1. Instantaneous velocity is defined as...

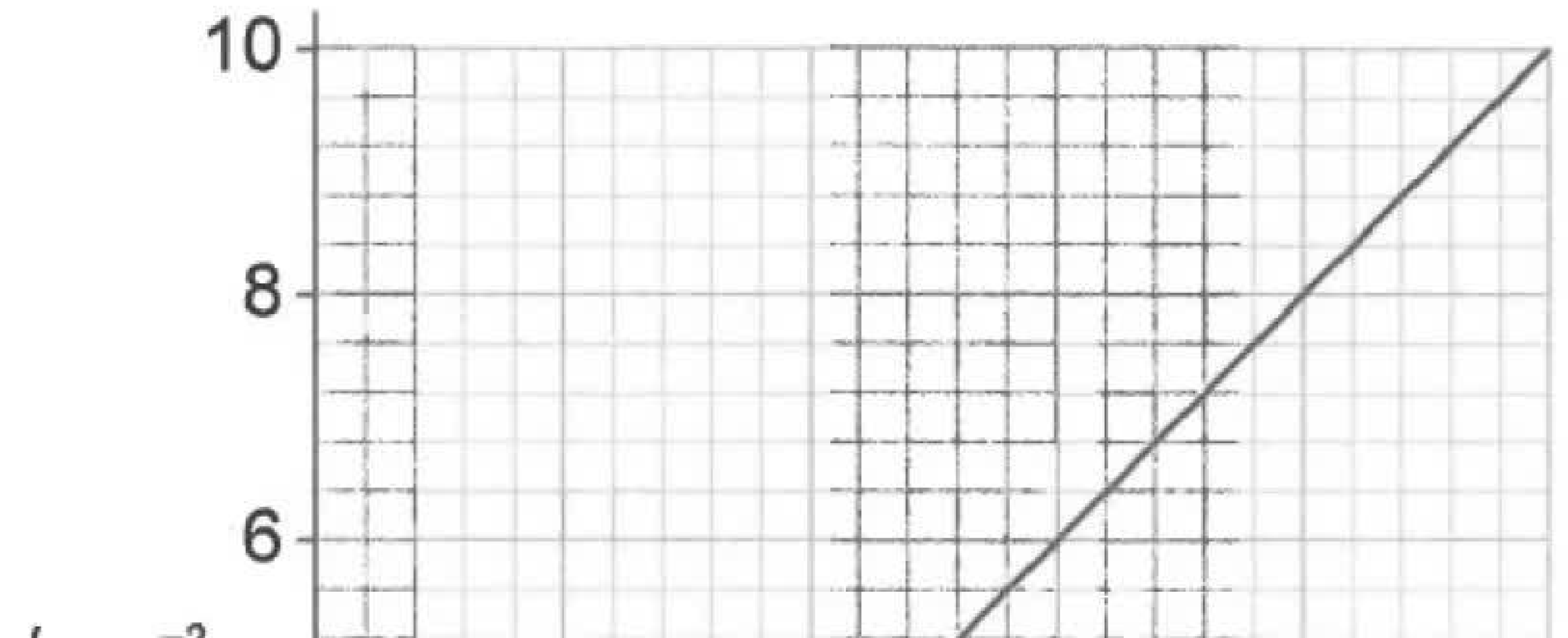
A. $\dfrac{\text{displacement}}{\text{time taken}}$.

B. rate of change of position.

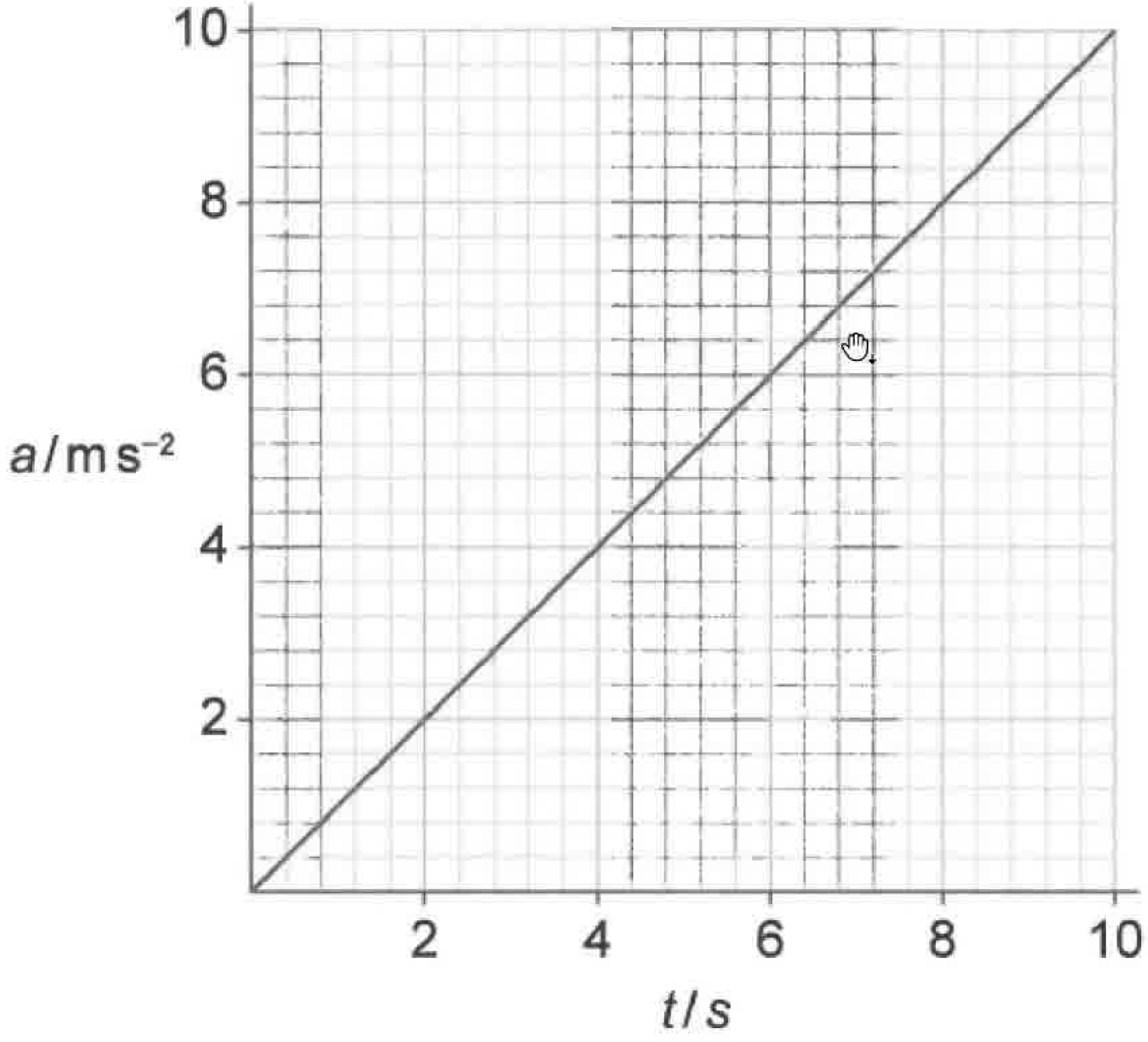
C. $\dfrac{\text{distance moved}}{\text{time taken}}$.

D. rate of change of distance.

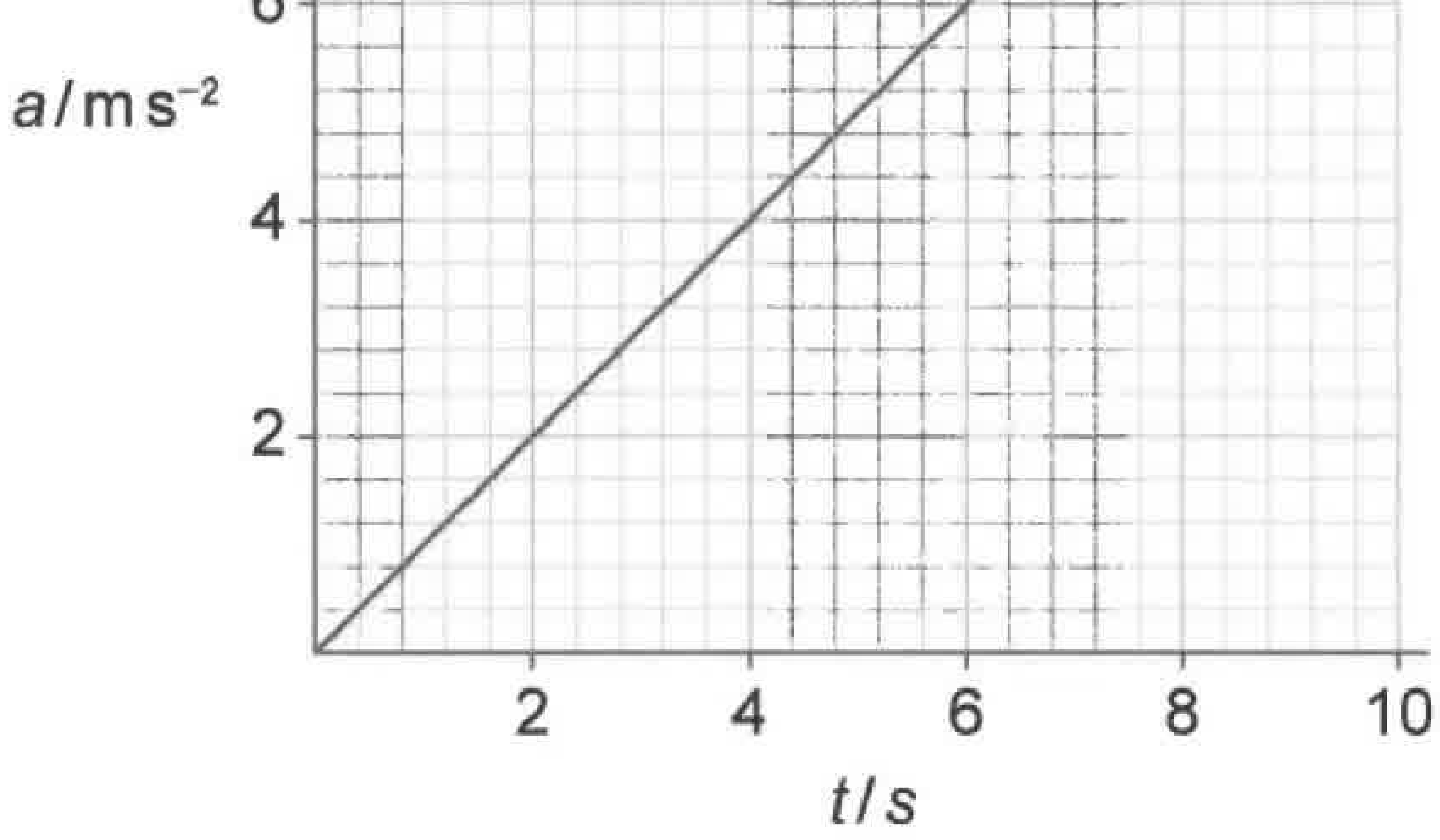
2. The variation with time t of the acceleration a of an object is shown. At $t = 0$ the object is at rest.



2. The variation with time t of the acceleration a of an object is shown. At $t = 0$ the object is at rest.



What is the speed of the object when $t = 8.0$ s?



What is the speed of the object when $t = 8.0\,\text{s}$?

