04 Energy and Fields

Practice A (10 MCQs)

1 An old-fashioned 60 W lamp converts 95% of its energy supply into heat. A 4.0 W modern lamp has the same power output of light as the old-fashioned lamp.

What is the efficiency of the modern lamp?

A 5.0% **B** 6.7% **C** 75% **D** 95%

[Prelim2020/ASRJC/1/10]

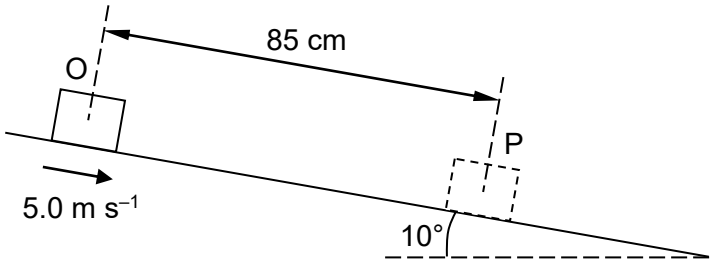
2 A car with a power output of 90 kW can travel at a maximum speed of 55 m s^{-1} along a straight horizontal road. The drag force on the car is directly proportional to the square of its speed.

What is the maximum speed of the car, if the power output of the car is reduced to 50 kW while travelling on the same road?

A 31 m s^{-1} **B** 41 m s^{-1} **C** 45 m s^{-1} **D** 67 m s^{-1}

[Prelim2020/JPJC/1/6]

3 An object of mass 1.5 kg slides down a rough plane inclined at 10° above the horizontal, as shown. The object has an initial speed of 5.0 m s^{-1} at point O, and comes to rest at point P after sliding 85 cm down the slope.



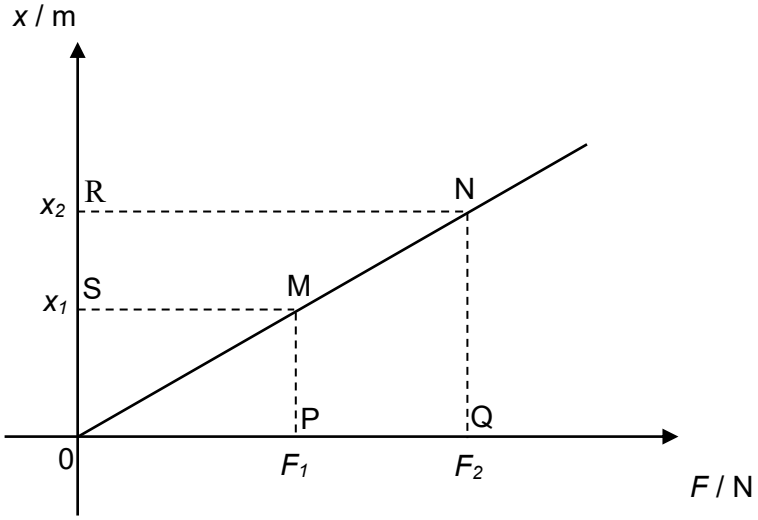
What is the work done by the frictional force on the object between points O and P?

A – 31 J **B** – 21 J **C** 21 J **D** 31 J

[Prelim2020/JPJC/1/7]

4 The variation with force *F* of the length *x* of a spring is shown below. The tension in the

spring is increased from F_1 to F_2, causing the length to increase from x_1 to x_2.

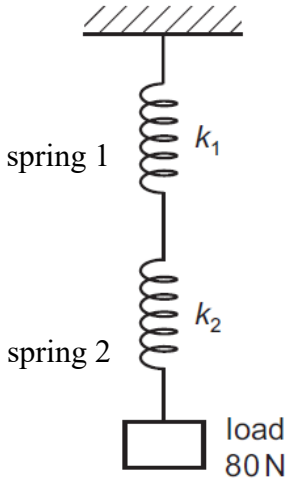


The work done in stretching the spring from x_1 to x_2 is given by the area

A LMS **B** MNRS **C** LMP **D** MNQP

[Prelim2020/TMJC/1/8]

5 Two springs labelled spring 1 and spring 2 are supporting a load of 80 N as shown. Spring 1 has an elastic constant k_1 = 4 kN m^{-1} and spring 2 has an elastic constant k_2 = 2 kN m^{-1}.



