NAME: ____ **DATE:** _______ PHYSICS

PAPER 1 REVISION

2.3 Work, Energy, and Power

1. An object of mass m_1 has a kinetic energy K_1. Another object of mass m_2 has a kinetic energy K_2. If the momentum of both objects is the same, the ratio $\frac{K_1}{K_2}$ is equal to

A. $\frac{m_2}{m_1}$. B. $\frac{m_1}{m_2}$. C. $\sqrt{\frac{m_2}{m_1}}$. D. $\sqrt{\frac{m_1}{m_2}}$.

(1)

2. A rocket is fired vertically. At its highest point, it explodes. Which **one** of the following describes what happens to its total momentum and total kinetic energy as a result of the explosion?

	Total momentum	Total kinetic energy
A.	unchanged	increased
B.	unchanged	unchanged
C.	increased	increased
D.	increased	unchanged

(1)

3. An electric motor is used to raise a weight of 2.0 N. When connected to a 4.0 V supply, the current in the motor is 1.5 A. Assuming no energy losses, the best estimate for the maximum steady speed at which the weight can be raised is

A. 0.3 m s^{-1}. B. 3.0 m s^{-1}. C. 9.0 m s^{-1}. D. 12.0 m s^{-1}.

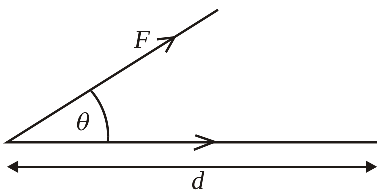
(1)

4. A machine lifts an object of weight 1.5×10^3 N to a height of 10 m. The machine has an overall efficiency of 20%. The work done by the machine in raising the object is

A. 3.0×10^3 J. B. 1.2×10^4 J. C. 1.8×10^4 J. D. 7.5×10^4 J.

(1)

5. The point of action of a constant force F is displaced a distance d. The angle between the force and the direction of the displacement is θ, as shown.



Which **one** of the following is the correct expression for the work done by the force?

A. Fd B. $Fd \sin \theta$ C. $Fd \cos \theta$ D. $Fd \tan \theta$

(1)

6. Which **one** of the following is a true statement about energy?

A. Energy is destroyed due to frictional forces.

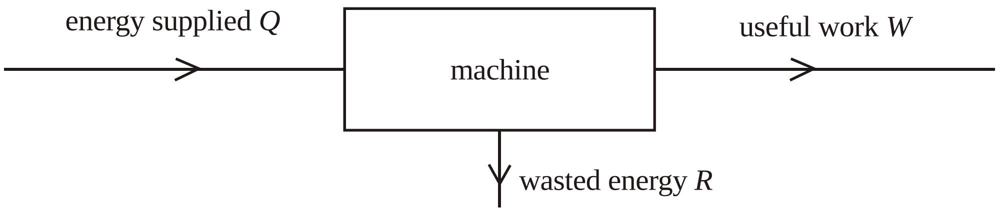
B. Energy is a measure of the ability to do work.

C. More energy is available when there is a larger power.

D. Energy and power both measure the same quantity.

(1)

7. An amount Q of energy is supplied to a machine. The machine does useful work W and an amount R of energy is wasted, as illustrated below.



Which **one** of the following is a correct expression for the efficiency of the machine?

A. $\frac{W}{Q}$ B. $\frac{R}{Q}$ C. $\frac{W+R}{Q}$ D. $\frac{W-R}{Q}$

(1)