A. $1.0\,\text{m s}^{-1}$

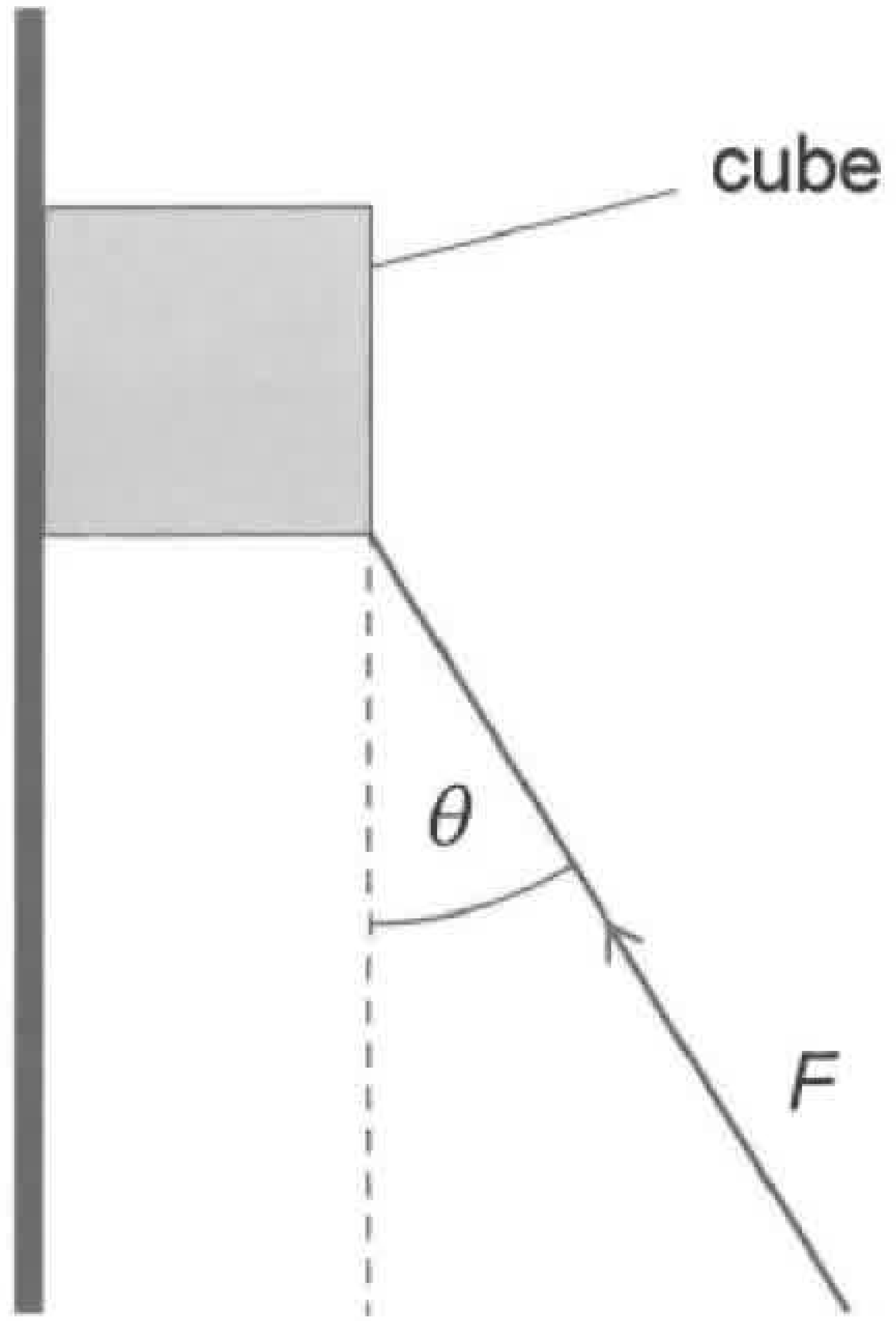
B. $32\,\text{m s}^{-1}$

C. $50\,\text{m s}^{-1}$

D. $64\,\text{m s}^{-1}$

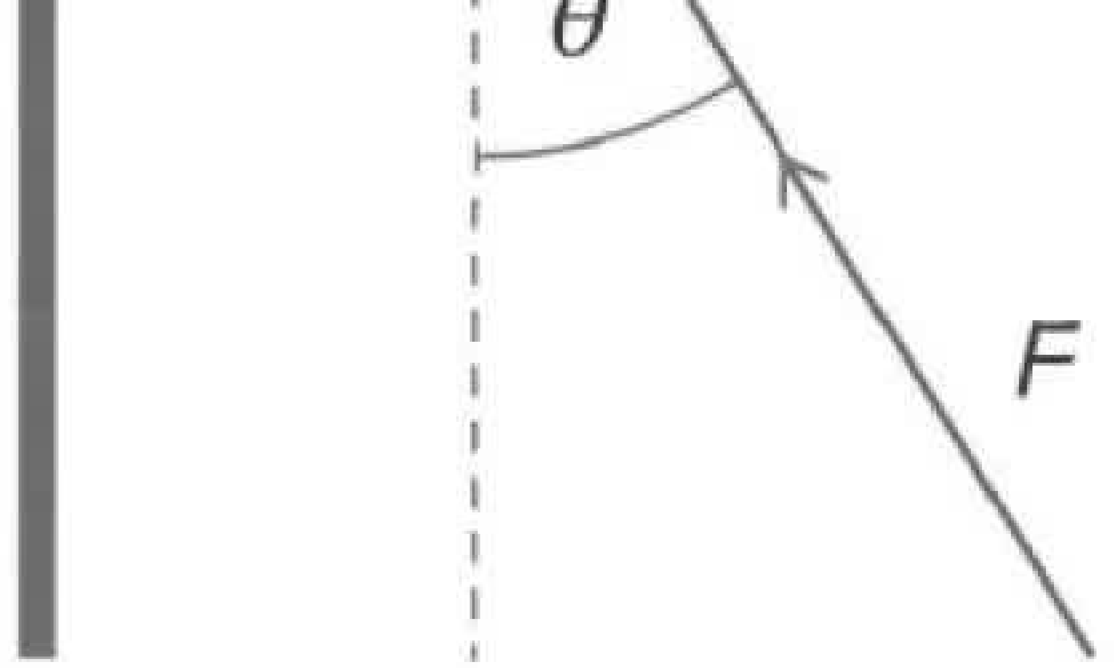
3. A force acts on a cube of mass *m* that accelerates upwards along a vertical frictionless surface.

The magnitude of the force is *F* and it acts at θ to the vertical.



What is the magnitude of the acceleration of the cube?

$(F\cos\theta - mg)$



What is the magnitude of the acceleration of the cube?

A. $\dfrac{(F\cos\theta - mg)}{m}$

B. $\dfrac{(F\sin\theta - mg)}{m}$

C. $\dfrac{(F\cos\theta - g)}{m}$

D. $\dfrac{(F\sin\theta - g)}{m}$

4. A sphere of density ρ and radius R rests on the bottom of a tank of water. The buoyancy force on

m

D. $\dfrac{(F\sin\theta - g)}{m}$

4. A sphere of density ρ and radius R rests on the bottom of a tank of water. The buoyancy force on the sphere is F_1.

A sphere of density 2ρ and radius $\dfrac{R}{2}$ is at the bottom of the same tank. The buoyancy force on the second sphere is F_2.

What is $\dfrac{F_1}{F_2}$?

A. 2

B. 4

C. 8

D. 16

5. A spring obeys Hooke's law and has a spring constant k.
The spring is extended horizontally. The extension of the spring is x.
When released, the spring returns to its original length in time Δt.

What is the average power developed by the spring as it returns to its original length?

A. $\dfrac{kx}{2\Delta t}$

B. $\dfrac{kx}{\Delta t}$

C. $\dfrac{kx^2}{2\Delta t}$

D. $\dfrac{kx^2}{\Delta t}$

6. An object of mass 5.0 kg is initially at rest. An impulse of 2.0 N s acts on the object.

What is the final kinetic energy of the object?

B. $\frac{kx}{\Delta t}$

C. $\frac{kx^2}{2\Delta t}$

D. $\frac{kx^2}{\Delta t}$

6. An object of mass 5.0 kg is initially at rest. An impulse of 2.0 N s acts on the object.

What is the final kinetic energy of the object?

A. 0.40 J

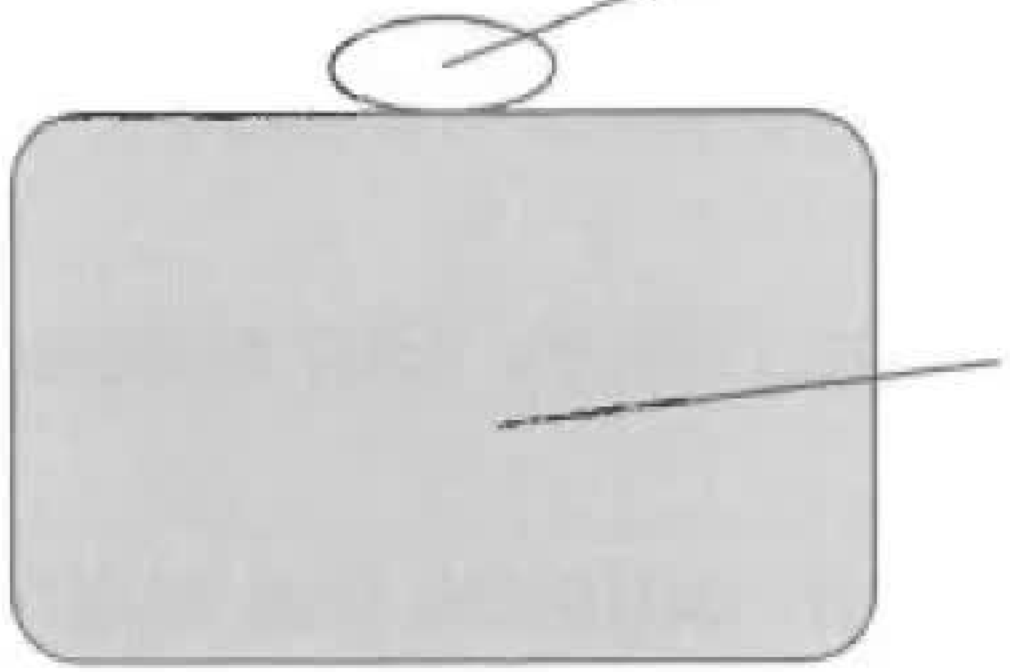
B. 10 J

C. 20 J

D. 40 J

7. A block of ice of mass M is at its melting point.

A smaller mass m of water at a temperature of T°C is placed on the top surface of the ice and remains there.

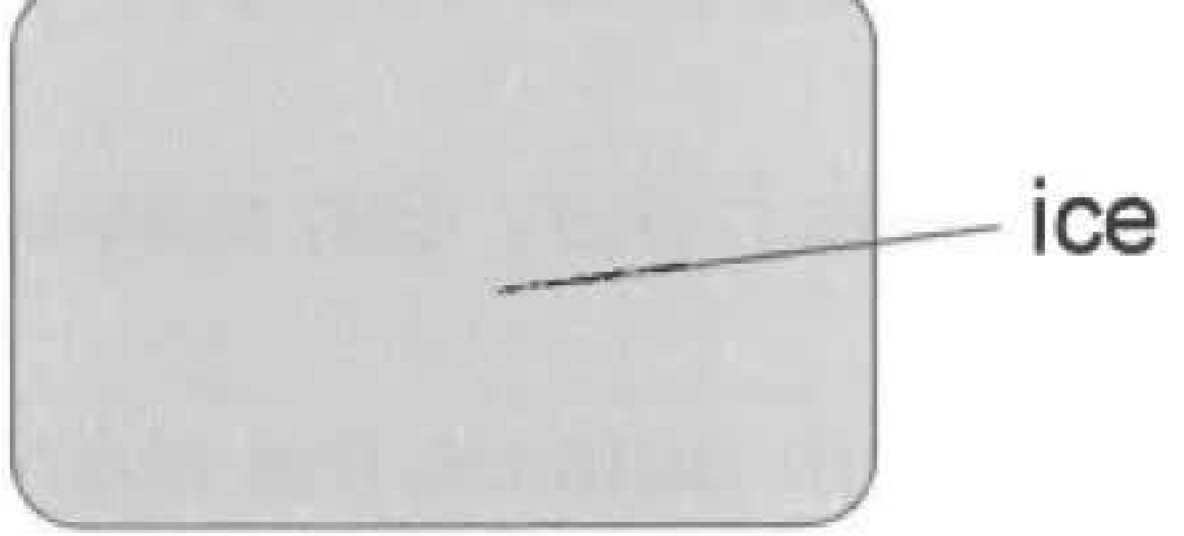


The specific latent heat of fusion of ice is L and the specific heat capacity of water is c.

What mass of ice melts?

A. $\frac{mcT}{L}$

B. $\frac{mLT}{}$



The specific latent heat of fusion of ice is L and the specific heat capacity of water is c.

What mass of ice melts?

A. $\dfrac{mcT}{L}$

B. $\dfrac{mLT}{c}$

C. $\dfrac{McT}{L}$

D. $\dfrac{MLT}{c}$

8. What is a primary cause of the enhanced greenhouse effect?

B. $\frac{mLT}{c}$

C. $\frac{McT}{L}$

D. $\frac{MLT}{c}$

8. What is a primary cause of the enhanced greenhouse effect?

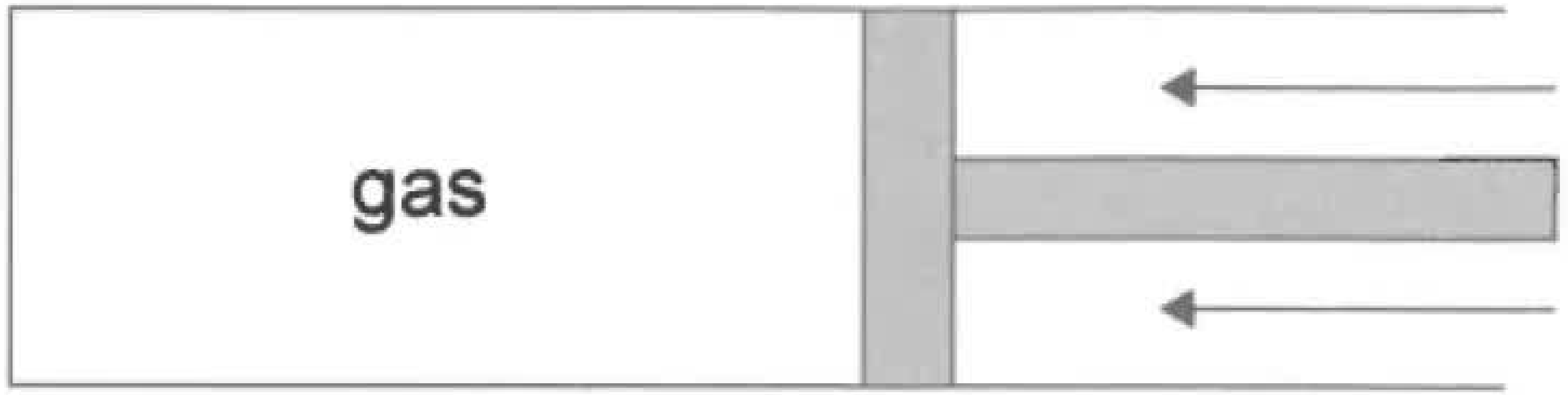
A. Melting of ice at Earth's poles

B. Increases in volcanic activity

C. Deforestation of rain forests

D. Burning of fossil fuels

9. An ideal gas is held in a cylinder by a piston. The piston compresses the gas rapidly.



The average speed of the gas molecules increases because the gas molecules...

A. have a smaller volume available in which they can move.

B. receive thermal energy transferred from outside the cylinder.

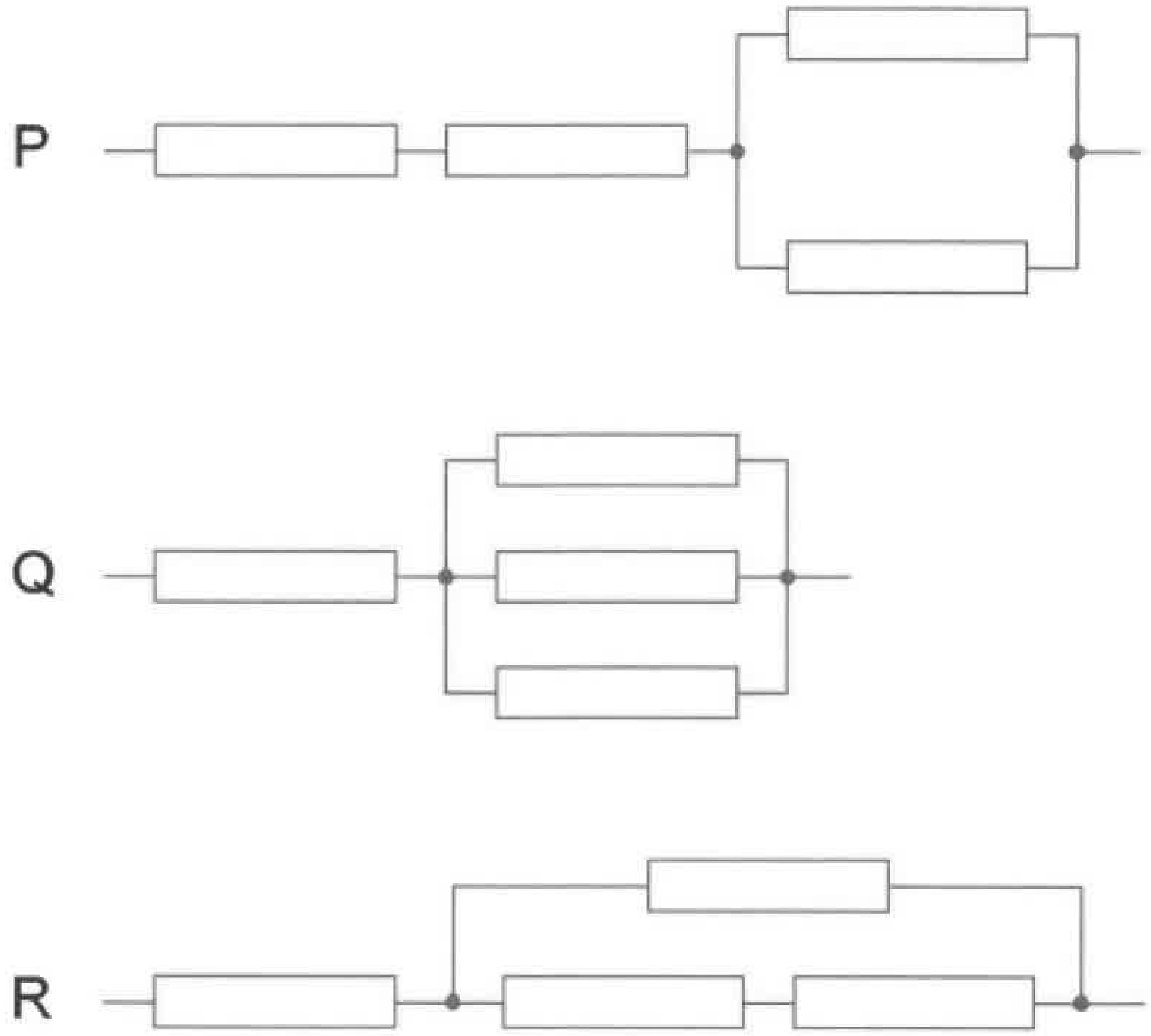
C. receive energy from the piston as they collide with it.

