IBY1 A.3 Paper 1A [45 marks]

1. SPM.1A.SL.TZ0.3

A net force of 8.0 N accelerates a 4.0 kg body from rest to a speed of 5.0 m s^{-1}.

What is the work done by the force?

A. 50 J

B. 40 J

C. 32 J

D. 20 J

[1]

2. SPM.1A.SL.TZ0.5

An object is released from rest in a vacuum at a height H above the Earth's surface.

As the object falls it passes a point at a height of $0.75H$ above the surface.

What is $\frac{kinetic\ energy\ of\ the\ object\ at\ a\ height\ of\ 0.75H}{\text{gravitational potential energy of the object at a height of } H}$?

A. $\frac{1}{16}$

B. $\frac{1}{4}$

C. $\frac{9}{16}$

D. $\frac{3}{4}$

[1]

3. SPM.1A.HL.TZ0.3

A net force of 8.0 N accelerates a 4.0 kg body from rest to a speed of 5.0 m s^{-1}.

What is the work done by the force?

A. 50 J

B. 40 J

C. 32 J

D. 20 J

[1]

4. SPM.1A.HL.TZ0.6

An object is released from rest in a vacuum at a height H above the Earth's surface.

As the object falls it passes a point at a height of $0.75H$ above the surface.

What is $\frac{kinetic\ energy\ of\ the\ object\ at\ a\ height\ of\ 0.75H}{\text{gravitational potential energy of the object at a height of } H}$?

A. $\frac{1}{16}$

B. $\frac{1}{4}$

C. $\frac{9}{16}$

D. $\frac{3}{4}$

[1]

5. 23M.1A.SL.TZ1.2

The kinetic energy of a body is determined from measurements of its momentum *p* and its mass *m*.

The percentage uncertainties in the measurements are:

p ± 3 %

m ± 4 %

What is the percentage uncertainty in the kinetic energy?

A. 7 %

B. 10 %

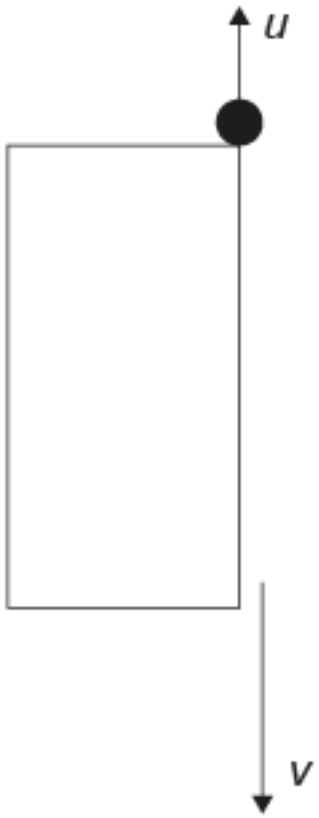
C. 13 %

D. 14 %

[1]

6. 23M.1A.SL.TZ1.4

A stone of mass *m* is projected vertically upwards with speed *u* from the top of a cliff. The speed of the stone when it is just about to hit the ground is *v*.



What is the magnitude of the change in momentum of the stone?

A. $m\left(\frac{v+u}{2}\right)$

B. $m\left(\frac{v-u}{2}\right)$

C. $m(v+u)$

D. $m(v-u)$

[1]

7. 23M.1A.SL.TZ1.8

The input power of an electric motor is 200 W. It is used to raise a mass of 10 kg at constant speed.
If the efficiency of the motor is 40 %, through what height will the mass be raised in 1 second?

A. 0.5 m

B. 0.8 m

C. 1.2 m

D. 2.0 m

[1]

8. 23M.1A.SL.TZ1.10

A tennis ball is dropped from rest from a height. It hits the ground and bounces back to a lower height. Air resistance is negligible.

What is correct about the collision of the tennis ball with the ground?

A. Elastic because momentum of the system is conserved

B. Elastic because the kinetic energy of the system is conserved

C. Inelastic because momentum of the system is not conserved

D. Inelastic because the kinetic energy of the system is not conserved

[1]

9. 23M.1A.SL.TZ1.6

A ball falls with terminal velocity through air. What is correct about the kinetic energy and the total energy of the ball?

	Kinetic energy	**Total energy**
A.	constant	decreases
B.	increases	decreases
C.	constant	constant
D.	increases	constant

[[N/A]]

10. 23M.1A.SL.TZ1.9

The input power of an electric motor is 200 W. It is used to raise a mass of 10 kg at constant speed.
If the efficiency of the motor is 40 %, through what height will the mass be raised in 1 second?

