: A 1 kg mass is slowly raised to a height of 10 m in 20 seconds. How much extra work is required if the lifting occurs in 1 second.
(2)

ANSWERS

1. 240 J

2. (a) 100 J
   (b) 8.16 ms^{-1}

3. 3 750 J

4. 1 200 000 J or 1.2 x 10^6

5. 1 000 000 J

6. 2 500 J

7. (a) 750 N
   (b) 37 500 J

8. 412 000 J

9. 588 000 J

10. 6.67 N

POTENTIAL ENERGY

(Use $g = 9.8$ m/s^2)

1. An oil drum is rolled onto a utility 1 m above the ground. The potential energy acquired by the drum is 2 000 J. Find the mass of the drum.

2. An artificial satellite (mass 20 kg) reaches a height of 100 km above the surface of the earth. What is its gain in potential energy?

3. A lawn-mower is pushed up a ramp onto the back of a trailer. The E_p of the mower increased by 750 J. If the mass of the mower is 100 kg find the height of the trailer.

4. The mass of an aeroplane is 12 000 kg. If it climbs up 5 000 m after take off what is its increase in potential energy?

5. The gain in potential energy of an aeroplane after take off is 5×10^6 J. If its mass is 10 000 kg what is its height above the ground?

6. If a ball of mass 0.5 kg is thrown vertically into the air to a height of 20 m what is the maximum potential energy it could acquire?

7. A pendulum bob weighing 30 N is displaced so it is 0.1 m above its lowest position. What is its potential energy?

ANSWERS			
1.	204 kg	5.	51 m
2.	1.96×10^7 J	6.	98 J
3.	0.76 m	7.	3 J
4.	5.88×10^8 J.		

KINETIC ENERGY

1. Calculate the Kinetic energy of a mass of 20 kg moving at a speed of 4 ms^{-1}.

2. A body accelerates at 5 ms^{-2} for 20 seconds from rest. If the increase in kinetic energy is 2 500 J find the mass of the body.

3. Calculate the kinetic energy of:

   (i) a cyclist of mass 80 kg travelling at 9 ms^{-1}.
   (ii) a car of mass 1 200 kg travelling at 30 ms^{-1}.
   (iii) a bullet of mass 4 g travelling at 400 ms^{-1}.

4. A body accelerates at 10 ms^{-2} for 10 seconds from rest. If the mass of the body is 20 kg calculate its increase in kinetic energy.

5. Calculate the kinetic energy of a body of mass 5 kg, 10 seconds after starting from rest with an acceleration of 4 ms^{-2}.

6. An object of mass 10 kg is moving at 20 ms^{-1}.

   (i) What is its kinetic energy?
   (ii) If it is now accelerated by a force so it reaches a velocity of 40 ms^{-1} what will be the increase in kinetic energy?

ANSWERS

1. 160 J

2. 0.5 kg

3. (i) 3240 J
   (ii) 540 000 J
   (iii) 320 J

4. 100 000 J

5. 4 000 J

6. (i) 2 000 J
   (ii) 6 000 J

ENERGY TRANSFORMATION

(Use $g = 9.8$ m/s^2)

1. Find the E_k gain of a 10 kg object falling through 8 metres.

2. A stone is dropped down a vertical shaft and has 200 J of energy just before impact at the bottom. If the mass of the stone is 0.5 kg find the depth of the shaft.

3. What is the maximum height that a 0.5 kg ball will reach when thrown vertically upwards with a E_k of 200 J.

4. A space capsule strikes the sea with a velocity of 20 ms^{-1}. If it has a mass of 1 500 kg what is its E_k on impact with the sea?

5. An arrow which is fired vertically upwards leaves the bow with a velocity of 20 ms^{-1}. If the arrow weighs 0.25 kg how much P.E. has it gained at the point when it just begins to fall.

6. A stone is dropped from a 20 m cliff and just before impact has 400 J of energy. What is the mass of the stone?

7. The E_p of a hill trolley is raised to 10 000 J. Through what distance would it be raised if its mass was 15 kg.

8. How much kinetic energy must be supplied to a 7 kg rock projected vertically upwards if it is just to reach a maximum height of 15 metres?

9. When an athlete does a high jump her centre of gravity increases from 1 m to 2 m. If the athlete's mass is 60 kg find:

    (a) her increase in potential energy
            and
    (b) her initial vertical velocity.

10 A 9 kg object is dropped 7 m from rest. Find:

    (a) its gain in kinetic energy
    (b) its loss in potential energy
            and
    (c) its velocity at this point.

ANSWERS

1. 784 J
2. 40.8 m
3. 40.8 m
4. 300 000 J
5. 50 J

6. 2 kg
7. 68 m
8. 1030 J
9. (a) 588 J
   (b) 4.4 ms^{-1}
10. (a) 617 J
    (b) 617 J
    (c) 11.7 ms^{-1}

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