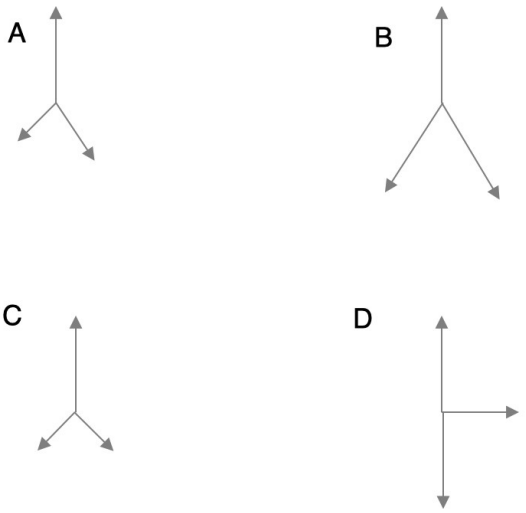
1. What is the best estimate for the radius of a hydrogen atom?

A. 10^{-10} cm
B. 10^{-8} cm
C. 10^{-15} cm
D. 10^{-13} cm

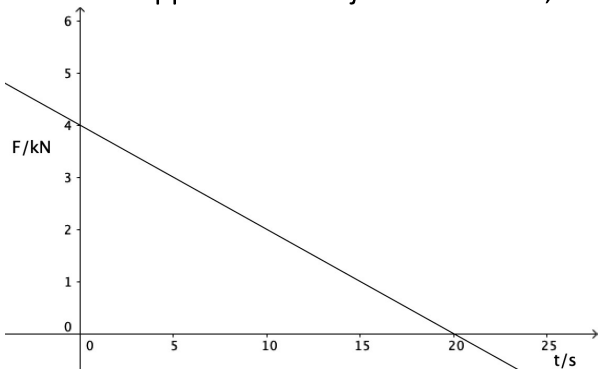
2. A motor raises a 10 kg mass at a constant speed of 5 ms^{-1}. If the input power is1 kW what is the efficiency of the system?

A. 25 %
B. 50 %
C. 100 %
D. 75 %

3. 3 forces act on a point object causing it to accelerate upwards. Which free-body diagram represents this situation?



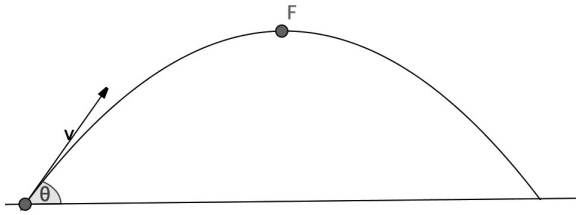
4. The graph represents the force applied to an object of mass 20,000 kg.



What is the change in speed from 0 – 20 s?

A. 4 ms^{-1}
B. 2 ms^{-1}
C. 8 ms^{-1}
D. 16 ms^{-1}

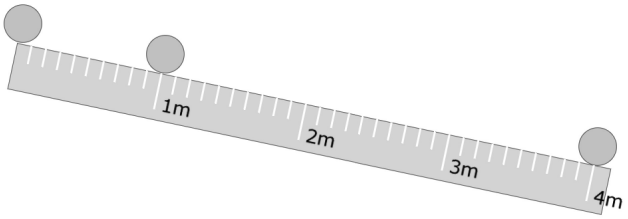
5. A ball of mass m is thrown with initial velocity v at angle θ to the horizontal as shown.



What is the kinetic energy at F?

A. zero
B. $\frac{1}{2}$ mv^2
C. $\frac{1}{2}$ $m(v\cos\theta)^2$
D. $\frac{1}{2}$ $m(v\sin\theta)^2$

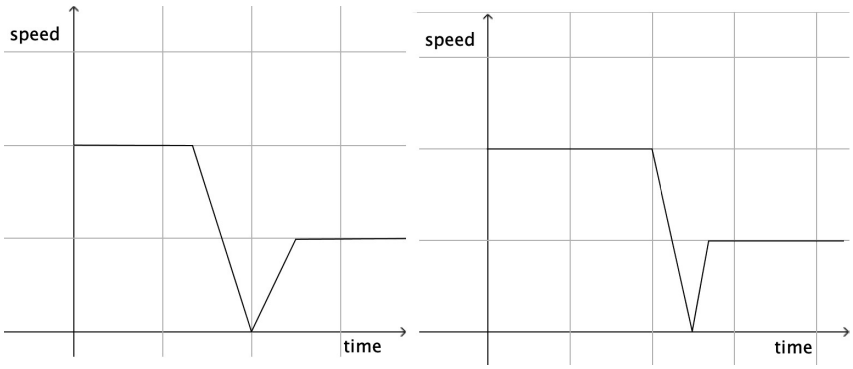
6. A ball starting from rest rolls down a slope with constant acceleration. It is photographed 3 times, at times t= 0 s, t = 1 s and t =2 s.