D. make more collisions every second with each other.

10. Three combinations of resistors are shown. The resistors are identical.

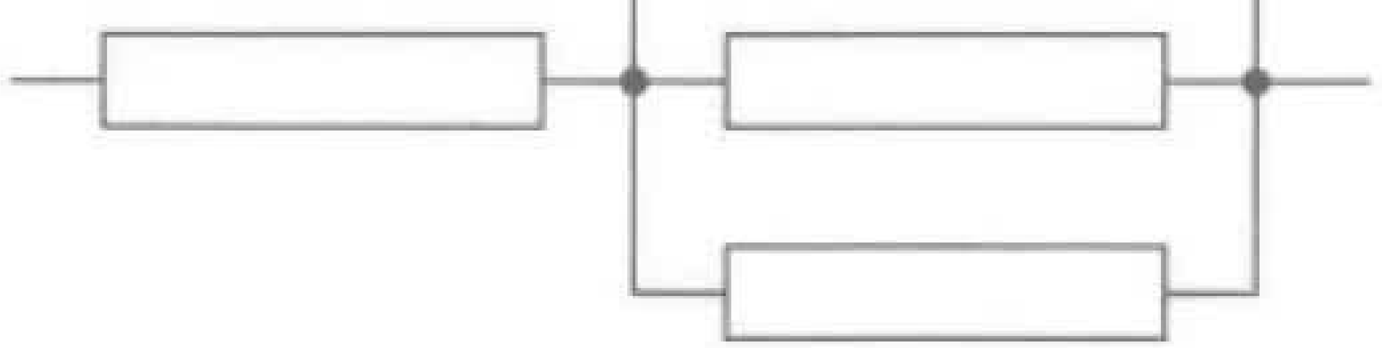
D. make more collisions every second with each other.

10. Three combinations of resistors are shown. The resistors are identical.

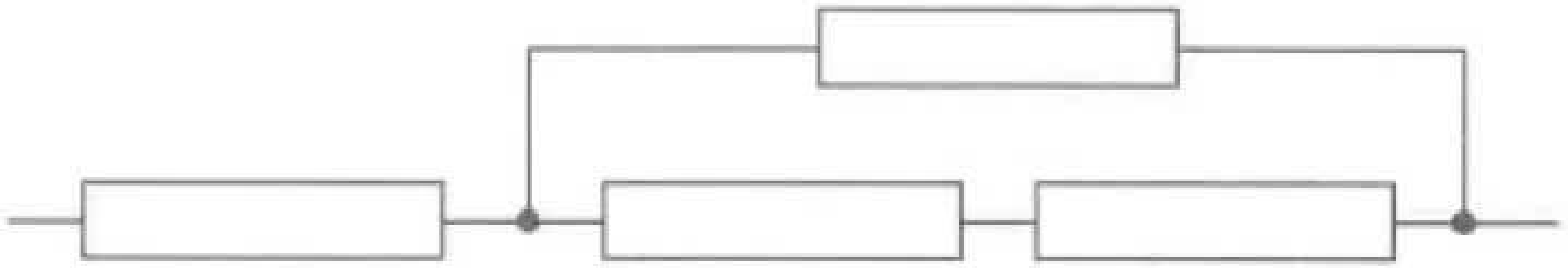


What is the total resistance of each combination of resistors in order of **increasing** resistance?

Q



R



What is the total resistance of each combination of resistors in order of **increasing** resistance?

A. P Q R

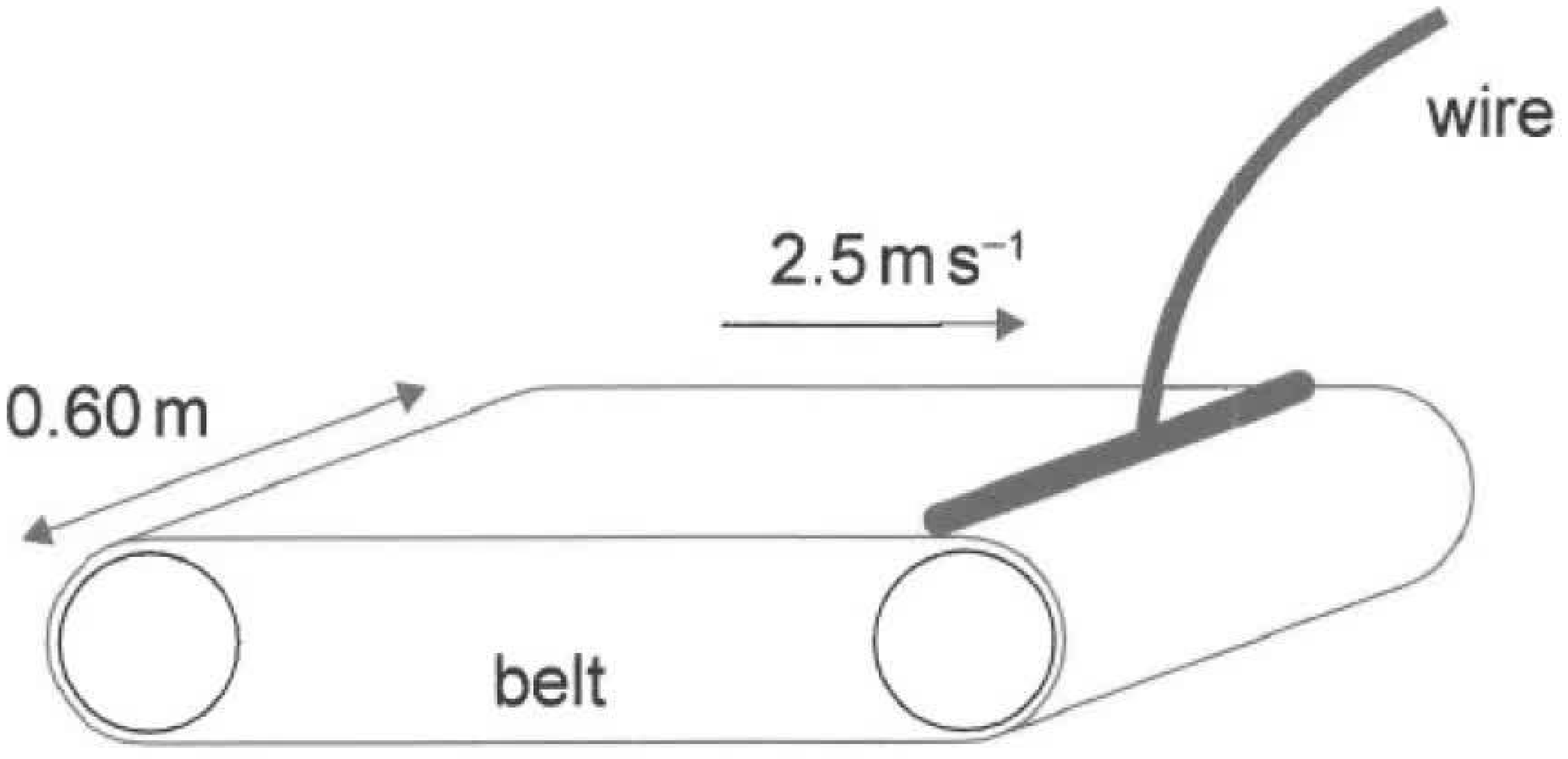
B. Q P R

C. P R Q

D. Q R P

11. A continuous belt of width 0.60 m travels at a constant speed of $2.5\,\text{m}\,\text{s}^{-1}$. The belt has a uniform distribution of charge of $5.0\,\text{mC}\,\text{m}^{-2}$ on its surface.

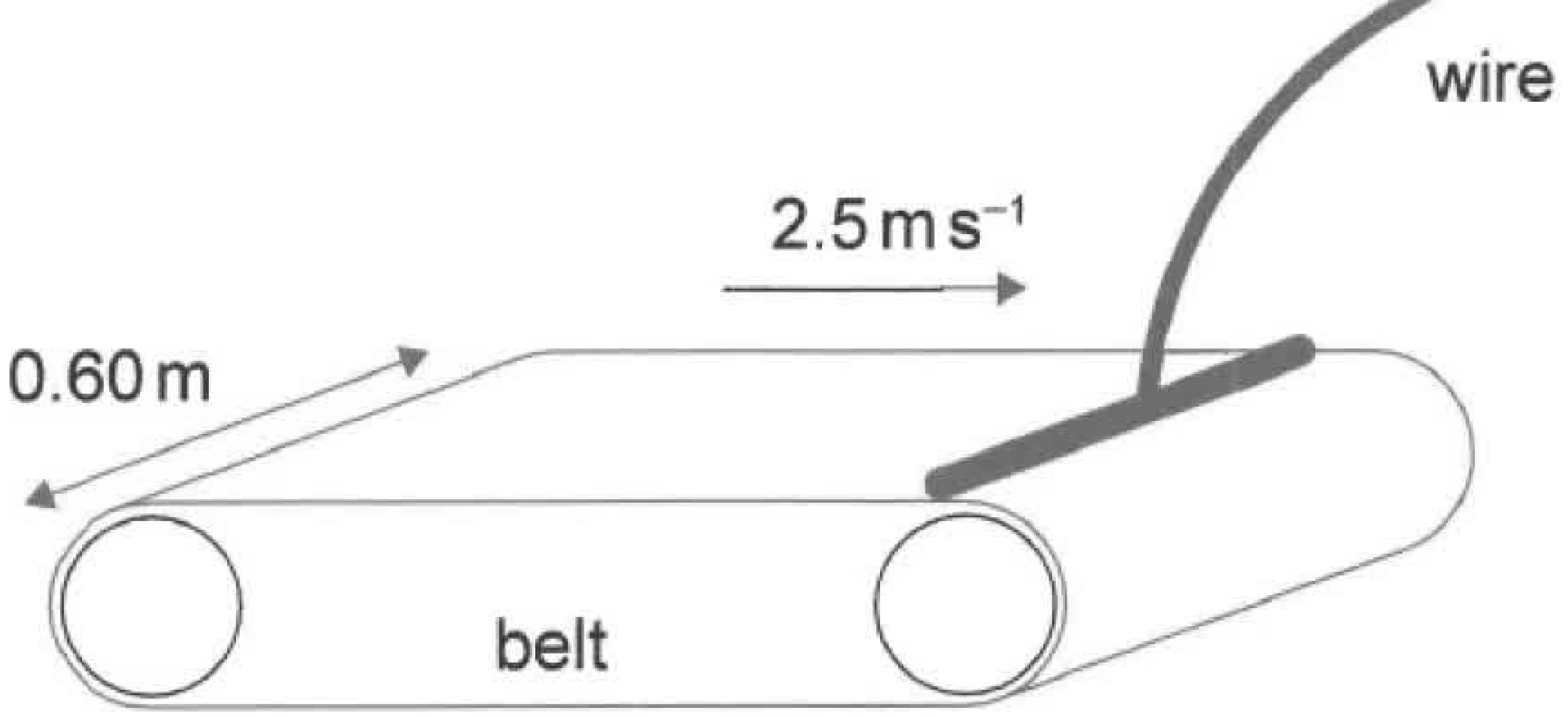
As the belt passes a point all the charge is removed and is carried as a current in a wire.



What is the current in the wire?

A. 1.2 mA

B. 7.5 mA



What is the current in the wire?

A. 1.2 mA

B. 7.5 mA

C. 19 mA

D. 21 mA

12. A solar panel has a surface area of 0.20 m^2. The efficiency of the solar panel is 30 %. At one instant the radiation intensity at normal incidence to the panel is 0.15 kJ m^{-2} s^{-1}.

A. 1.2 mA

B. 7.5 mA

C. 19 mA

D. 21 mA

12. A solar panel has a surface area of $0.20\,m^2$. The efficiency of the solar panel is 30%. At one instant the radiation intensity at normal incidence to the panel is $0.15\,kJ\,m^{-2}\,s^{-1}$.

What is the power output of the panel?