A. 0.5 m

B. 0.8 m

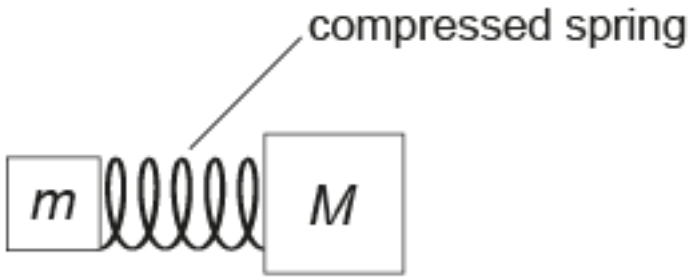
C. 1.2 m

D. 2.0 m

[1]

11. 23M.1A.SL.TZ2.6

A spring of negligible mass is compressed and placed between two stationary masses *m* and *M*. The mass of *M* is twice that of *m*. The spring is released so that the masses move in opposite directions.



What is $\frac{kinetic\ energy\ of\ m}{kinetic\ energy\ of\ M}$?

A. $\frac{1}{2}$

B. 1

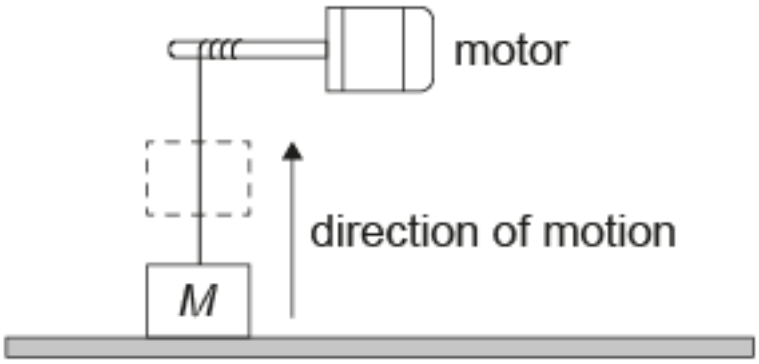
C. 2

D. 4

[1]

12. 23M.1A.SL.TZ2.7

An object of mass *M* is accelerated vertically upwards by a motor at a constant acceleration. The object is initially at rest and reaches a vertical speed of 4.0 m s^{-1} in 2.0 s.



What is the average power output of the motor?

A. $8M$

B. $24M$

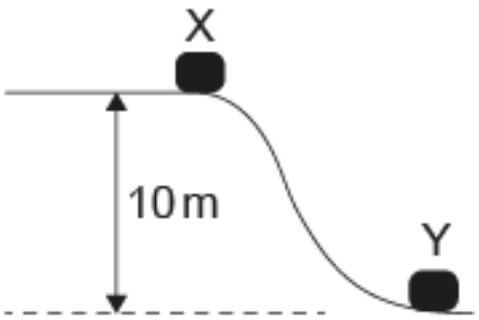
C. $32M$

D. $48M$

[1]

13. 23M.1A.SL.TZ2.8

An object is released from rest at X and slides to Y. The vertical distance between X and Y is 10 m. During the motion, 20 % of the object's initial gravitational potential energy is lost as friction.



What is the speed of the object at Y?

A. $\frac{16}{\sqrt{g}}$

B. $2\sqrt{g}$

C. $4\sqrt{g}$

D. $8g$

[1]

14. 23M.1A.SL.TZ2.25

A car engine has a useful power output of 20 kW and an efficiency of 50 %. The engine consumes 1×10^{-5} m^3 of fuel every second. What is the energy density of the fuel?

A. 2 MJ m^{-3}

B. 4 MJ m^{-3}

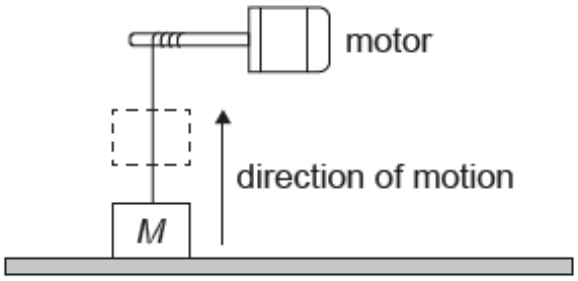
C. 2 GJ m^{-3}

D. 4 GJ m^{-3}

[1]

15. 23M.1A.SL.TZ2.7

An object of mass *M* is accelerated vertically upwards by a motor at a constant acceleration. The object is initially at rest and reaches a vertical speed of 4.0 m s^{-1} in 2.0 s.



What is the average power output of the motor?