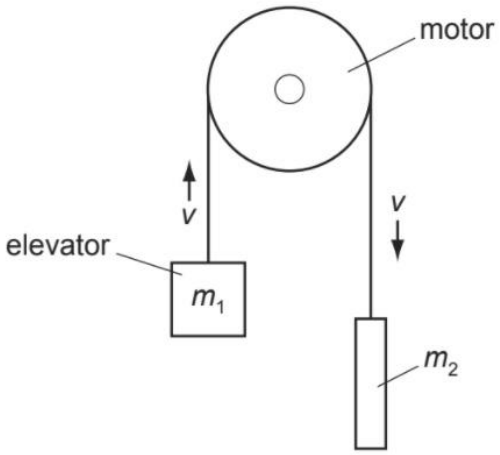
What is the ratio

$$\frac{\text{elastic potential energy stored in the spring 1}}{\text{elastic potential energy stored in the spring 2}} ?$$

A 4:1 **B** 2:1 **C** 1:4 **D** 1:2

[Prelim2020/TJC/1/8]

6 The diagram shows a lift system in which the elevator (mass m_1) is partly counterbalanced by a heavy weight (mass m_2).



At what rate does the motor provide energy to the system when the elevator is rising at a steady speed v? (g = acceleration of free fall)

A $\frac{1}{2}m_1v^2$

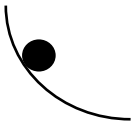
B $\frac{1}{2}(m_1 - m_2)v^2$

C m_1gv

D $(m_1 - m_2)gv$

[Prelim2020/RVHS/1/7]

7 A ball rolls down the circularly curved track shown below.



Which of the following correctly describes its speed, acceleration along the slope and kinetic energy?

	speed	acceleration	kinetic energy
A	increases	increases	increases
B	decreases	decreases	decreases
C	increases	decreases	increases
D	increases	constant	increases

[Prelim2020/NYJC/1/9]

8 A rock is thrown with an initial kinetic energy of 15 J at an angle of 30^{o} to the horizontal.

What is its kinetic energy at the highest point of its trajectory?

[Prelim2020/ACJC/1/7]

9 An electric motor is required to haul a cage of mass 400 kg up a mine shaft through a vertical height of 1000 m in 3 minutes.

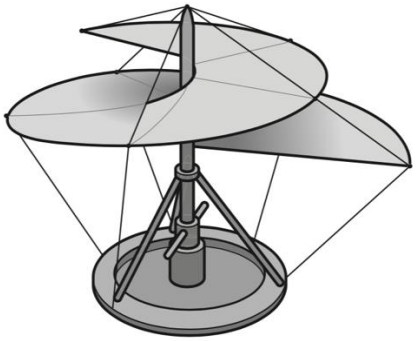
What will be its electrical power required if its overall efficiency is 87%?

A 2.55 kW **B** 19.0 kW

C 21.8 kW **D** 25.1 Kw

[Prelim2020/MI/1/6]

10 Leonardo da Vinci proposed a flying machine that would work like a screw to lift the pilot into the air. The 'screw' is rotated by the pilot.



The machine and the pilot together have a total mass of 120 kg.