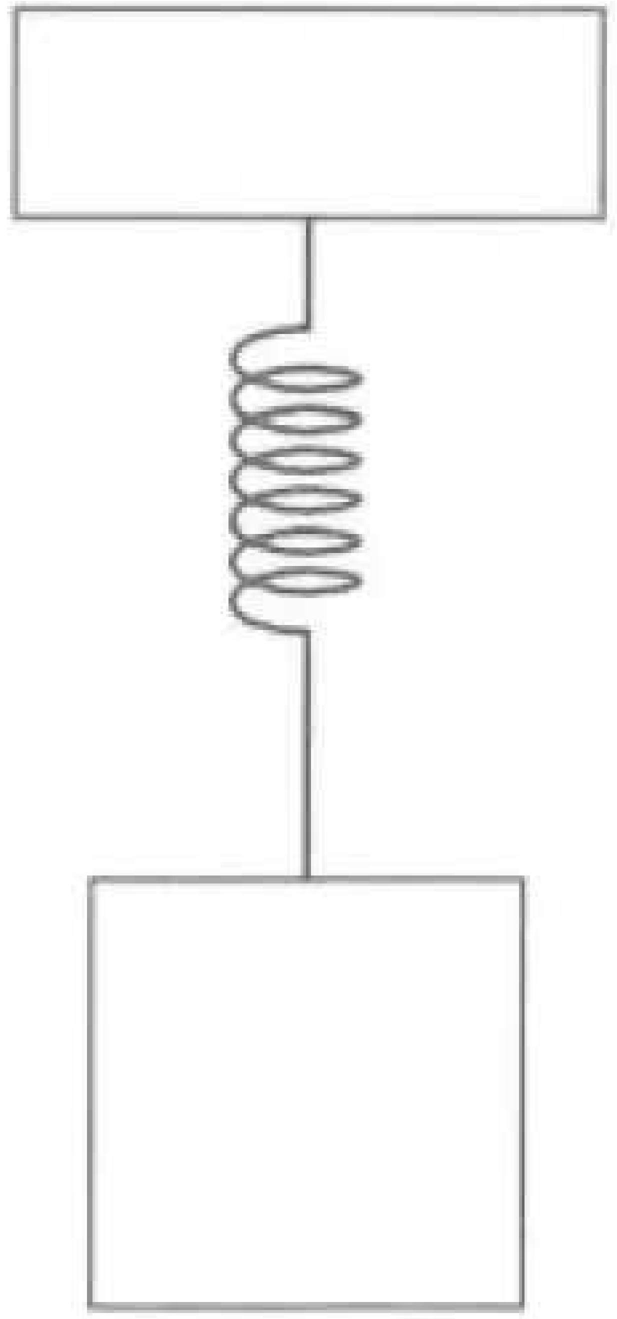
A. 9.0 mW

B. 30 mW

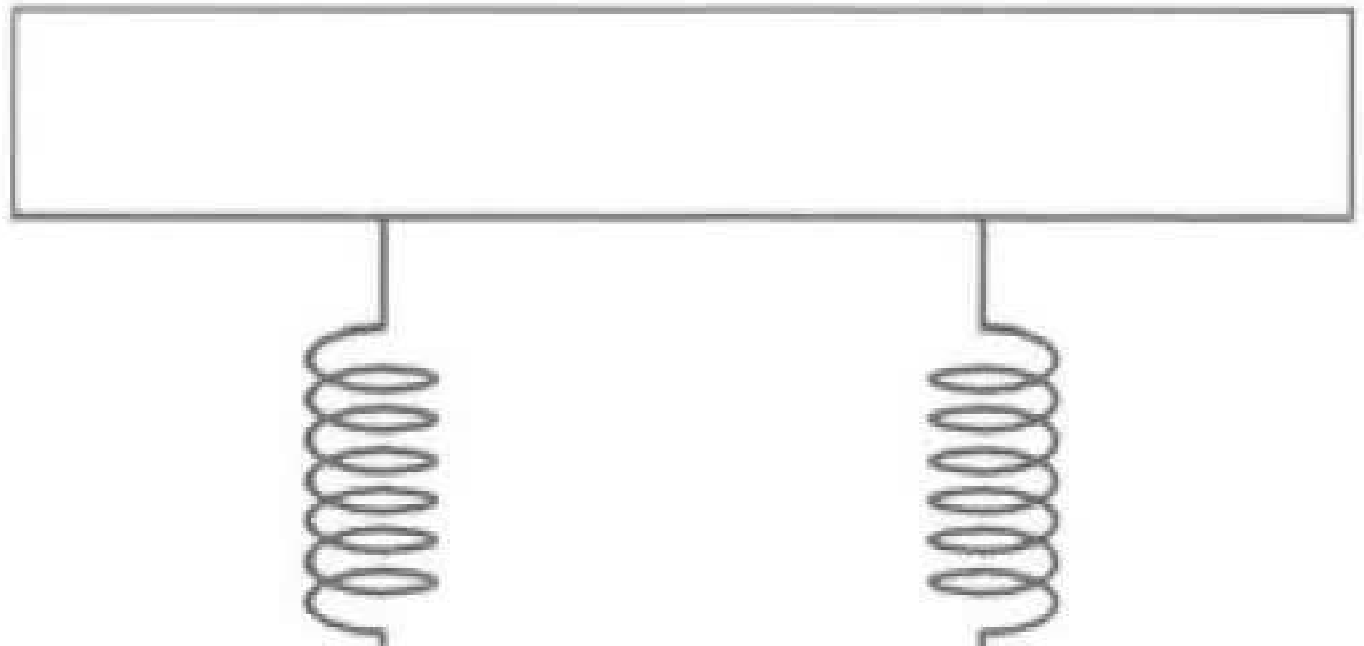
C. 9.0 W

D. 30 W

13. A mass–spring system oscillates with time period T_1.



Another identical spring is connected in parallel with the first spring as shown. The mass is unchanged.



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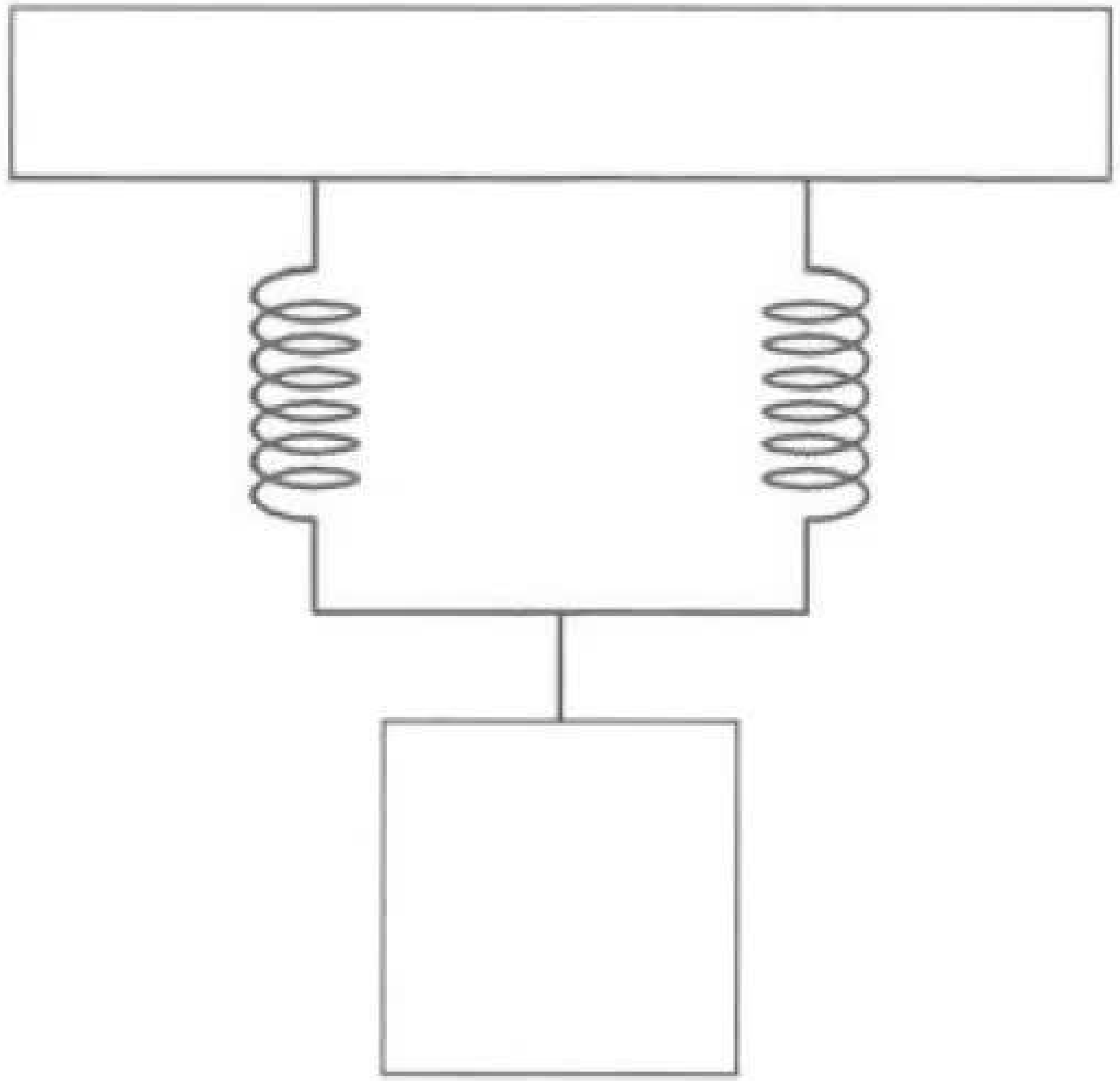
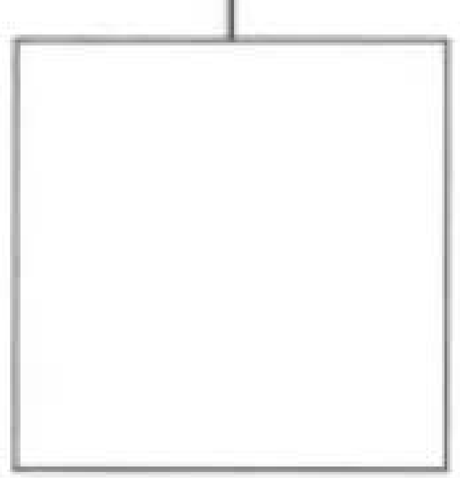


The time period of the oscillation for the two-spring system is T_2.

What is $\frac{T_2}{T_1}$?



The time period of the oscillation for the two-spring system is T_2.

What is $\frac{T_2}{T_1}$?

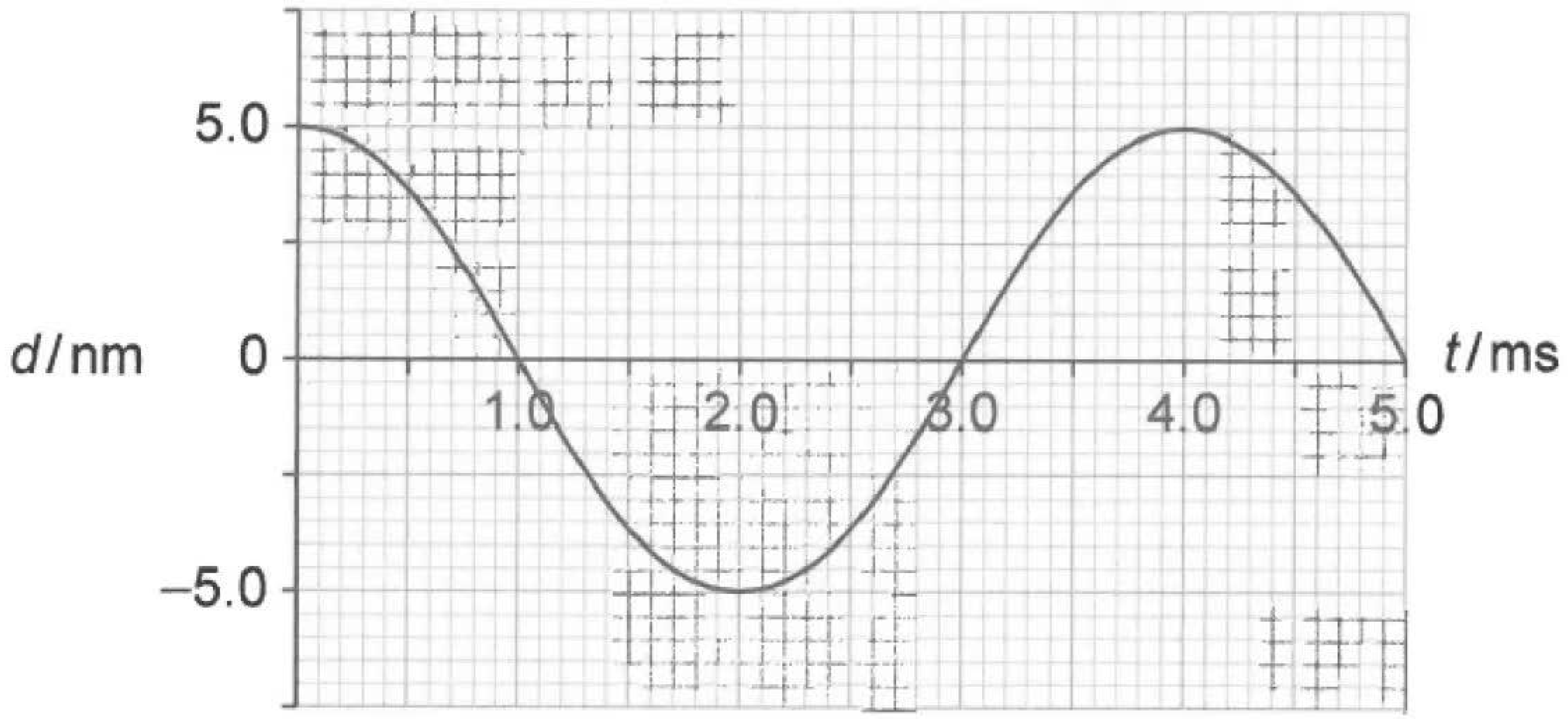
A. $\frac{1}{2}$

B. $\frac{1}{\sqrt{2}}$

C. $\sqrt{2}$

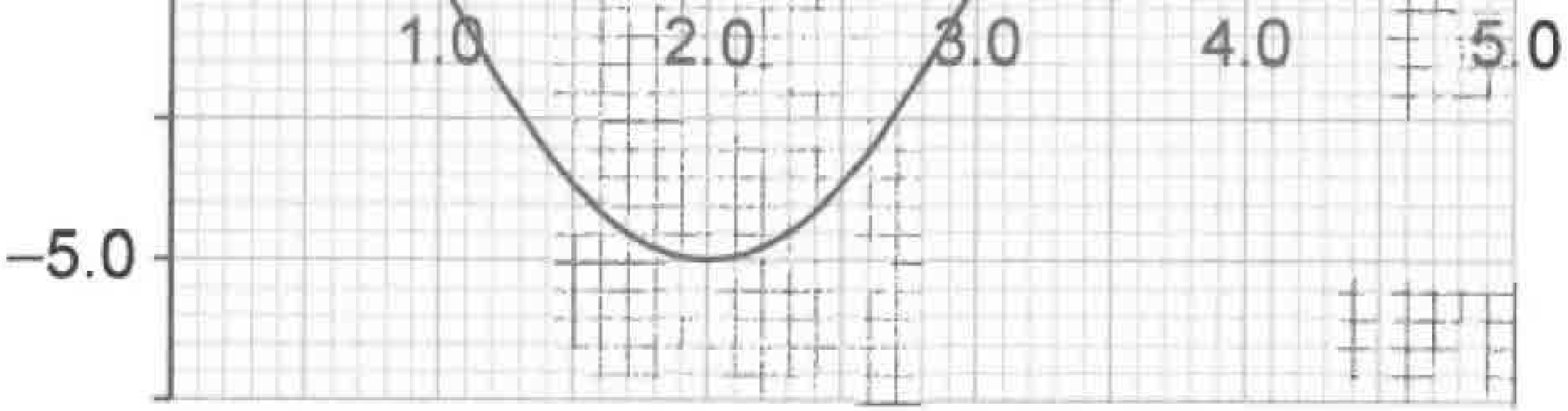
D. 2

14. A wave is travelling through a medium. The variation with time *t* of the displacement *d* of a particle in the medium is shown.



What is the frequency and the amplitude of the wave?