A. 8*M*

B. 24*M*

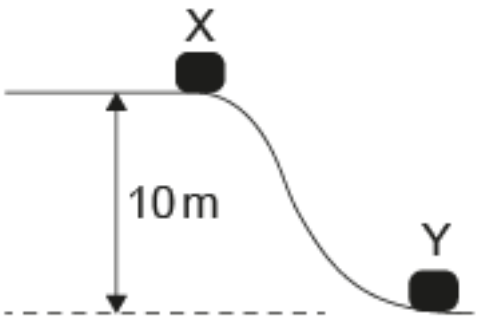
C. 32*M*

D. 48*M*

[1]

16. 23M.1A.SL.TZ2.8

An object is released from rest at X and slides to Y. The vertical distance between X and Y is 10 m. During the motion, 20 % of the object's initial gravitational potential energy is lost as friction.



What is the speed of the object at Y?

A. $\frac{16}{\sqrt{g}}$

B. $2\sqrt{g}$

C. $4\sqrt{g}$

D. $8g$

[1]

17. 23M.1A.HL.TZ1.33

Which law is equivalent to the law of conservation of energy?

A. Coulomb's law

B. Ohm's Law

C. Newton's first law

D. Lenz's law

[1]

18. 22N.1A.SL.TZ0.8

An engine is exerting a horizontal force F on an object that is moving along a horizontal surface at a constant velocity v. The mass of the object is m and the coefficient of dynamic friction between the object and the surface is μ.

What is the power of the engine?

A. $\frac{Fv}{\mu}$

B. μFv

C. $\frac{mgv}{\mu}$

D. μmgv

[1]

19. 22N.1A.SL.TZ0.6

A person lifts a total mass of 20 kg through a vertical distance of 0.60 m. The person repeats the lift *n* times to transfer a total energy of 6.0×10^4 J.

What is *n*?

A. 5

B. 50

C. 500

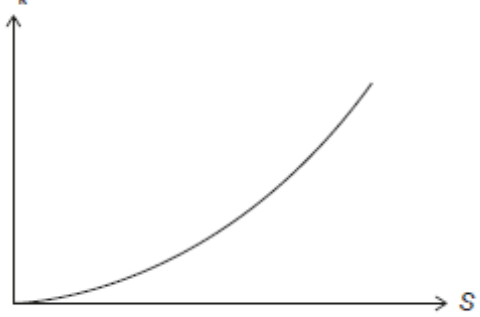
D. 5000

[1]

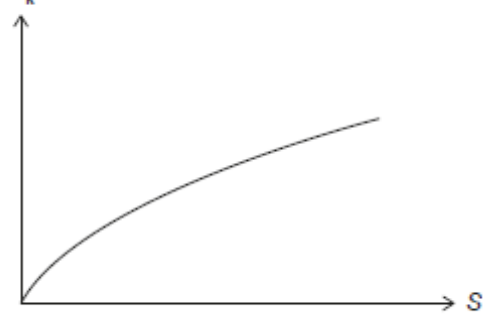
20. 22M.1A.SL.TZ1.8

A cart travels from rest along a horizontal surface with a constant acceleration. What is the variation of the kinetic energy E_k of the cart with its distance s travelled? Air resistance is negligible.

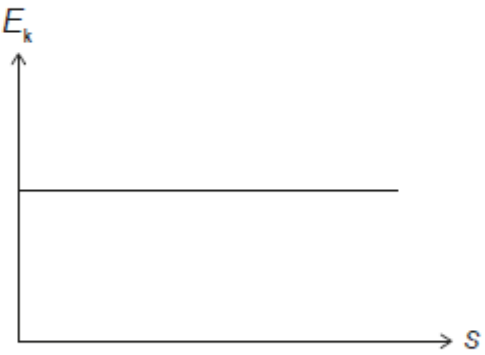
A.



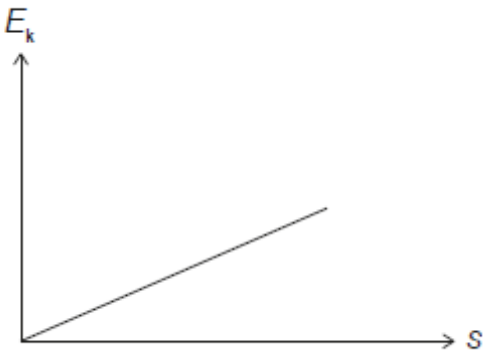
B.



C.