What Is the acceleration of the ball?

A. 1 ms^{-2}
B. 2 ms^{-2}
C. 3 ms^{-2}
D. 4 ms^{-2}

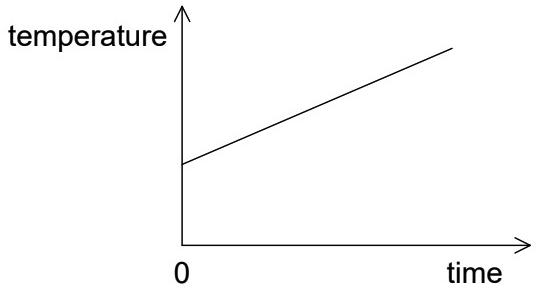
7. The two graphs below represent the collision of two balls of equal mass with a wall.



If the scales on each graph are the same how is the impulse and force different?

	Impulse	**Force**
A.	no difference	different
B.	different	different
C.	no difference	no difference
D.	different	no difference

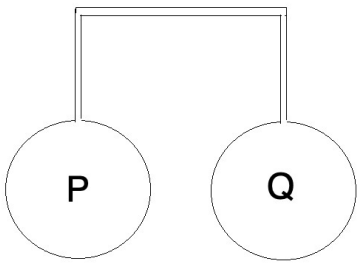
8. The graph shows the rise of temperature as a metal cube of mass m is heated



If the power supplied is P and the gradient of the line k, what is the heat capacity of the metal cube?

A. P/k
B. P/mk
C. Pk
D. Pk/m

9. Two gas flasks of equal volume are connected by a narrow tube. Flask P is kept at a temperature of 200 K and flask Q at 600 K.

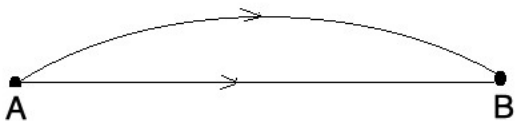


What is the ratio

$$\frac{number\ of\ moles\ in\ P}{number\ of\ moles\ in\ Q}$$

A. 1/3
B. 1
C. 2
D. 3

10. Sound travels from A to B by two paths, one direct 680 m through cold air near the ground and the other 20m longer as it refracts through layers of warm air. Each sound arrives at the same time.



If the speed of sound in cold air is 340 ms^{-1} what is the speed in warm air?

A. 350 ms^{-1}
B. 700 ms^{-1}
C. 320 ms^{-1}
D. 400 ms^{-1}

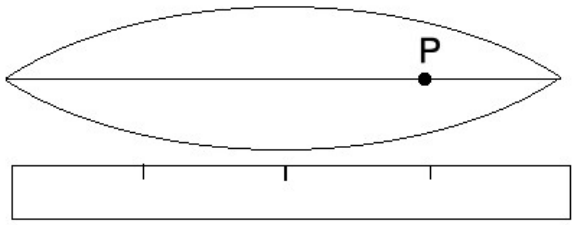
11. What is true about the velocity of a pendulum bob executing simple harmonic motion?

A. It is proportional to displacement
B. It always is in the direction of displacement
C. It is maximum when acceleration is minimum
D. It is inversely proportional to acceleration

12. What are the changes to speed and wavelength when sound passes from air into water?

	Speed	**Wavelength**
A.	increase	increase
B.	increase	decrease
C.	decrease	increase
D.	decrease	decrease

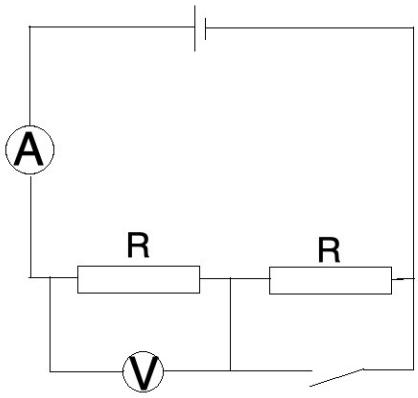
13. The 1st harmonic of the guitar string shown has frequency f.



What frequency note would be played if a node is made to appear at point P?

A. f/4
B. f/2
C. 2f
D. 4f

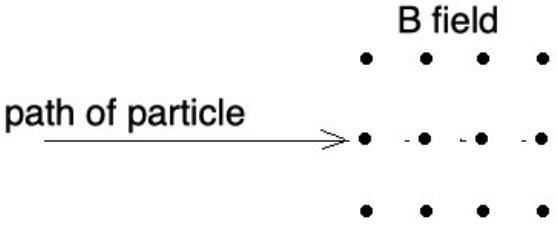
14. The circuit represents two resistors connected to a cell.



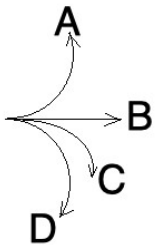
What changes would occur in the ammeter and voltmeter readings if the switch was closed.