	Frequency / Hz	Amplitude / nm
A.	4.0×10^{-3}	5.0
B.	250	5.0



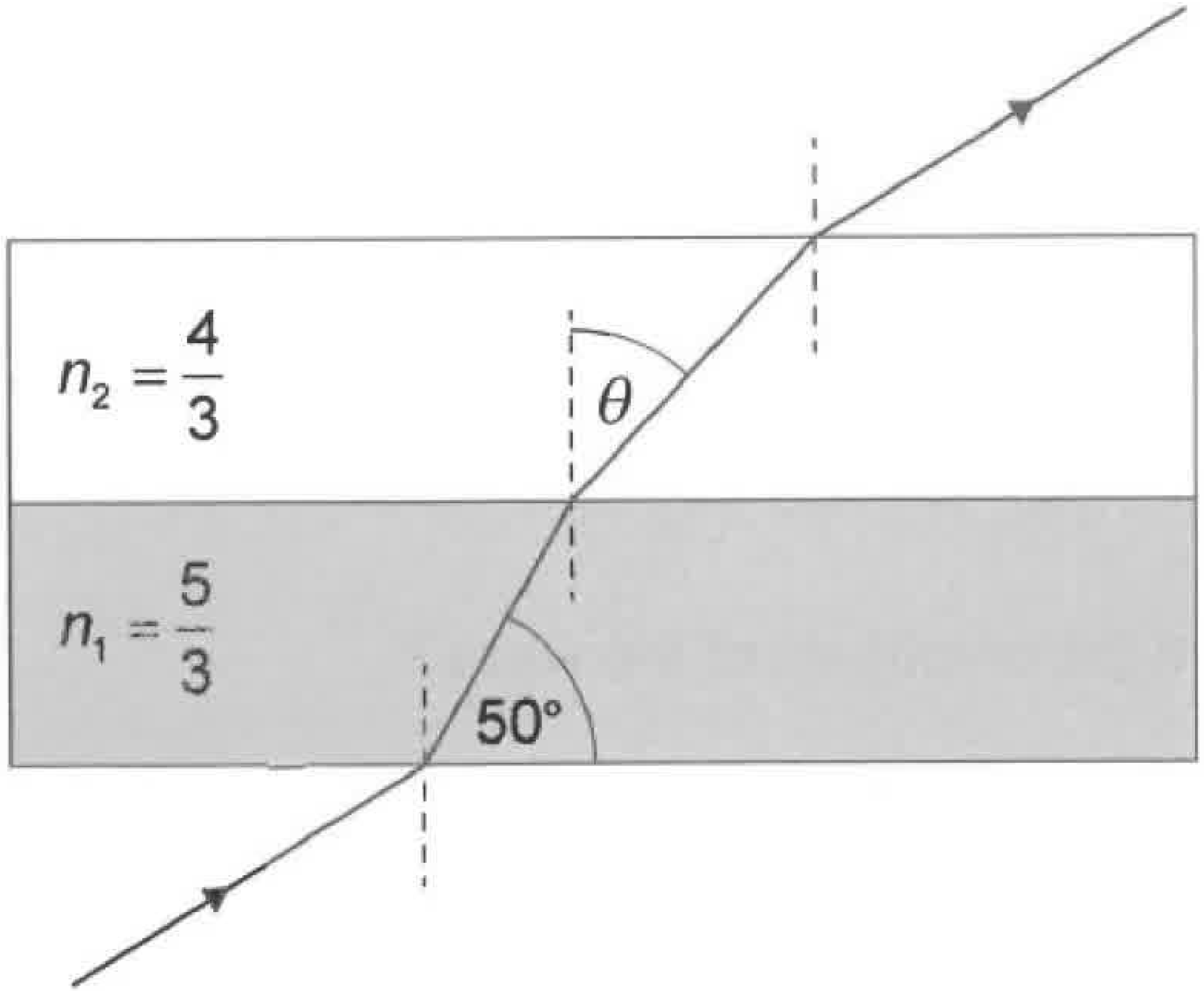
What is the frequency and the amplitude of the wave?

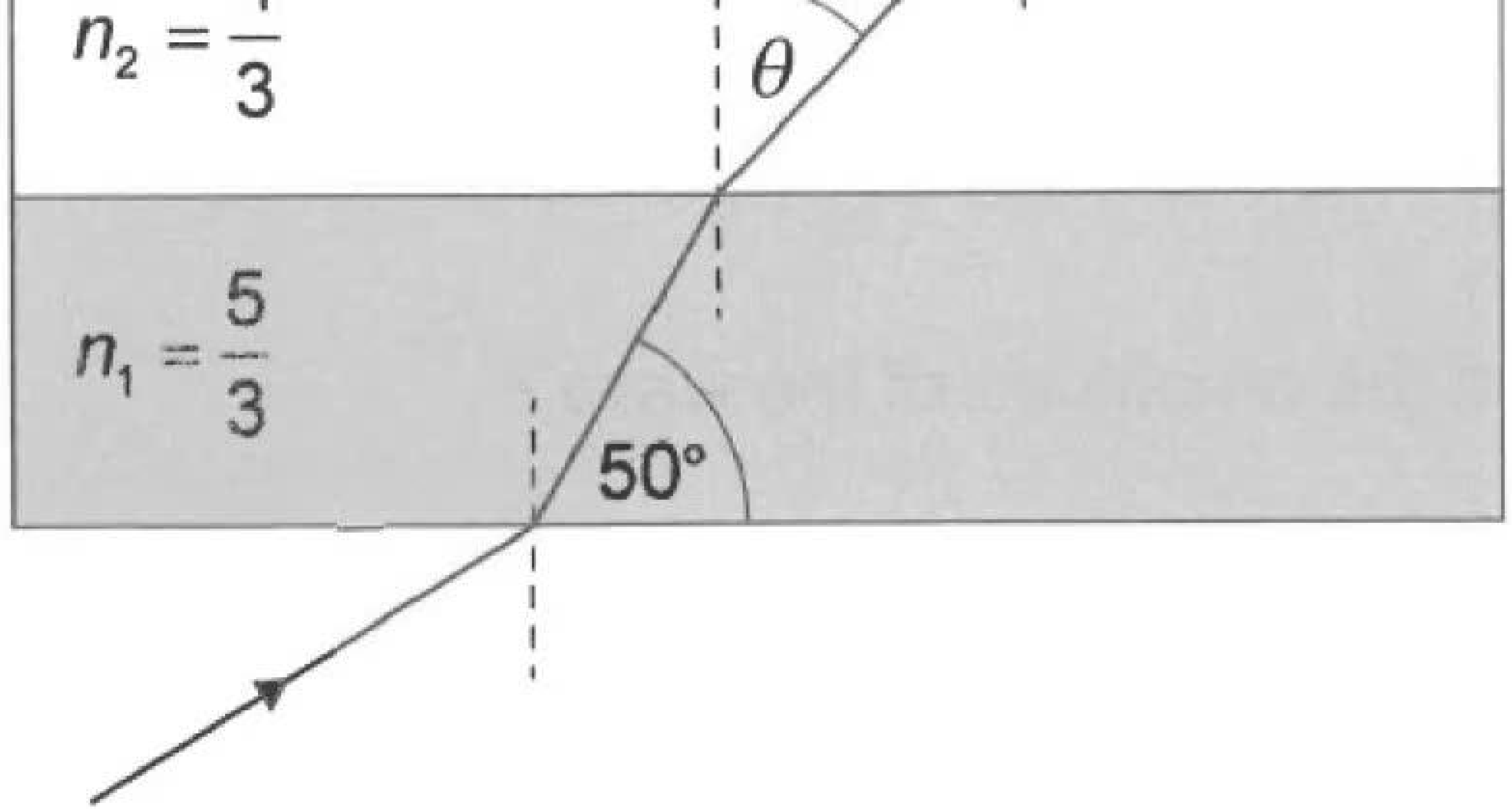
	Frequency / Hz	Amplitude / nm
A.	4.0×10^{-3}	5.0
B.	250	5.0
C.	4.0×10^{-3}	10.0
D.	250	10.0

15. Light passes through two parallel layers as shown.

The refractive indices for light travelling between air and the media are shown in the diagram as n_1 and n_2.

diagram not to scale





What is θ?

A. 31°

B. 38°

C. 53°

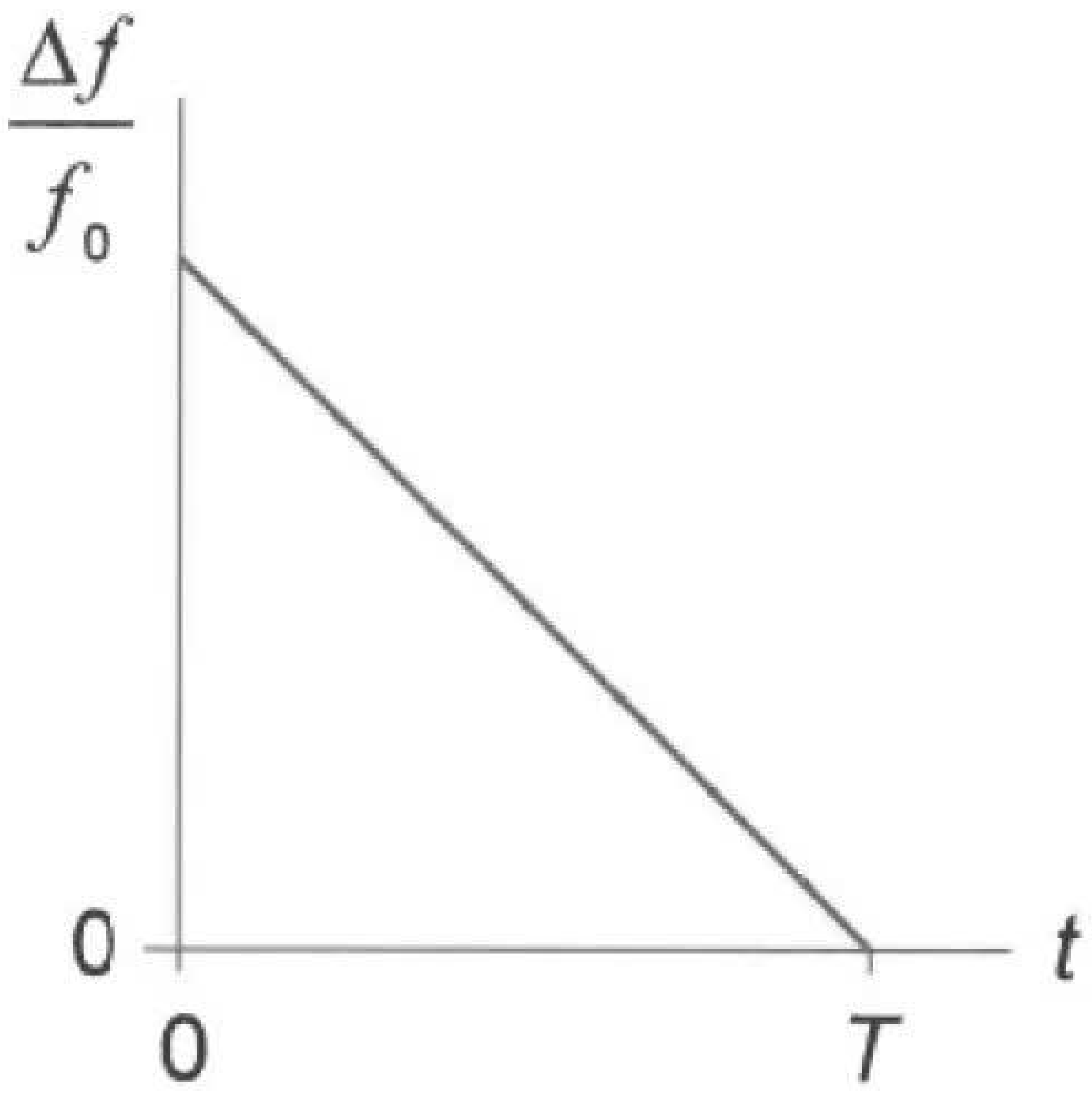
D. 73°

16. A source emitting a sound of frequency f_0 is approaching an observer. At time $t = 0$ the source begins to decelerate and comes to rest when $t = T$. The source does not pass the observer.

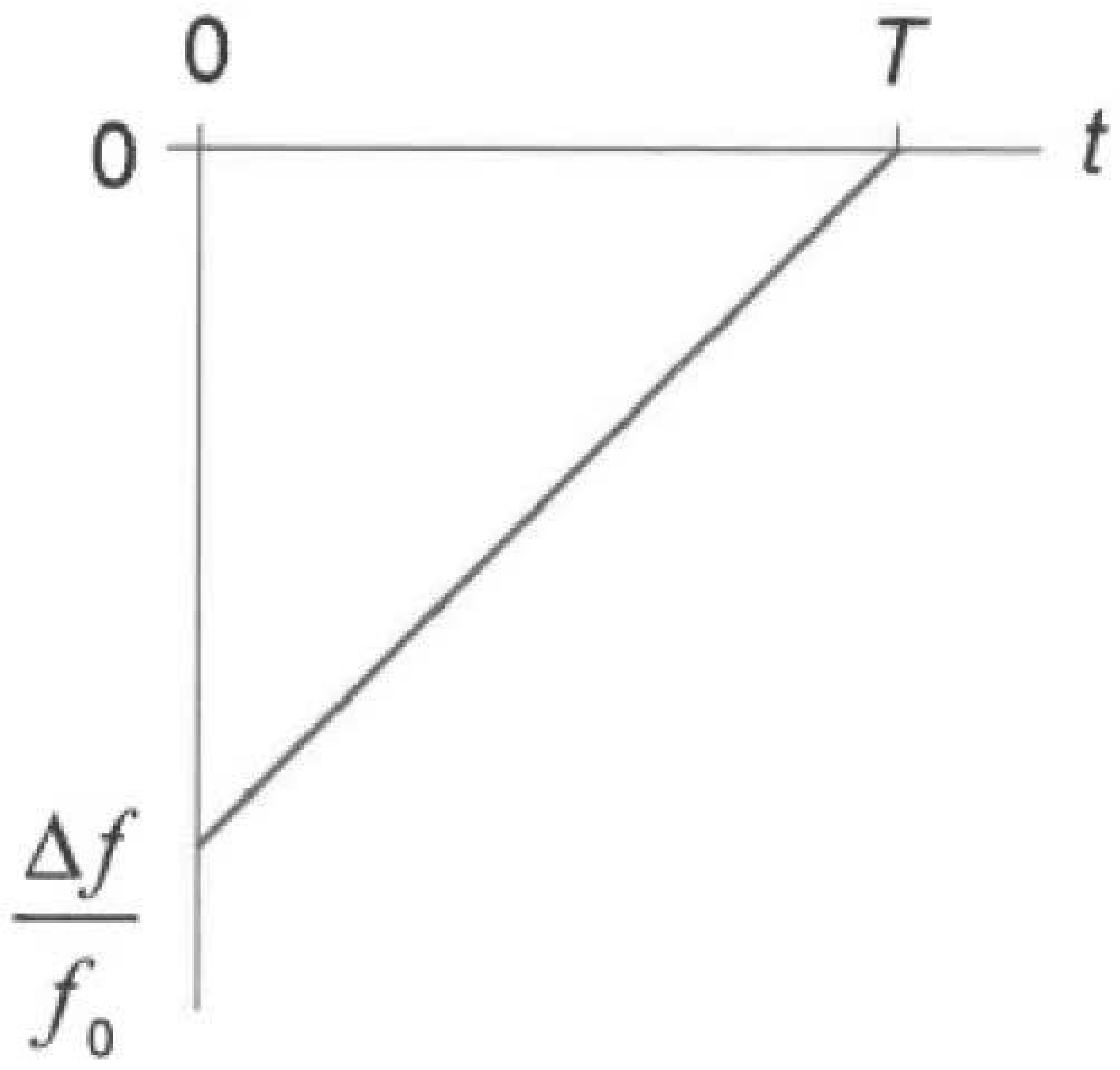
The speed of the source is always much less than the speed of sound.

What is the variation with t of the relative change of frequency $\frac{\Delta f}{f_0}$ of the observed sound?