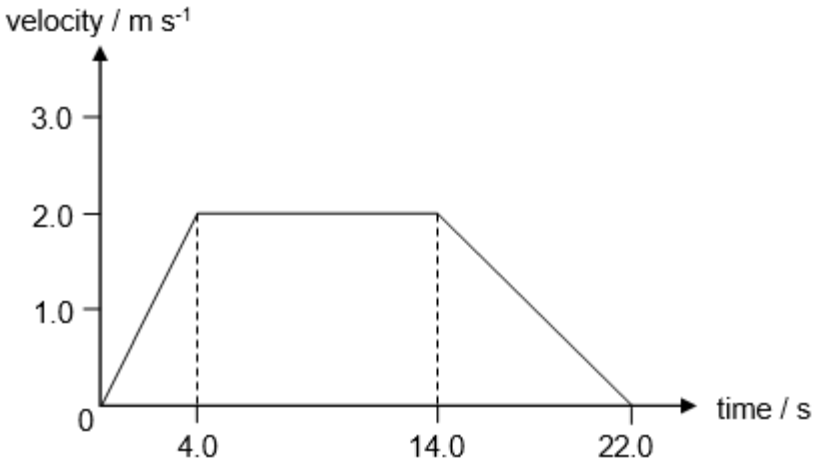
Which useful output power must the pilot provide to move vertically upwards at a constant speed of 2.5 m s^{-1}?

A 48 W **B** 300 W **C** 470 W **D** 2900 W

[Prelim2020/NJC/1/8]

Practice B (10 MCQs)

1 The diagram shows the velocity-time graph of a 500 kg elevator during its upward motion.



What is the maximum power generated by the engine of the elevator?

A 7810 W **B** 9310 W **C** 9810 W **D** 10300 W

[Prelim2020/CJC/1/8]

2 A ball of mass *m* is dropped into a viscous fluid and is allowed to fall through the fluid until it is travelling at a constant speed *v*.

Which of the following statements is true when it is falling at terminal velocity?

A The kinetic energy of the ball is not a constant.

B The total mechanical energy of the ball is a constant.

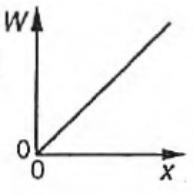
C The gravitational potential energy of the ball is decreasing at a rate of *mgv*.

D The total resistive force acting on the ball is zero.

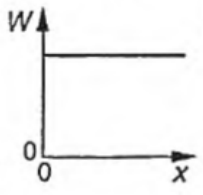
[Prelim2020/TMJC/1/7]

3 A block is projected across a smooth, horizontal surface and is brought to rest by air resistance. Which graph best shows how *W*, the total work done against air resistance, vary with *x*, the distance travelled by the block?

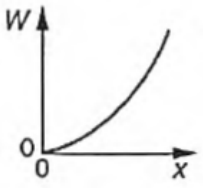
A



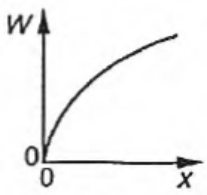
B



C



D



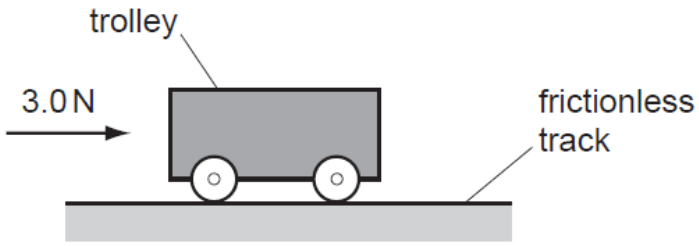
[Prelim2020/VJC/1/5]

4 A car of mass 1200 kg is moving at 20 m s^{-1} up a slope which is inclined at an angle of 30°. The frictional force opposing the motion is 900 N. If the car accelerates at 3.0 m s^{-2} when it is moving at this speed, what is the power delivered by the engine at this instant?