	Ammeter	**Voltmeter**
A.	increase	increase
B.	increase	decrease
C.	decrease	increase
D.	decrease	decrease

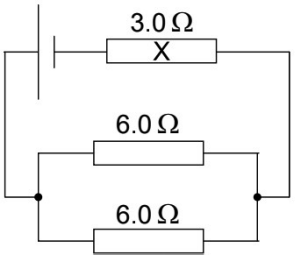
15. A hydrogen atom enters a region of magnetic field, in the direction shown.



Which of the arrows below best represents the path of the particle?



16. A cell of EMF 12 V is connected to 4 resistors as shown.



What is the potential difference across X?

A. 3 V
B. 9 V
C. 6 V
D. 12 V

17. A mass m moves in a circle of radius r at constant speed v due to the tension T in a string.
What is the work done on the mass?

A. Tv
B. $\frac{1}{2}mv^2$
C. $2\pi rT$
D. zero

18. The activity of a radioactive source decays from 110 Bq to 35 Bq in 1 minute. After 1 hour the detector still registers a constant count rate of 10 Bq. What is the half-life of the source?

A. 30 s
B. 15 s
C. 60 s
D. 120 s

19. A radioactive element ${}^{A}_{Z}X$ decays into ${}^{A-4}_{z-1}Y$. Which series of emissions could result in this?

A. 2β
B. 1α
C. 1α, 1β
D. 1α, 2β

20. Which conservation law is violated by the following interaction?

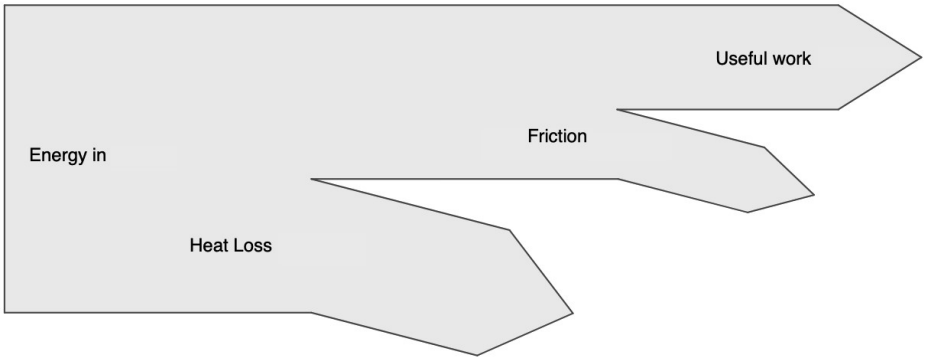
$$p^{+} + e^{-} \rightarrow n^{0}$$

A. Strangeness
B. Lepton number
C. Baryon number
D. Charge

21. The power output from a wind turbine is 10 kW with a wind speed of 4 ms^{-1}. What will the power output be for a wind speed of 12 ms^{-1}?

A. 90 kW
B. 180 kW
C. 270 kW
D. 360 kW

22. The Sankey diagram represents the energy flow in a power station.



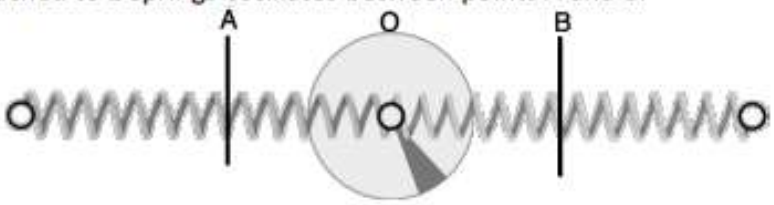
The efficiency of the power station is approximately

A. 30 %
B. 50 %
C. 75 %
D. 90 %

23. What part of a nuclear power station reduces the rate of the chain reaction?

A. Moderator
B. Heat exchanger
C. Pressure vessel
D. control rod

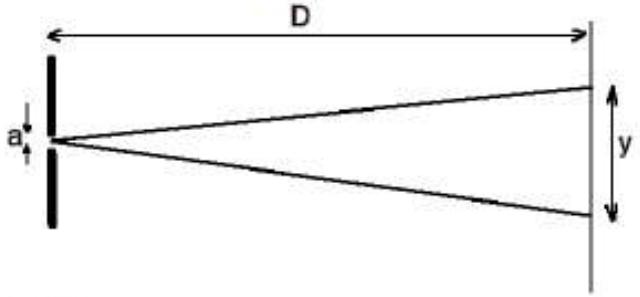
24. A mass attached to 2 springs oscillates between points A and B.



At which position is the resultant force on the mass zero?

A. A
B. B
C. O
D. The resultant force is never zero

25. The diagram represents light of wavelength λ diffracted by a slit of width a.



What change would increase y?

A. Increase a
B. Decrease a
C. Decrease D
D. Decrease λ