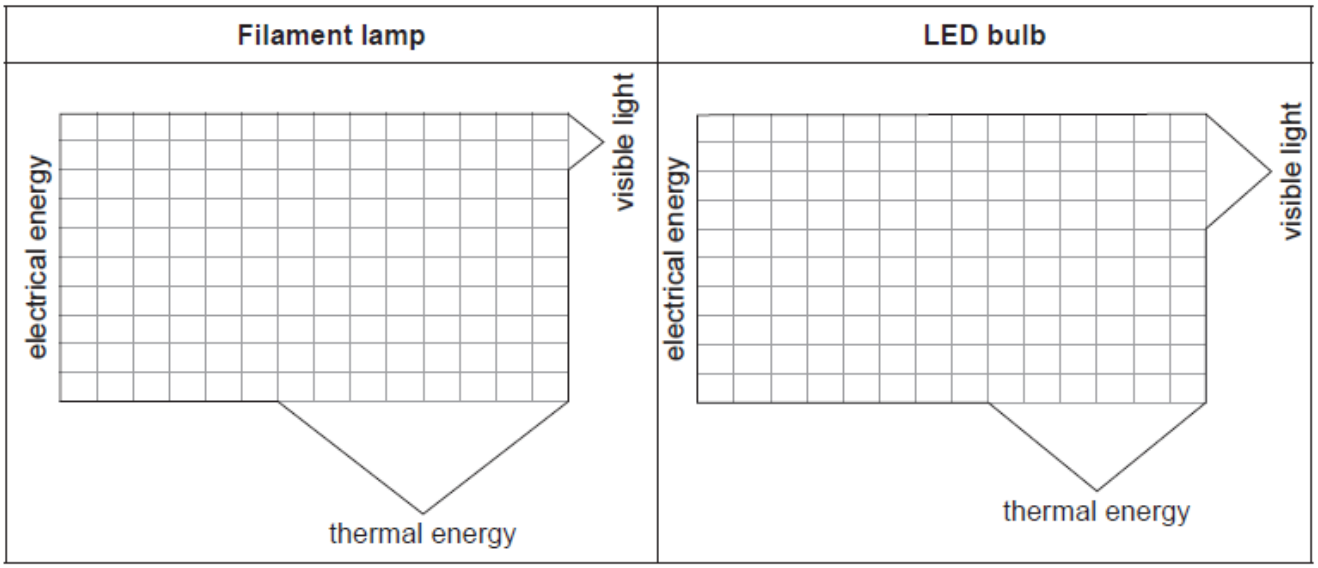
D.



[1]

21. 22M.1A.SL.TZ2.30

The Sankey diagrams for a filament lamp and for an LED bulb are shown below.



What is the efficiency of the filament lamp and the LED bulb?

	Filament lamp	LED bulb
A.	20 %	40 %
B.	25 %	40 %
C.	20 %	67 %
D.	25 %	67 %

[1]

22. 21N.1A.SL.TZ0.5

A cyclist rides up a hill of vertical height 100 m in 500 s at a constant speed. The combined mass of the cyclist and the bicycle is 80 kg. The power developed by the cyclist is 200 W. What is the efficiency of the energy transfer in this system?

A. 8 %

B. 20 %

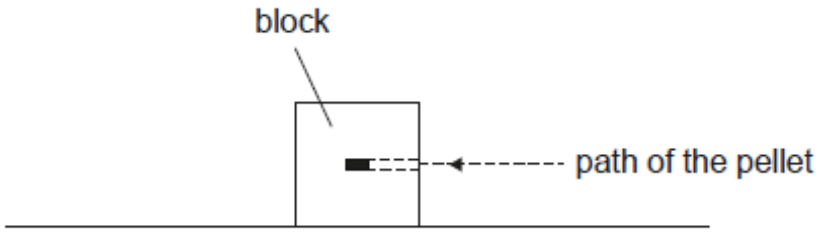
C. 60 %

D. 80 %

[1]

23. 21N.1A.SL.TZ0.6

A block rests on a frictionless horizontal surface. An air rifle pellet is fired horizontally into the block and remains embedded in the block.



What happens to the total kinetic energy and to the total momentum of the block and pellet system as a result of the collision?

	Total kinetic energy	Total momentum
A.	no change	no change
B.	no change	decreases
C.	decreases	no change
D.	decreases	decreases

[1]

24. 21N.1A.SL.TZ0.28

A fuel has mass density ρ and energy density u. What mass of the fuel has to be burned to release thermal energy E?