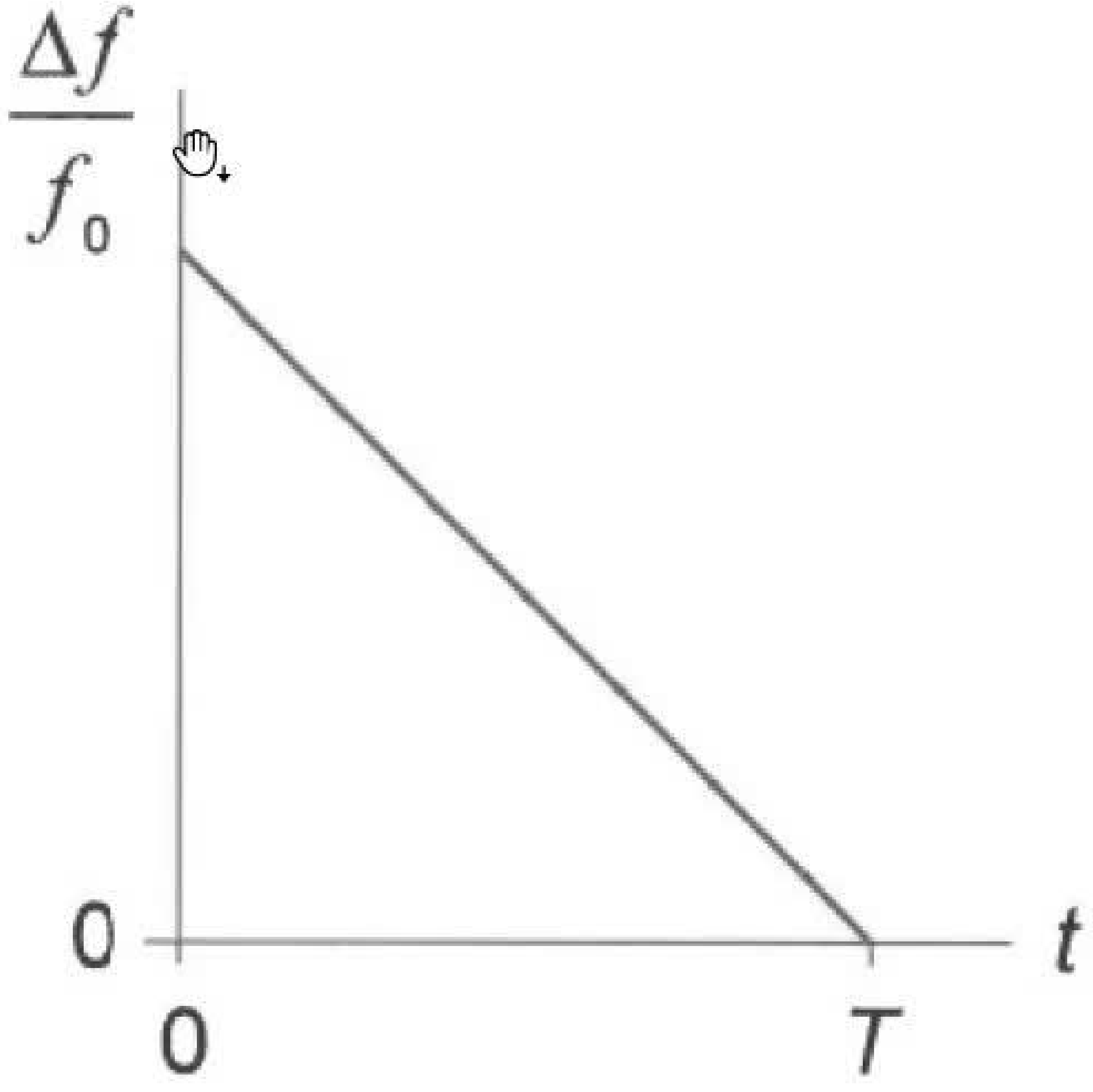
A.



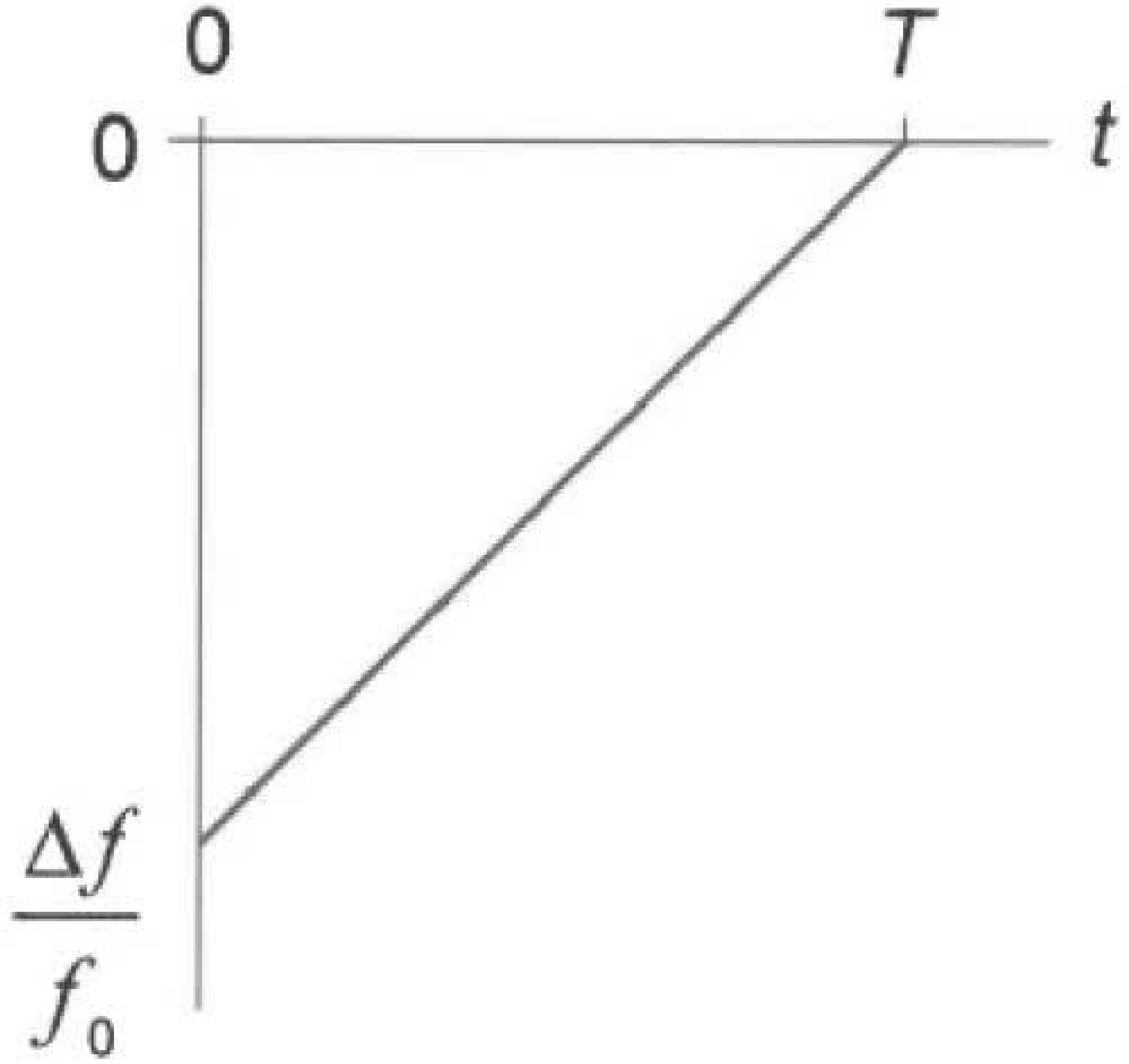
B.



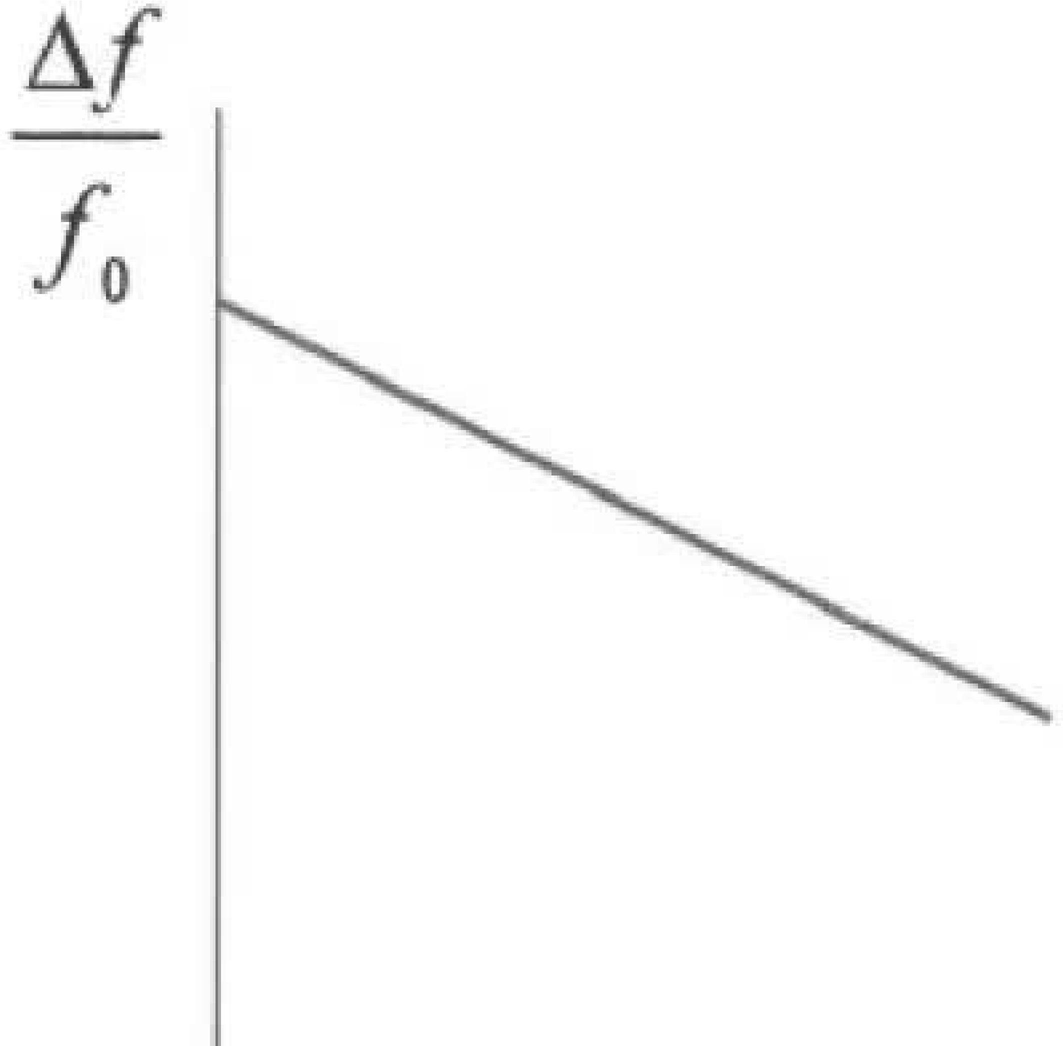
A.



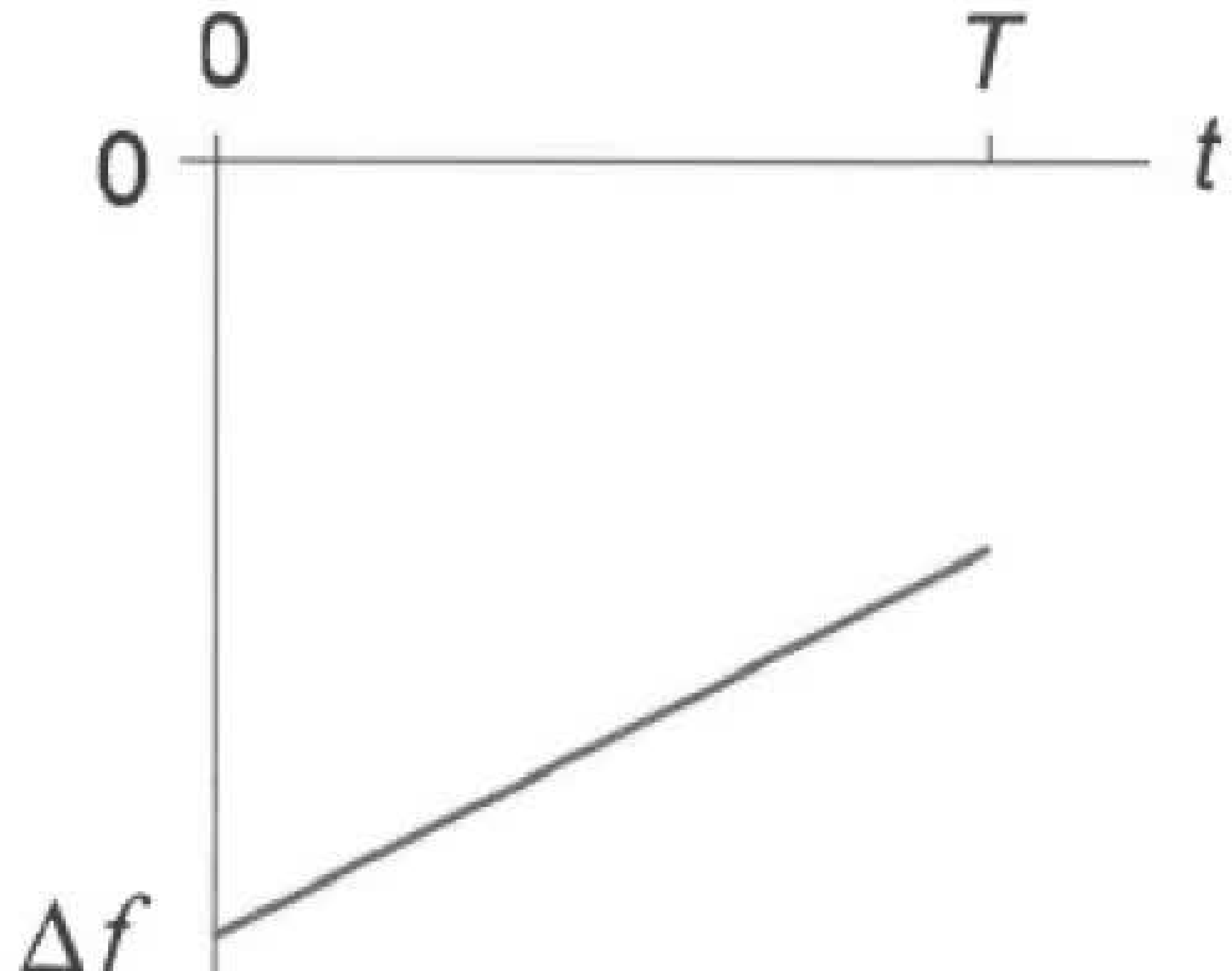
B.

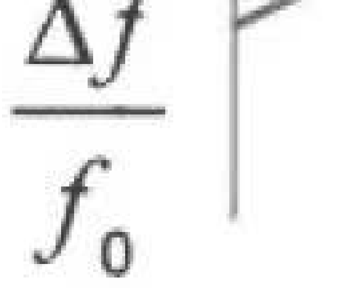


C.



D.