8. The graph shows the variation with displacement d of the force F acting on a particle.

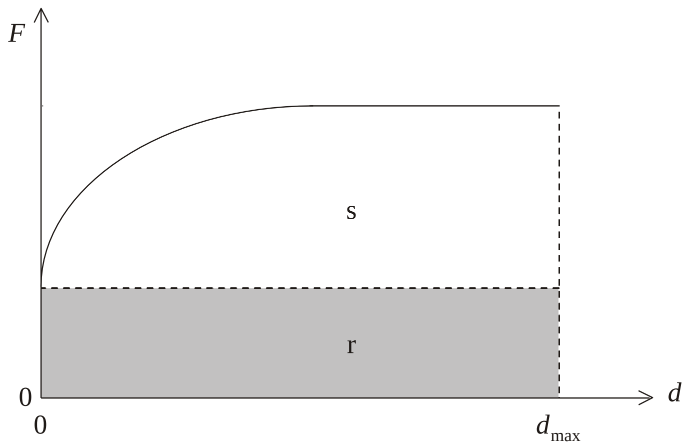
The area that represents the work done by the force between $d = 0$ and $d = d_{max}$ is

A. s − r.

B. r.

C. s.

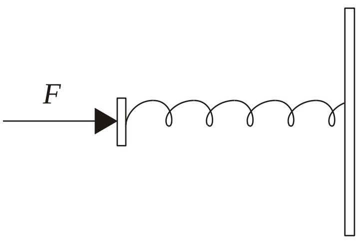
D. s + r.



(1)

9. A spring is compressed by a force F.

For a compression e, the force F is given by $F = ke$. When the compression force is removed, the spring returns to its original length in time t. The best estimate for the power developed by the spring during its expansion is



A. $\frac{ke}{2t}$. B. $\frac{ke}{t}$. C. $\frac{ke^2}{2t}$. D. $\frac{ke^3}{t}$.

(1)

10. An object of weight 50 N is dragged up an inclined plane at constant speed, through a vertical height of 12 m. The total work done is 1500 J.

The work done against friction is

A. 2100 J. B. 1500 J. C. 900 J. D. 50 J.

(1)

11. A machine lifts an object of weight W at constant speed through a vertical distance h. The efficiency of the machine is 25%. The total input energy to the machine is

A. $0.25Wh$. B. $0.75Wh$. C. $2.5Wh$. D. $4.0Wh$.

(1)

12. A rocket is fired vertically into the air. When the rocket reaches its maximum height, the rocket explodes. What change, if any, occurs in the momentum and in the kinetic energy of the rocket during the explosion?

	momentum	**kinetic energy**
A.	increases	increases
B.	increases	constant
C.	constant	increases
D.	constant	constant

(1)

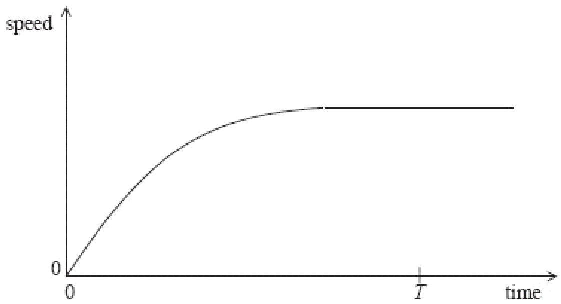
13. A box of weight W is moved at constant velocity v along a horizontal floor. There is a constant frictional force F between the box and the floor.

What is the power required to move the box through a distance s?

A. Fs B. Fv C. Ws D. Wv

(1)

14. The variation with time of the vertical speed of a ball falling in air is shown.



During the time from 0 to T, the ball gains kinetic energy and loses gravitational potential energy ΔE_p. Which of the following statements is true?

A. ΔE_p is equal to the gain in kinetic energy.

B. ΔE_p is greater than the gain in kinetic energy.

C. ΔE_p is equal to the work done against air resistance.

D. ΔE_p is less than the work done against air resistance.

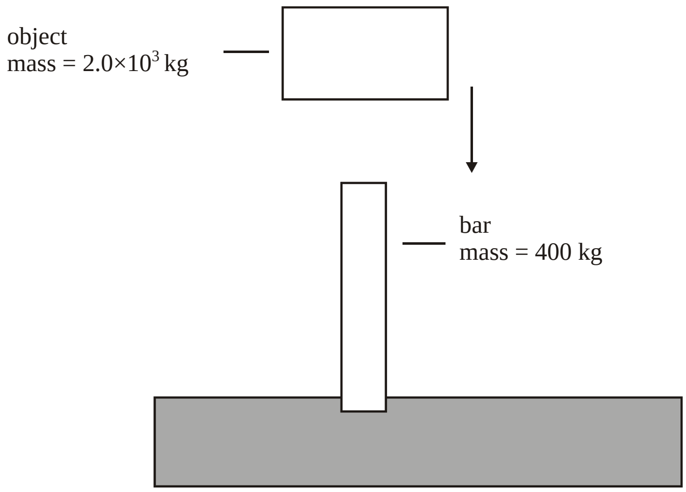
(1)