A. $\frac{\rho E}{u}$

B. $\frac{uE}{\rho}$

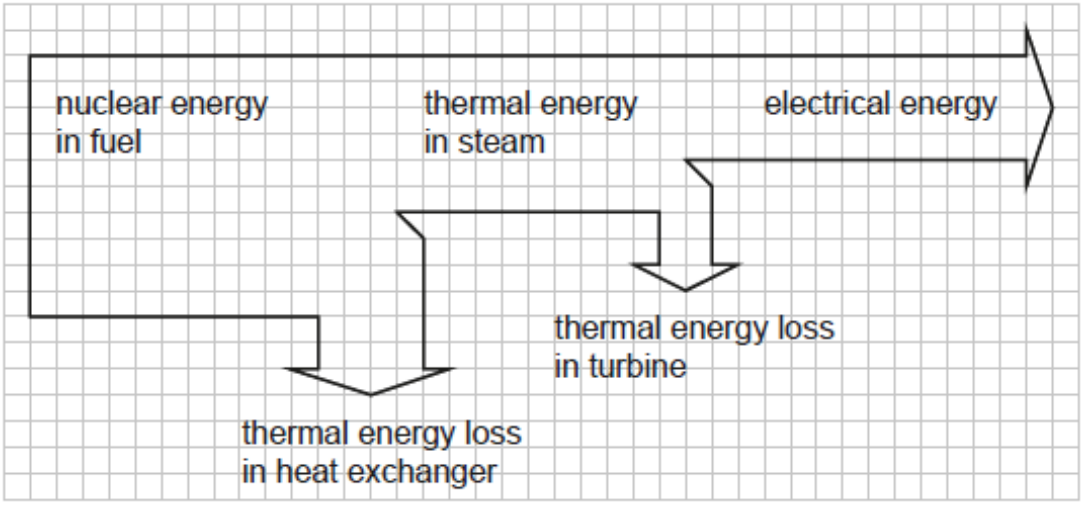
C. $\frac{\rho u}{E}$

D. ρuE

[1]

25. 21N.1A.SL.TZ0.29

The Sankey diagram shows the energy transfers in a nuclear power station.



Electrical power output of the power station is 1000 MW.

What is the thermal power loss in the heat exchanger?

A. 500 MW

B. 1000 MW

C. 1500 MW

D. 2500 MW

[1]

26. 21N.1A.SL.TZ0.7

An object of mass 1.0 kg hangs at rest from a spring. The spring has a negligible mass and the spring constant k is 20 N m^{-1}

What is the elastic potential energy stored in the spring?

A. 1.0 J

B. 2.5 J

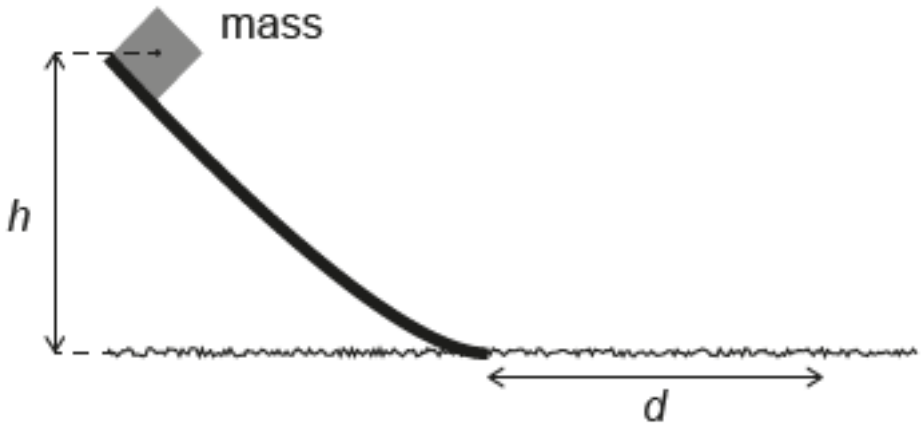
C. 5.0 J

D. 10 J

[1]

27. 21M.1A.SL.TZ1.5

A mass is released from the top of a smooth ramp of height h. After leaving the ramp, the mass slides on a rough horizontal surface.



The mass comes to rest in a distance *d*. What is the coefficient of dynamic friction between the mass and the horizontal surface?

A. $\frac{gd}{h}$

B. $\sqrt{\frac{d}{2gh}}$

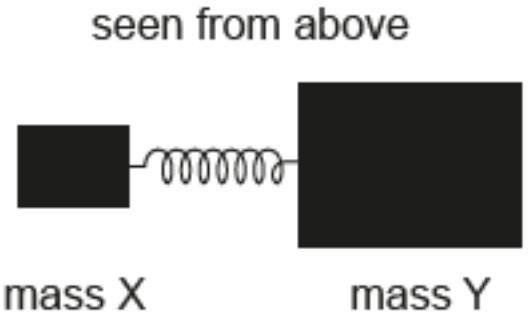
C. $\frac{d}{h}$

D. $\frac{h}{d}$

[1]

28. 21M.1A.SL.TZ1.6

Masses X and Y rest on a smooth horizontal surface and are connected by a massless spring. The mass of X is 3.0 kg and the mass of Y is 6.0 kg. The masses are pushed toward each other until the elastic potential energy stored in the spring is 1.0 J.



The masses are released. What is the maximum speed reached by mass Y?

A. 0.11 m s^{-1}

B. 0.33 m s^{-1}

C. 0.45 m s^{-1}

D. 0.66 m s^{-1}

[1]

29. 21M.1A.SL.TZ1.5

A car takes 20 minutes to climb a hill at constant speed. The mass of the car is 1200 kg and the car gains gravitational potential energy at a rate of 6.0 kW. Take the acceleration of gravity to be 10 m s^{-2}. What is the height of the hill?