17. A planet P has a diameter one-third that of the Earth. The mass of Earth is 18 times that of P.

The gravitational field strength at the surface of the Earth is g.

What is the gravitational field strength at the surface of P?

A. $\frac{g}{6}$

B. $\frac{g}{2}$

C. $2g$

D. $6g$

18. The unit of $\mu_0 \times \varepsilon_0$ expressed in fundamental SI units is...

A. $m^{-2}s^{2}$.

B. $T\,C\,N^{-1}m^{-1}s$.

C. $m^{2}s^{-2}$.

D. $T\,C^{2}A^{-1}N^{-1}m^{-1}$.

19. Charge is moving in a wire that is at right angles to a uniform magnetic field.

The length of the wire is 0.32 m.

When the current in the wire is increased by 5.0A, the force acting on the wire increases by 4.0 mN.

What is the strength of the magnetic field?

A. 2.5 mT

B. 25 mT

C. $m^2 s^{-2}$.

D. $TC^2A^{-1}N^{-1}m^{-1}$.

19. Charge is moving in a wire that is at right angles to a uniform magnetic field.

The length of the wire is 0.32 m.

When the current in the wire is increased by 5.0 A, the force acting on the wire increases by 4.0 mN.

What is the strength of the magnetic field?

A. 2.5 mT

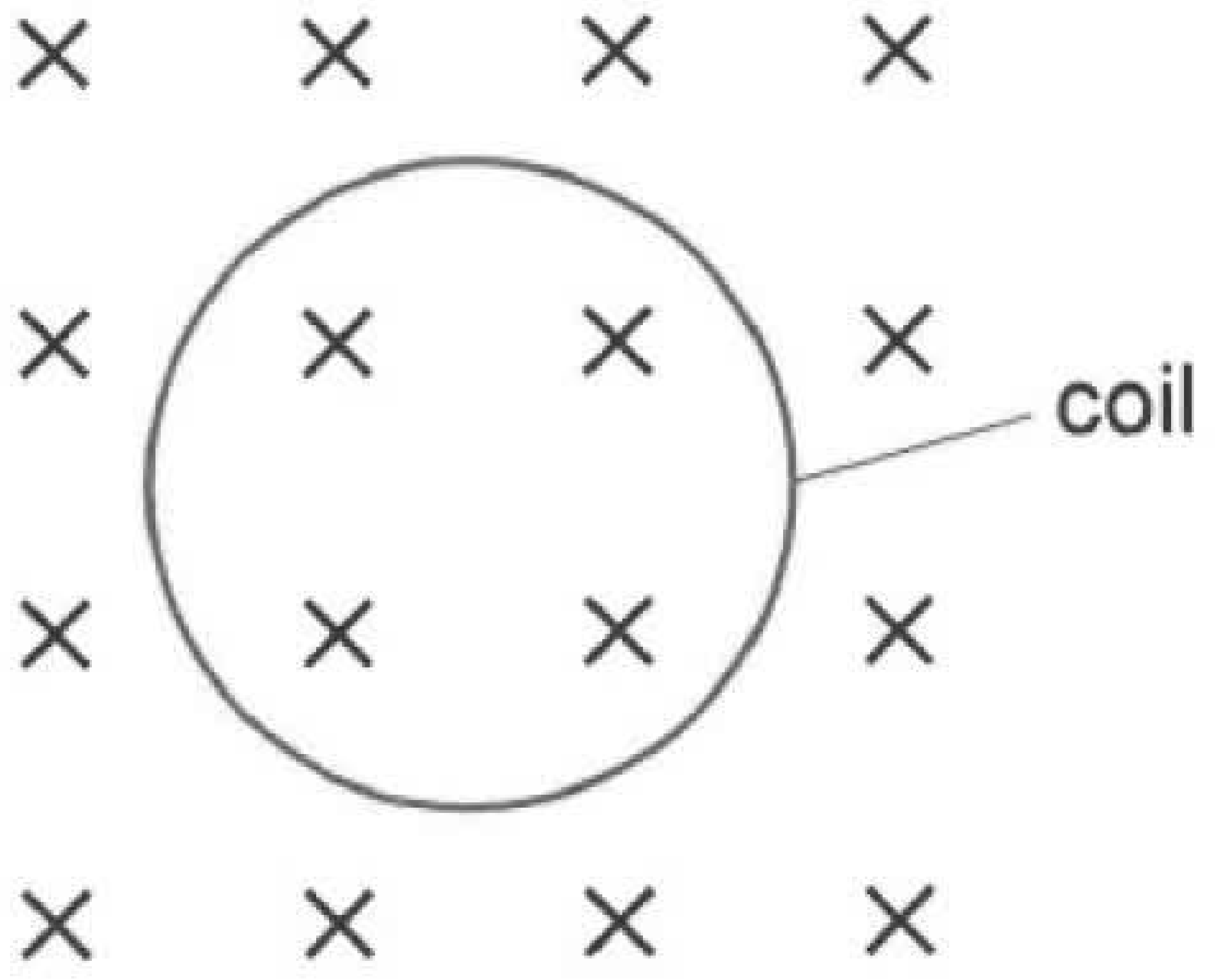
B. 25 mT

C. 40 T

D. 40 kT

20. Negative charge carriers travel counter-clockwise in a circular coil that lies in the plane of the page.

The coil is in a uniform magnetic field directed into the page.



What is the magnetic effect on the coil?

A. The coil will rotate clockwise in the plane of the paper.

B. The coil will rotate counter-clockwise in the plane of the paper.

C. The diameter of the coil will tend to increase.

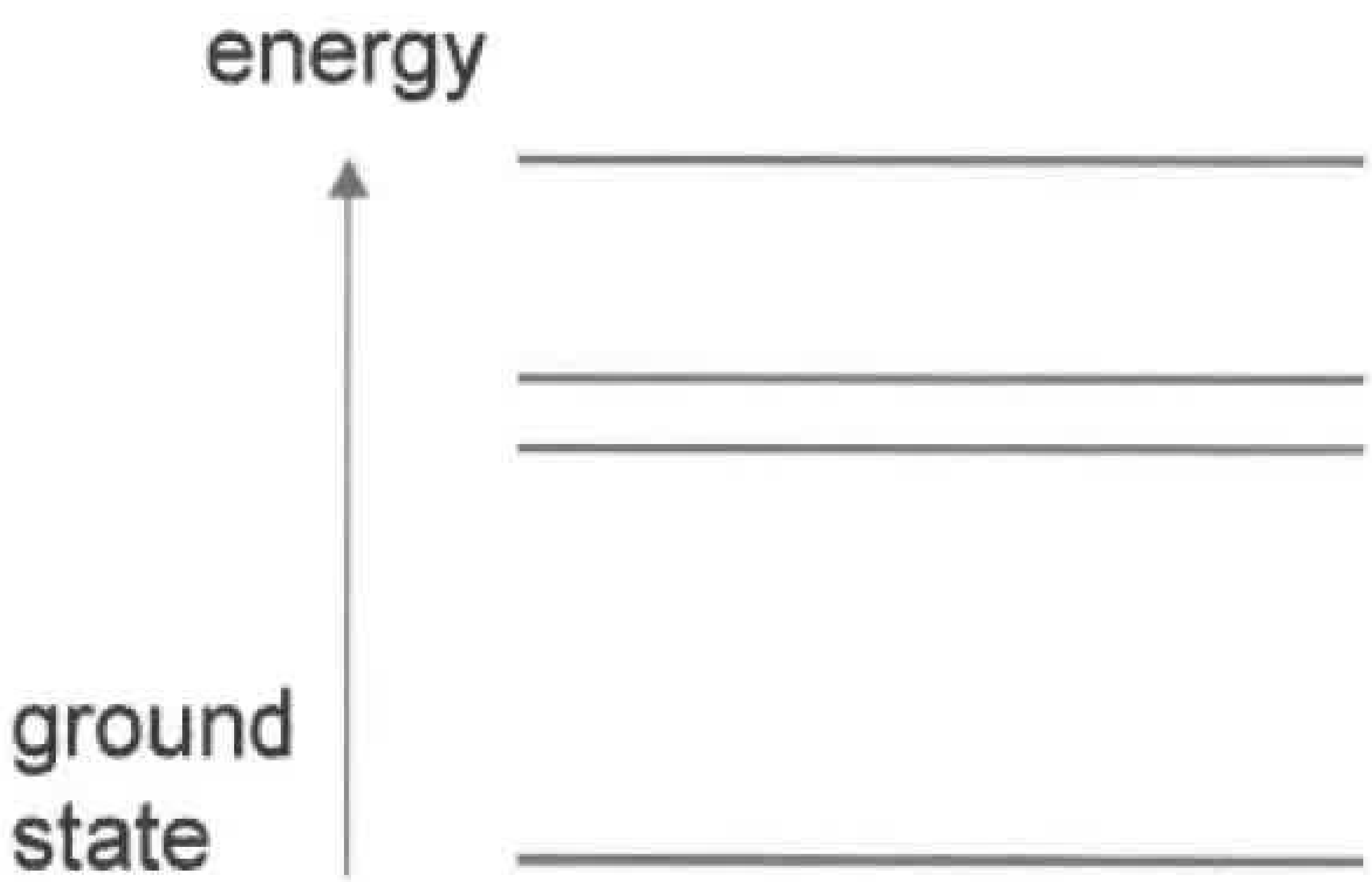
D. The diameter of the coil will tend to decrease.

21. In this question, all diagrams are drawn to scale.

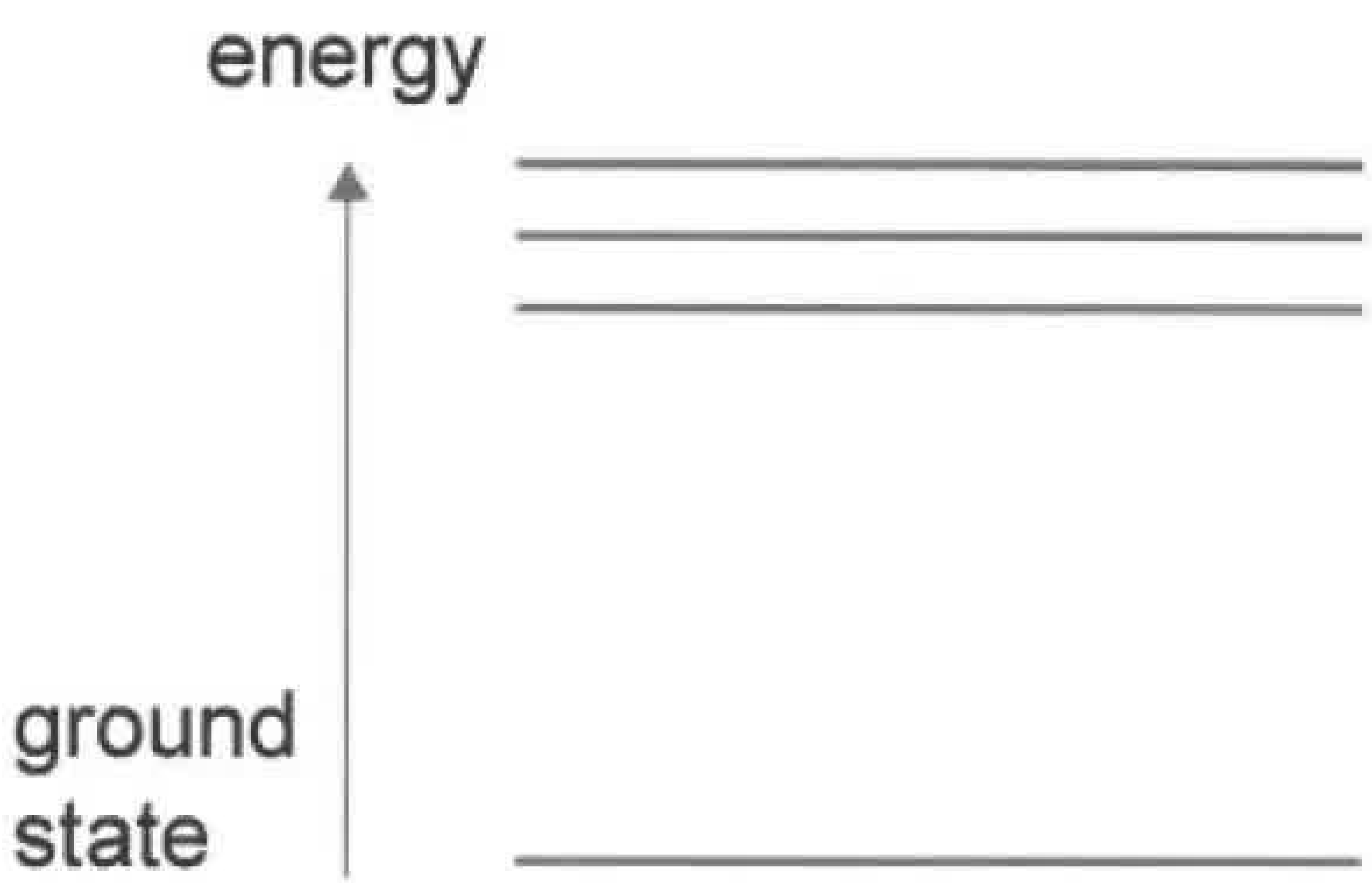
Part of the emission spectrum of an atom is shown.

Which set of energy levels can give rise to this part of the emission spectrum?

A.