PAPER 2 REVISION

2.3 Work, Energy, and Power

15. This question is about driving a metal bar into the ground.

Large metal bars can be driven into the ground using a heavy falling object.



In the situation shown, the object has a mass 2.0×10^3 kg and the metal bar has a mass of 400 kg.

The object strikes the bar at a speed of 6.0 m s^{-1}. It comes to rest on the bar without bouncing. As a result of the collision, the bar is driven into the ground to a depth of 0.75 m.

(a) Determine the speed of the bar immediately after the object strikes it.

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(4)

(b) Determine the average frictional force exerted by the ground on the bar.

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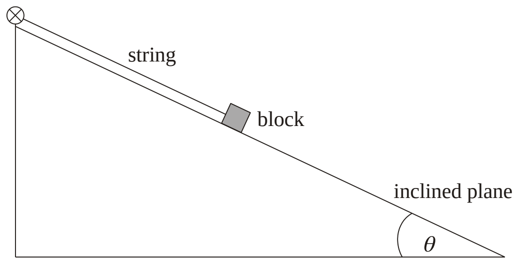
(3)
(Total 7 marks)

17. Block on an inclined plane

A block is held stationary on a frictionless inclined plane by means of a string as shown below.



(a) (i) On the diagram draw arrows to represent the three forces acting on the block.

(3)

(ii) The angle θ of inclination of the plane is 25°. The block has mass 2.6 kg. Calculate the force in the string. You may assume that g = 9.8 m s^{-2}.

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(2)

(b) The string is pulled so that the block is now moving at a constant speed of 0.85 m s^{-1} up the inclined plane.

(i) Explain why the magnitude of the force in the string is the same as that found in (a)(ii).

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(2)

(ii) Calculate the power required to move the block at this speed.

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(2)

(iii) State the rate of change of the gravitational potential energy of the block. Explain your answer.

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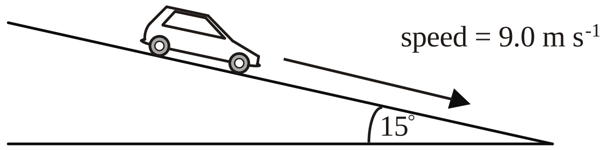
(2)
(Total 11 marks)

18. This question is about the breaking distance of a car and specific heat capacity.

(a) A car of mass 960 kg is free-wheeling down an incline at a constant speed of 9.0 m s^{-1}.



The slope makes an angle of 15° with the horizontal.

(i) Deduce that the average resistive force acting on the car is 2.4×10^3N.

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(2)

(ii) Calculate the kinetic energy of the car.

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(1)

(b) The driver now applies the brakes and the car comes to rest in 15 m. Use your answer to (a)(ii) to calculate the average braking force exerted on the car in coming to rest.

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(2)

(Total 5 marks)

20. **This question is about power.**

(a) Define *power*.