A. 0.6 m

B. 10 m

C. 600 m

D. 6000 m

[1]

30. 21M.1A.SL.TZ1.9

An electron has a linear momentum of 4.0×10^{-25} kg m s^{-1}. What is the order of magnitude of the kinetic energy of the electron?

A. 10^{-50} J

B. 10^{-34} J

C. 10^{-19} J

D. 10^{6} J

[1]

31. 21M.1A.SL.TZ2.8

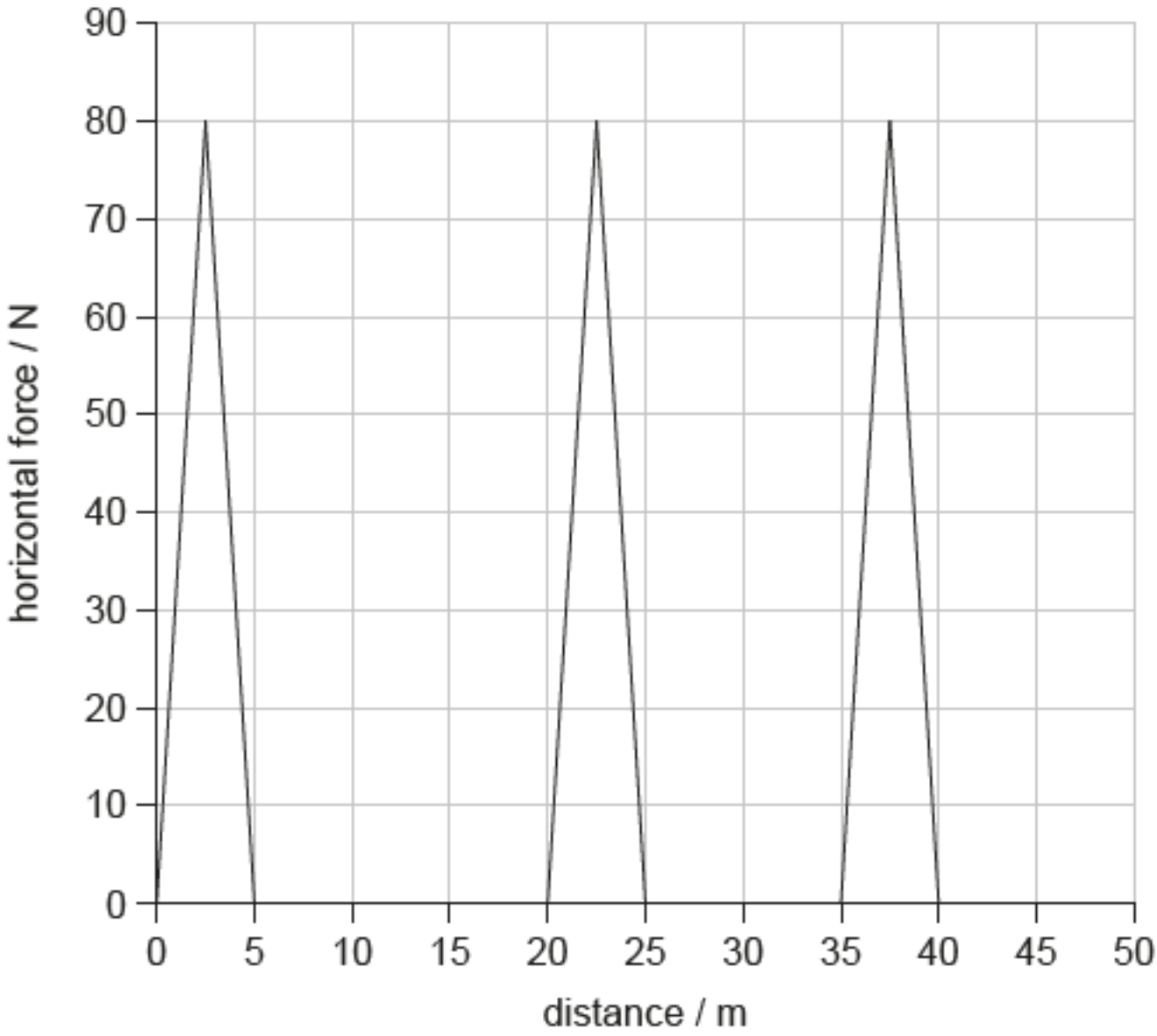
A projectile is launched upwards at an angle θ to the horizontal with an initial momentum p_0 and an initial energy E_0. Air resistance is negligible. What are the momentum and total energy of the projectile at the highest point of the motion?

	Momentum	Energy
A.	$< p_0$	E_0
B.	p_0	E_0
C.	p_0	$< E_0$
D.	$< p_0$	$< E_0$

[1]

32. 21M.1A.SL.TZ2.9

The graph shows the variation with distance of a horizontal force acting on an object. The object, initially at rest, moves horizontally through a distance of 50 m.