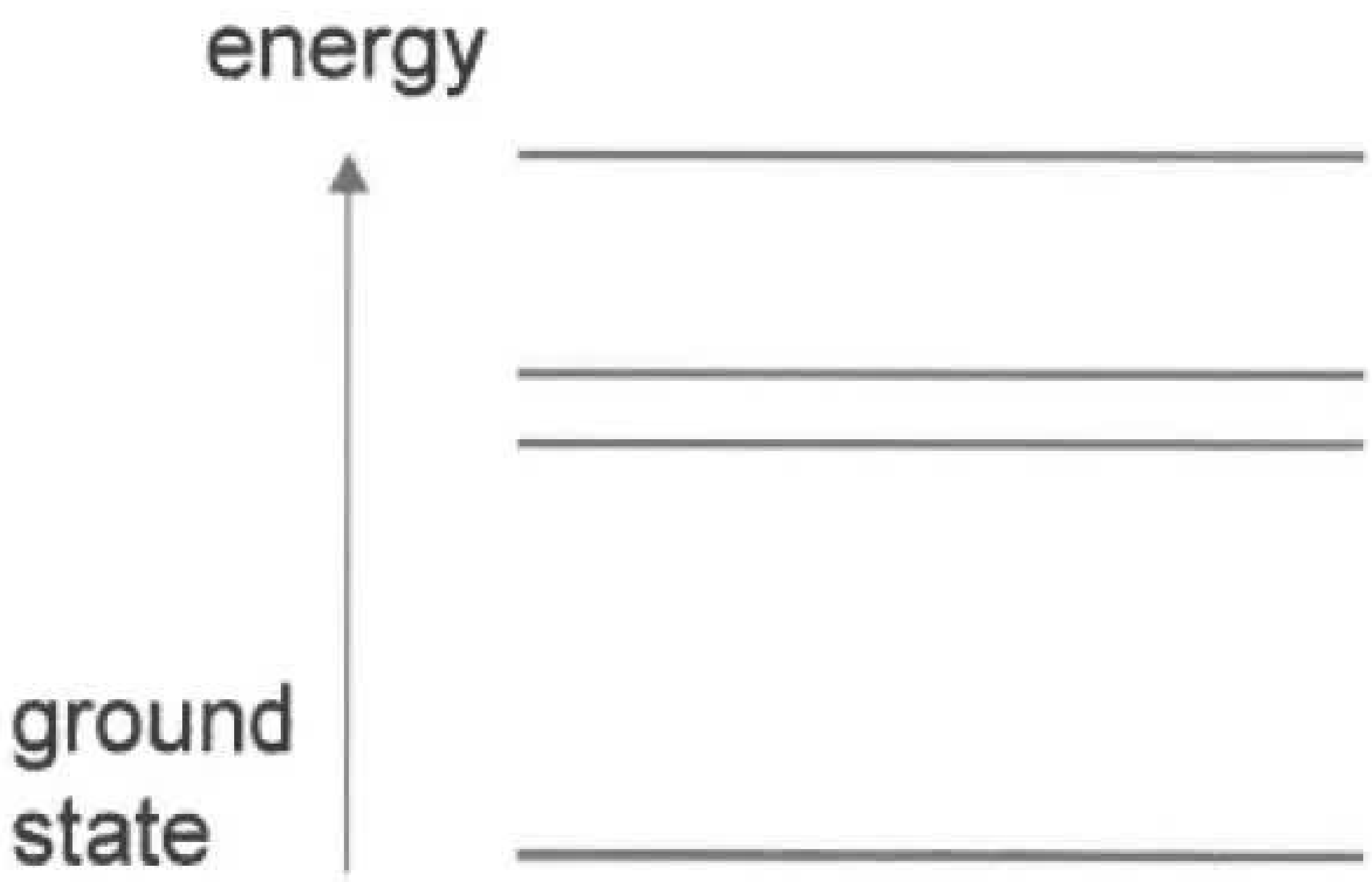


B.

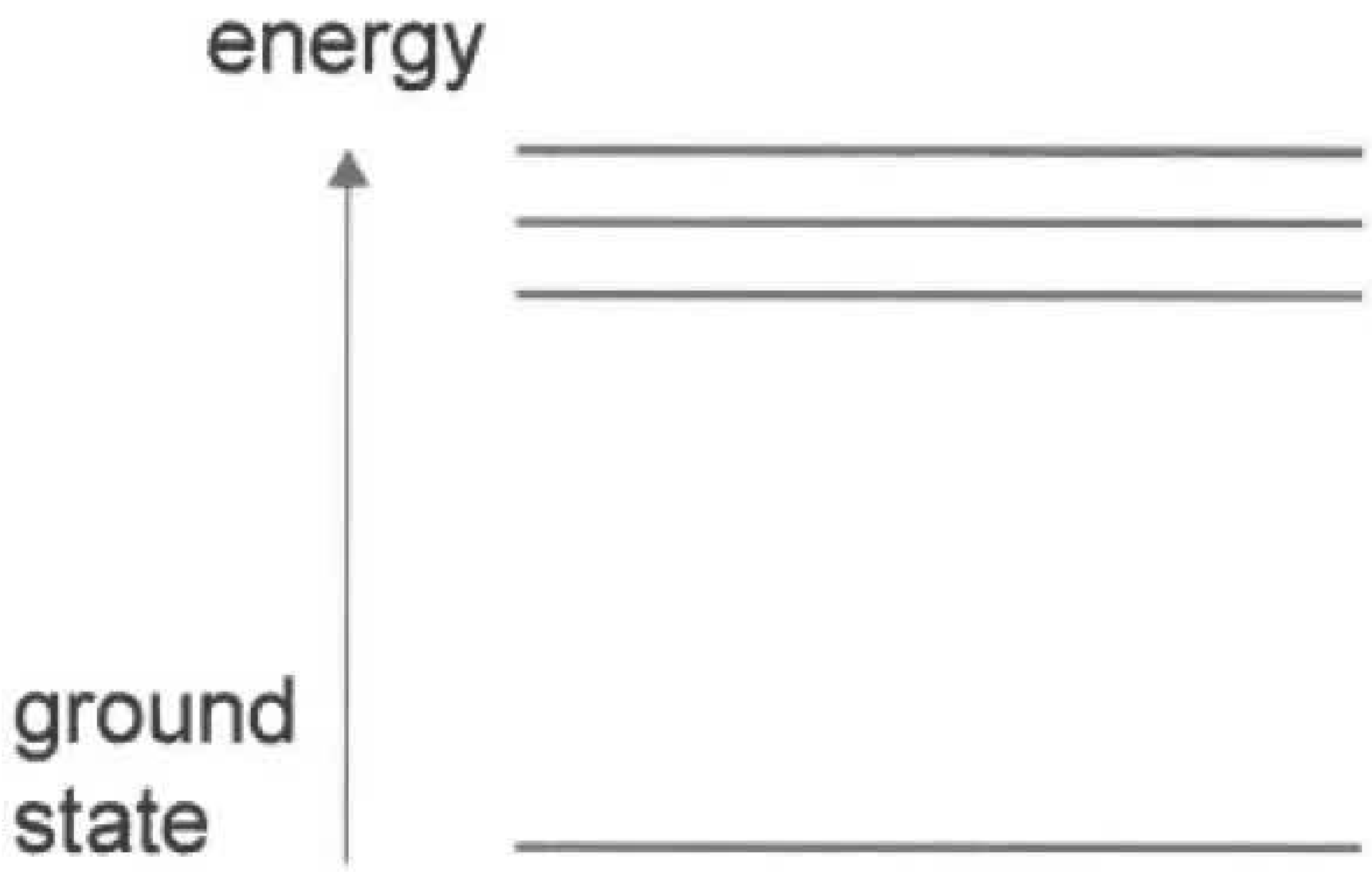


Which set of energy levels can give rise to this part of the emission spectrum?

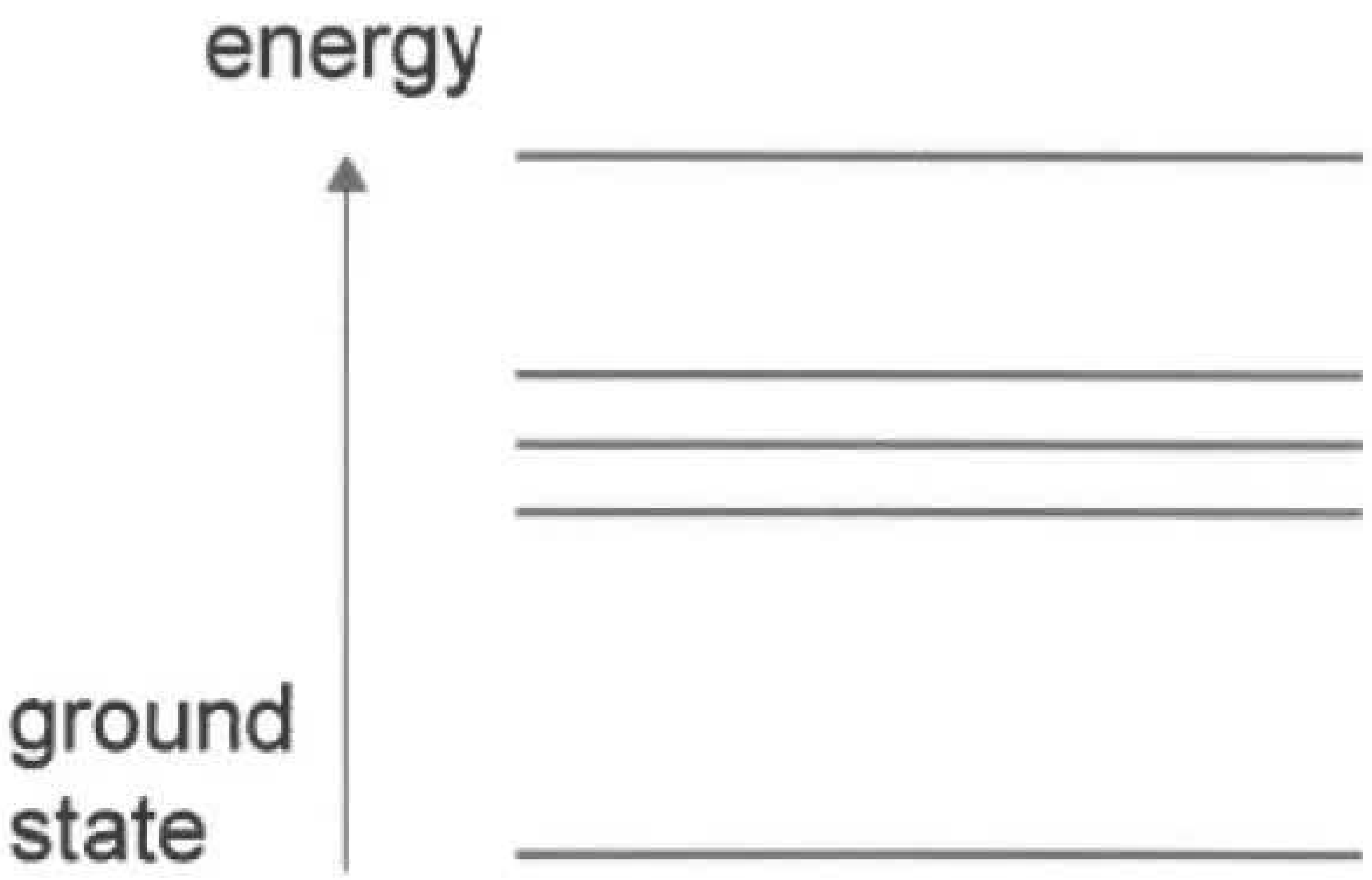
A.



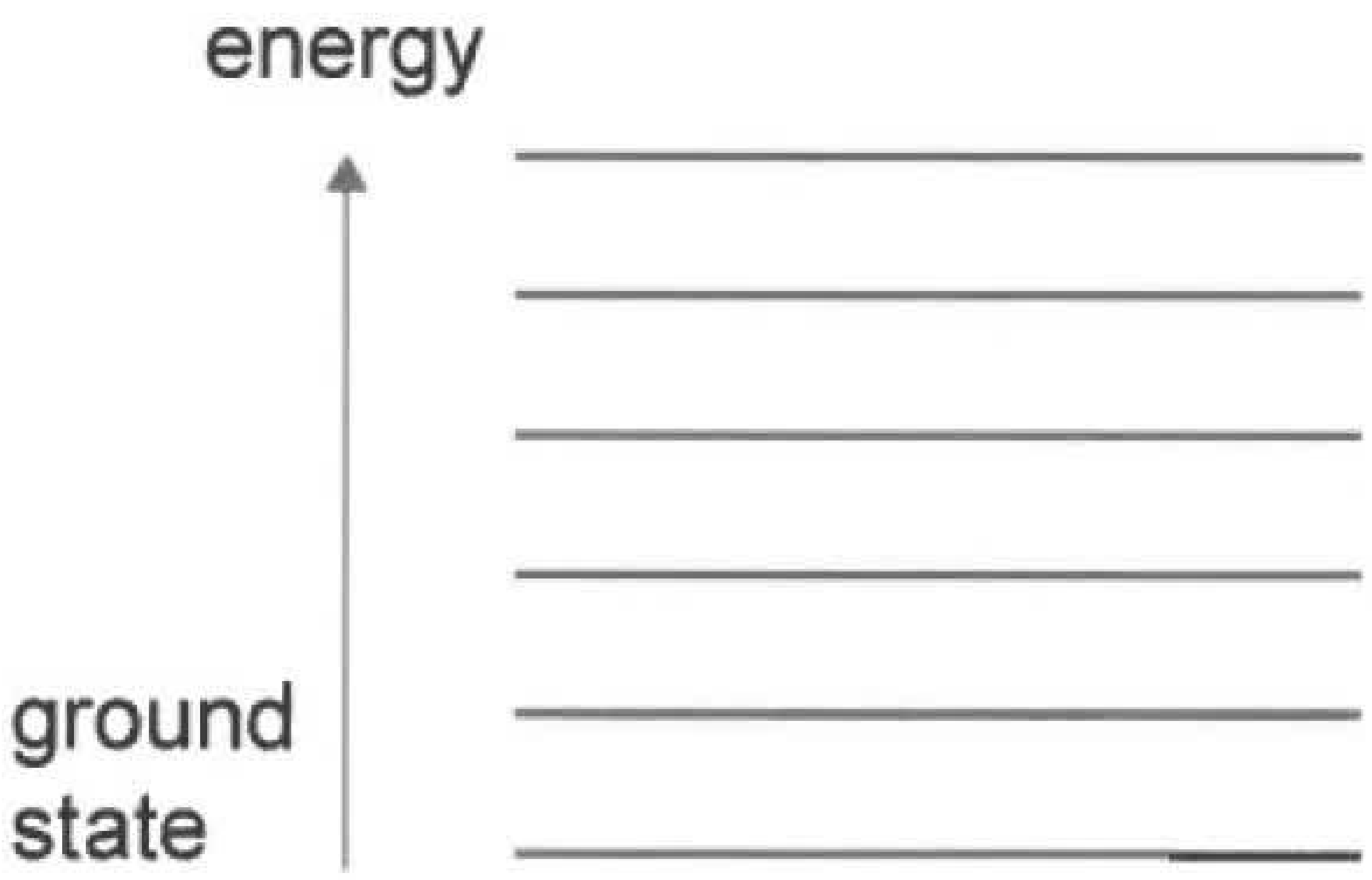
B.



C.



D.



22. An ion X contains the following particles:

- 53 protons
- 89 neutrons
- 54 electrons.

What is the nuclear notation for X?

A. $^{142}_{53}X$

B. $^{89}_{53}X$

C. $^{143}_{54}X$

D. $^{107}_{54}X$

23. A suitable material for use as a moderator in a nuclear reactor is...

A. cadmium.

B. concrete.

C. uranium-238.

D. water.

24. In a simple model of a nuclear reactor, four neutrons are emitted per fission on average.

The average number of neutrons absorbed by the control rods is N_c per fission.

The average number of neutrons that are lost through the walls of the reactor is N_1 per fission.

Any remaining neutrons induce further fissions.

What are possible values for N_c and N_1 for the reactor to maintain a steady reaction?

	N_c	N_1

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The average number of neutrons that are lost through the walls of the reactor is N_1 per fission.

Any remaining neutrons induce further fissions.

What are possible values for N_c and N_1 for the reactor to maintain a steady reaction?

	N_c	N_1
A.	1	1
B.	1	3
C.	2	1
D.	2	2

B.	1	3
C.	2	1
D.	2	2

25. A star has a parallax angle of 1×10^{-2} arc-second at the orbit of the Earth.

What is the distance from the Sun to the star?

A. 0.01 pc

B. 0.02 pc

C. 50 pc

D. 100 pc

1. B	2. B	3. A	4. C	5. C	6. A	7. A	8. D	9. C	10. D
11. B	12. C	13. B	14. B	15. C	16. A	17. B	18. A	19. A	20. C
21. A	22. A	23. D	24. C	25. D					