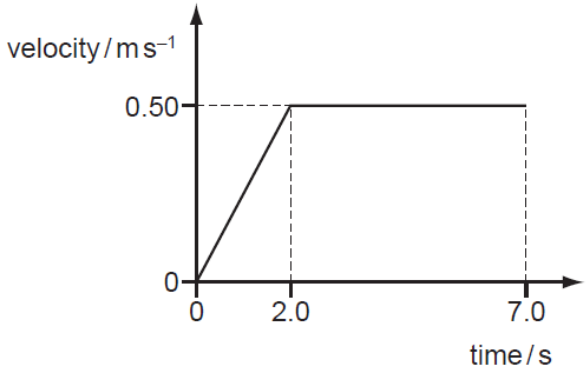
A 140 W **B** 170 kW **C** 210 Kw **D** 250 kW

[Prelim2020/VJC/1/6]

5 A trolley is pushed with a force of 3.0 N for 2.0 s along a frictionless track.



The graph shows the velocity of the trolley against time.

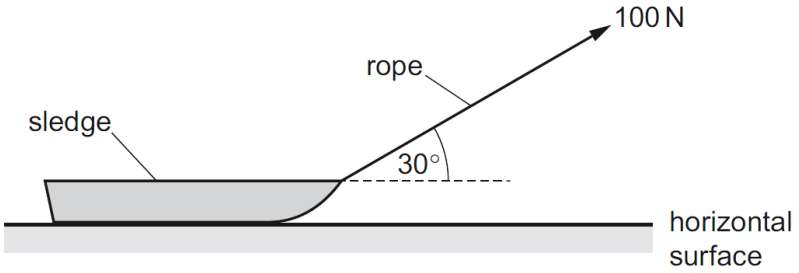


How much work is done by the force on the trolley?

A 1.5 J **B** 3.0 J **C** 6.0 J **D** 9.0 J

[Prelim2020/TJC/1/9]

6 A rope is attached to a sledge and a boy uses the rope to pull the sledge along a horizontal surface with a constant velocity. The tension in the rope is 100 N and the rope is held at 30° to the horizontal.



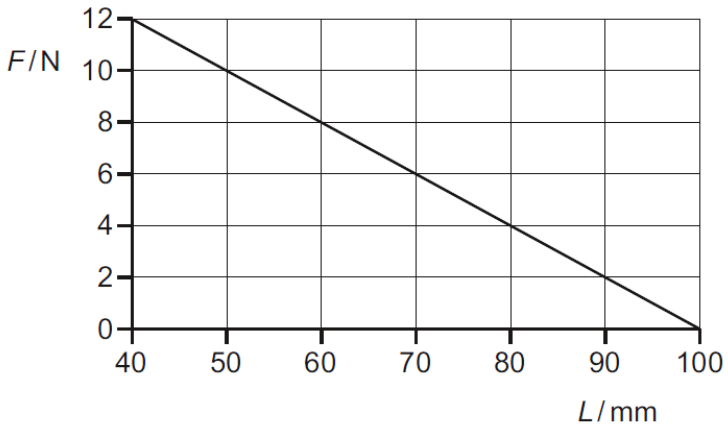
How much work does the boy do on the sledge when he pulls it a distance of 5.0 m along the surface?

A 250 J **B** 290 J

C 430 J **D** 500 J

[Prelim2020/SAJC/1/9]

7 A spring of original length 100 mm is compressed by a force. The graph shows the variation of the compressing force *F* with the length *L* of the spring.



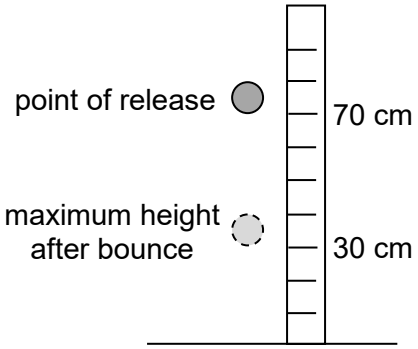
What is the energy stored in the spring when the length is 70 mm?