A constant frictional force of 2.0 N opposes the motion. What is the final kinetic energy of the object after it has moved 50 m?

A. 100 J

B. 500 J

C. 600 J

D. 1100 J

[1]

33. 20N.1A.SL.TZ0.5

A car is driven from rest along a straight horizontal road. The car engine exerts a constant driving force. Friction and air resistance are negligible. How does the power developed by the engine change with the distance travelled?

A. Power does not change.

B. Power decreases linearly.

C. Power increases linearly.

D. Power increases non-linearly.

[1]

34. 20N.1A.SL.TZ0.13

A bicycle of mass M comes to rest from speed v using the back brake. The brake has a specific heat capacity of c and a mass m. Half of the kinetic energy is absorbed by the brake.

What is the change in temperature of the brake?

A. $\frac{Mv^2}{4mc}$

B. $\frac{Mv^2}{2mc}$

C. $\frac{mv^2}{4Mc}$

D. $\frac{mv^2}{2Mc}$

[1]

35. 20N.1A.SL.TZ0.19

An electric motor raises an object of weight $500\,N$ through a vertical distance of $3.0\,m$ in $1.5\,s$. The current in the electric motor is $10\,A$ at a potential difference of $200\,V$. What is the efficiency of the electric motor?

A. $17\,\%$

B. $38\,\%$

C. $50\,\%$

D. $75\,\%$

[1]

36. 20N.1A.SL.TZ0.3

An object of mass $2m$ moving at velocity $3v$ collides with a stationary object of mass $4m$. The objects stick together after the collision. What is the final speed and the change in total kinetic energy immediately after the collision?

	Final speed	Change in total kinetic energy
A.	v	$3mv^2$
B.	v	$6mv^2$
C.	$2v$	$3mv^2$
D.	$2v$	$6mv^2$

[1]

37. 20N.1A.SL.TZ0.4

An object of mass $1\,kg$ is thrown downwards from a height of $20\,m$. The initial speed of the object is $6\,m\,s^{-1}$.
The object hits the ground at a speed of $20\,m\,s^{-1}$. Assume $g = 10\,m\,s^{-2}$. What is the best estimate of the energy transferred from the object to the air as it falls?

A. $6\,J$

B. $18\,J$

C. $182\,J$

D. $200\,J$

[1]

38. 19N.1A.SL.TZ0.6

A nuclear particle has an energy of 10^8 eV. A grain of sand has a mass of 32 mg. What speed must the grain of sand have for its kinetic energy to equal the energy of the nuclear particle?

A. 1 mm s^{-1}

B. 3 mm s^{-1}

C. 10 mm s^{-1}

D. 16 mm s^{-1}

[1]

39. 19N.1A.SL.TZ0.22

An object of mass *m* makes *n* revolutions per second around a circle of radius *r* at a constant speed. What is the kinetic energy of the object?

A. 0

B. $\frac{1}{2}\pi^2 mn^2 r^2$

C. $2\pi^2 mn^2 r^2$

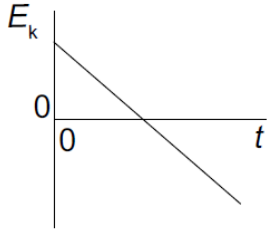
D. $4\pi^2 mn^2 r^2$

[1]

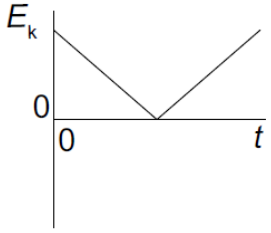
40. 19N.1A.SL.TZ0.7

A ball is thrown vertically upwards. Air resistance is negligible. What is the variation with time *t* of the kinetic energy E_k of the ball?

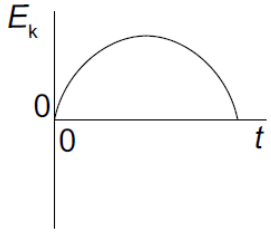
A.



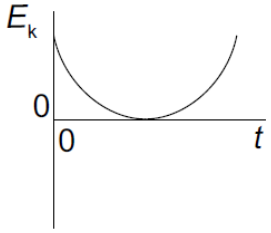
B.



C.



D.



[1]

41. 19N.1A.SL.TZ0.8

The tension in a horizontal spring is directly proportional to the extension of the spring. The energy stored in the spring at extension x is E. What is the work done by the spring when its extension changes from x to $\frac{x}{4}$?