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(b) A constant force of magnitude F moves an object at constant speed v in the direction of the force. Deduce that the power P required to maintain constant speed is given by the expression

$$P = Fv$$

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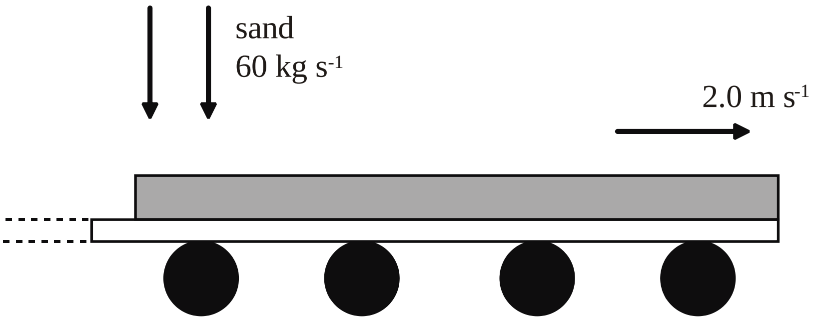
.... **(2)**

(c) Sand falls vertically on to a horizontal conveyor belt at a rate of 60 kg s^{-1}.



The conveyor belt that is driven by an engine, moves with speed 2.0 m s^{-1}.

When the sand hits the conveyor belt, its horizontal speed is zero.

(i) Identify the force F that accelerates the sand to the speed of the conveyor belt.

.... **(1)**

(ii) Determine the magnitude of the force F.

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(2)

(iii) Calculate the power P required to move the conveyor belt at constant speed.

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(1)

(iv) Determine the rate of change of kinetic energy K of the sand.

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(2)

(v) Explain why P and K are not equal.

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(2)

(d) The engine that drives the conveyor belt has an efficiency of 40%. Calculate the input power to the engine.

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(2)
(Total 13 marks)

21. Mechanical power

(a) Define *power*.

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(1)

(b) A car is travelling with constant speed v along a horizontal straight road. There is a total resistive force F acting on the car.
Deduce that the power P to overcome the force F is $P = Fv$.

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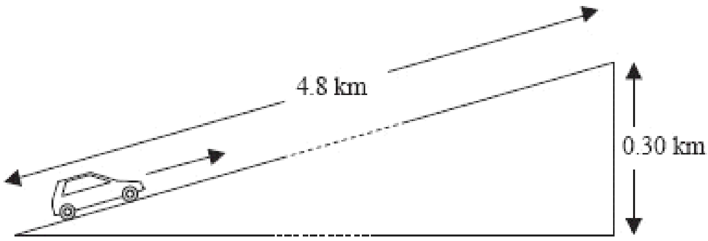
(2)

(c) A car drives up a straight incline that is 4.8 km long. The total height of the incline is 0.30 km.
The car moves up the incline at a steady speed of 16 m s^{-1}. During the climb, the average friction force acting on the car is 5.0×10^2 N. The total weight of the car and the driver is 1.2×10^4 N.



(i) Determine the time it takes the car to travel from the bottom to the top of the incline.

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(2)

(ii) Determine the work done against the gravitational force in travelling from the bottom to the top of the incline.

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(1)

(iii) Using your answers to (c)(i) and (c)(ii), calculate a value for the minimum power output of the car engine needed to move the car from the bottom to the top of the incline.

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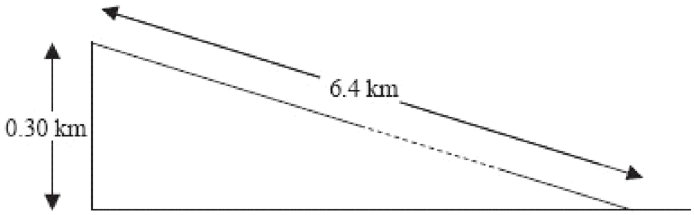
(4)

(d) From the top of the incline, the road continues downwards in a straight line. At the point where the road starts to go downwards, the driver of the car in (c), stops the car to look at the view. In continuing his journey, the driver decides to save fuel. He switches off the engine and allows the car to move freely down the hill. The car descends a height of 0.30 km in a distance of 6.4 km before levelling out.



The average resistive force acting on the car is 5.0×10^2 N.

Estimate

(i) the acceleration of the car down the incline.

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(5)

(ii) the speed of the car at the bottom of the incline.

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(2)

(e) In fact, for the last few hundred metres of its journey down the hill, the car travels at constant speed. State the value of the frictional force acting on the car whilst it is moving at constant speed.

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(1)
(Total 18 marks)