A 0.090 J **B** 0.21 J

C 0.27 J **D** 0.63 J

[Prelim2020/SAJC/1/10]

8 A rubber ball is released from rest with the bottom of the ball 70 cm above a horizontal surface. It falls vertically and then bounces back up so that the maximum height reached by the bottom of the ball is 30 cm, as shown in the diagram below.



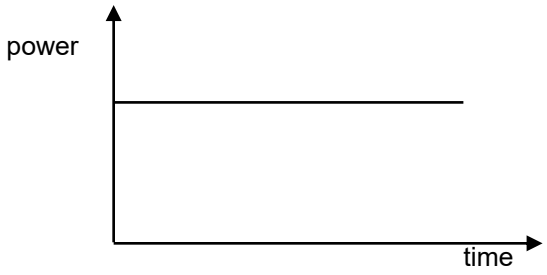
If the kinetic energy of the ball is 0.80 J just before it strikes the surface, what is the kinetic energy just after it leaves the surface?

A 0.34 J **B** 0.37 J **C** 0.40 J **D** 0.46 J

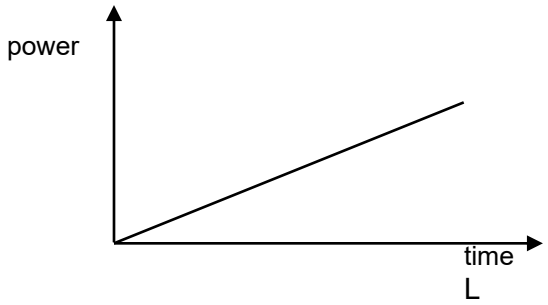
[Prelim2020/ACJC/1/16]

9 A train starts from rest and accelerates uniformly.

Which graph shows how the power output of the train varies with time after the train starts moving?

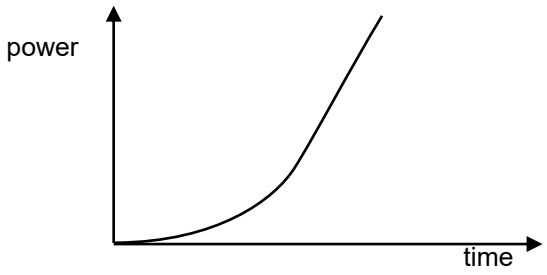


A

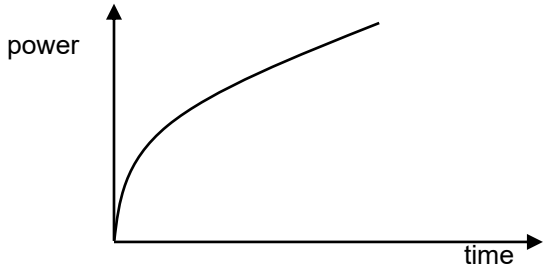


L

B



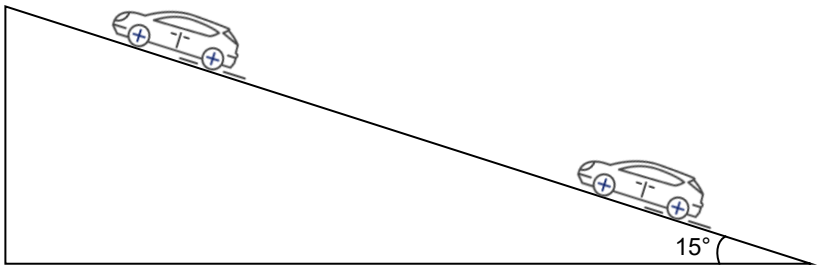
C



D

[Prelim2020/EJC/1/25]

10 A car of mass 990 kg is driven up a slope angled at 15° to the horizontal, at a steady speed of 12 m s^{-1}.



What is the work done by gravity on the car for 8.3 seconds of travel on the slope?

A 250 kJ **B** -250 kJ **C** 970 kJ **D** -970 kJ

[Prelim2019/TMJC/1/7]