A. $\frac{E}{16}$

B. $\frac{E}{4}$

C. $\frac{3E}{4}$

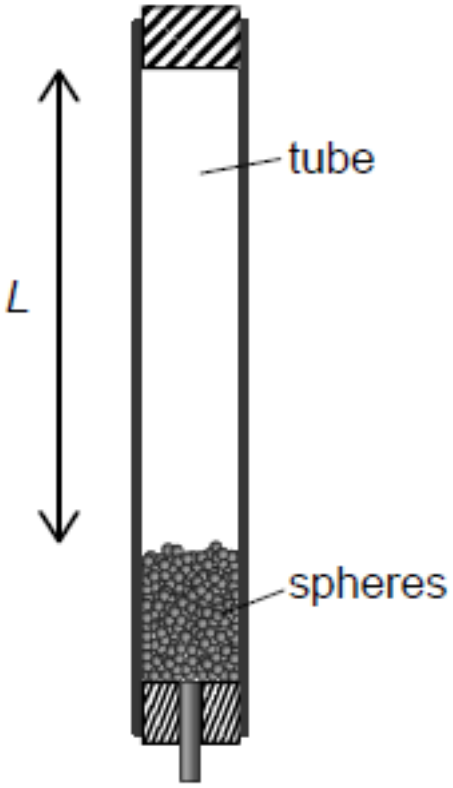
D. $\frac{15E}{16}$

[1]

42. 19M.1A.SL.TZ1.11

An insulated tube is filled with a large number *n* of lead spheres, each of mass *m*. The tube is inverted *s* times so that the spheres completely fall through an average distance *L* each time. The temperature of the spheres is measured before and after the inversions and the resultant change in temperature is ΔT.

What is the specific heat capacity of lead?



A. $\frac{sgL}{nm\Delta T}$

B. $\frac{sgL}{\Delta T}$

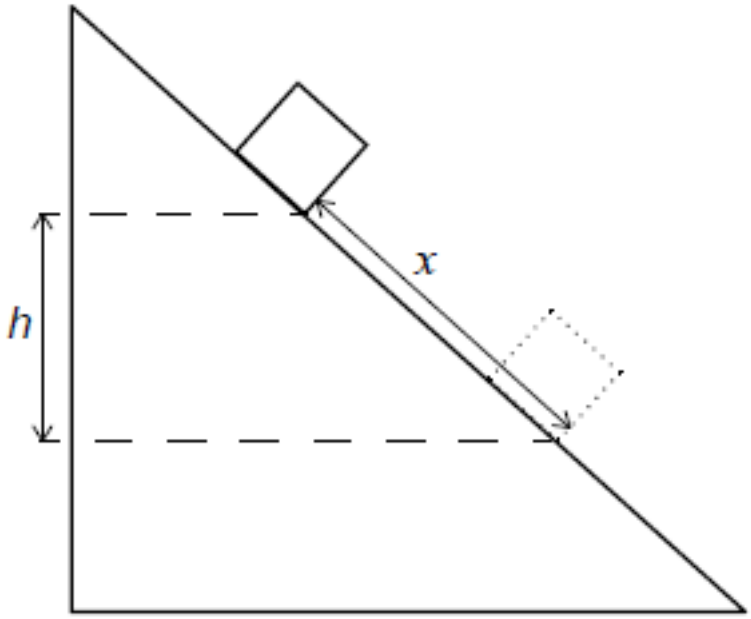
C. $\frac{sgL}{n\Delta T}$

D. $\frac{gL}{m\Delta T}$

[1]

43. 19M.1A.SL.TZ1.6

An object of mass *m* is sliding down a ramp at constant speed. During the motion it travels a distance x along the ramp and falls through a vertical distance *h*. The coefficient of dynamic friction between the ramp and the object is *μ*. What is the total energy transferred into thermal energy when the object travels distance x?



A. *mgh*

B. *mgx*

C. *μmgh*

D. *μmgx*

[1]

44. 19M.1A.SL.TZ2.5

An object has a weight of 6.10×10^2 N. What is the change in gravitational potential energy of the object when it moves through 8.0 m vertically?

A. 5 kJ

B. 4.9 kJ

C. 4.88 kJ

D. 4.880 kJ

[1]

45. 19M.1A.SL.TZ2.6

A boat with an output engine power of 15 kW moves through water at a speed of 10 m s^{-1}. What is the resistive force acting on the boat?

A. 0.15 kN

B. 0.75 kN

C. 1.5 kN

D. 150 kN

[1]

46. 19M.1A.SL.TZ2.7

An astronaut is moving at a constant velocity in the absence of a gravitational field when he throws a tool away from him.

What is the effect of throwing the tool on the total kinetic energy of the astronaut and the tool and the total momentum of the astronaut and the tool?

	Total kinetic energy of the astronaut and tool	Total momentum of the astronaut and tool
A.	no change	increases
B.	no change	no change
C.	increases	increases
D.	increases	no change

[1]