RIVER VALLEY HIGH SCHOOL
JC2 PRELIMINARY EXAMINATIONS

H2 PHYSICS 9749
PAPER 1
26 SEP 2025

1 HOUR

CANDIDATE NAME									
CENTRE NUMBER	S					**INDEX NUMBER**				
CLASS	2	4	J						

INSTRUCTIONS TO CANDIDATES

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

Read these notes carefully.
Write your name, class and index number above.

There are **thirty** questions in this section. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider correct and shade your choice in **soft pencil** on the separate **Optical Answer Sheet**.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done on the Question Paper.

The use of an approved scientific calculator is expected where appropriate.

Hand in the Optical Answer Sheet.

This document consists of 17 printed pages **and** 1 blank page.

Data

speed of light in free space,	c	=	3.00×10^{8} m s^{-1}
permeability of free space,	μ_O	=	$4\pi \times 10^{-7}$ H m^{-1}
permittivity of free space,	ε_O	=	8.85×10^{-12} F m^{-1}
			$(1/(36\pi)) \times 10^{-9}$ F m^{-1}
elementary charge,	e	=	1.60×10^{-19} C
the Planck constant,	h	=	6.63×10^{-34} J s
unified atomic mass constant,	u	=	1.66×10^{-27} kg
rest mass of electron,	m_e	=	9.11×10^{-31} kg
rest mass of proton,	m_p	=	1.67×10^{-27} kg
molar gas constant,	R	=	8.31 J K^{-1} mol^{-1}
the Avogadro constant,	N_A	=	6.02×10^{23} mol^{-1}
the Boltzmann constant,	k	=	1.38×10^{-23} J K^{-1}
gravitational constant,	G	=	6.67×10^{-11} N m^2 kg^{-2}
acceleration of free fall,	g	=	9.81 m s^{-2}

Formulae

uniformly accelerated motion	$s = ut + \frac{1}{2}at^2$
	$v^2 = u^2 + 2as$
work done on/by a gas	$W = p\Delta V$
hydrostatic pressure	$p = \rho gh$
gravitational potential	$\phi = -Gm/r$
temperature	T / K = T / °C + 273.15
pressure of an ideal gas	$p = \frac{1}{3}\frac{Nm}{V} < c^2 >$
mean translational kinetic energy of an ideal gas molecule	$E = \frac{3}{2}kT$
displacement of particle in s.h.m.	$x = x_0 \sin \omega t$
velocity of particle in s.h.m.	$v = v_0 \cos \omega t$
	$= \pm\omega\sqrt{x_0^2 - x^2}$
electric current	$I = Anvq$
resistors in series	$R = R_1 + R_2 + \ldots$
resistors in parallel	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential	$V = \frac{Q}{4\pi\varepsilon_0 r}$
alternating current/voltage	$x = x_0 \sin \omega t$
magnetic flux density due to a long straight wire	$B = \frac{\mu_0 I}{2\pi d}$
magnetic flux density due to a flat circular coil	$B = \frac{\mu_0 NI}{2r}$
magnetic flux density due to a long solenoid	$B = \mu_0 nI$
radioactive decay	$x = x_0 \exp(-\lambda t)$
decay constant	$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$

For each question, there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider correct and shade your choice in **soft pencil** on the separate **Answer Sheet**.

1 Which of the following quantities has a unit that can be expressed in terms of just two different SI base units?

A area

B charge

C current

D force

2 Which of the following experimental techniques reduces the systematic error of the quantity being investigated?

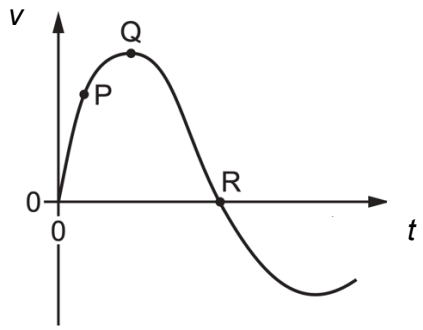
A measuring several distances between adjacent nodes on a standing wave to find the mean distance

B measuring the diameter of a wire repeatedly and calculating the average

C adjusting an analogue ammeter to remove its zero error before measuring a current

D timing a large number of oscillations to find a period

3 The graph shows how velocity *v* varies with time *t* for a bungee jumper.



At which point is the bungee jumper momentarily at rest and at which point does she have zero acceleration?

	jumper at rest	jumper with zero acceleration
A	P	Q
B	Q	R
C	R	Q
D	R	R

4 A stationary uranium nucleus disintegrates, emitting an alpha-particle of mass 6.65×10^{-27} kg and another nucleus X of mass 3.89×10^{-25} kg.

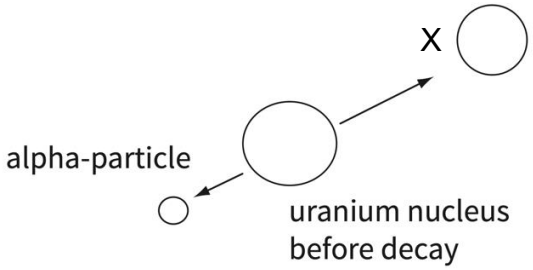


diagram not drawn to scale

Which of the following gives the ratio $\frac{\text{speed of alpha-particle}}{\text{speed of nucleus X}}$?

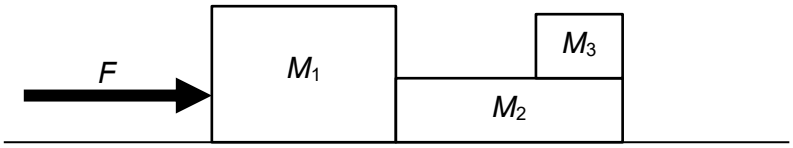
A 0.017

B 0.98

C 1.0

D 58

5 A force F acts on a system of masses M_1, M_2 and M_3 on a frictionless floor as shown.



The structure of the system of the masses remains unchanged as it accelerates.

Which of the following gives the magnitude of the frictional force on M_3?

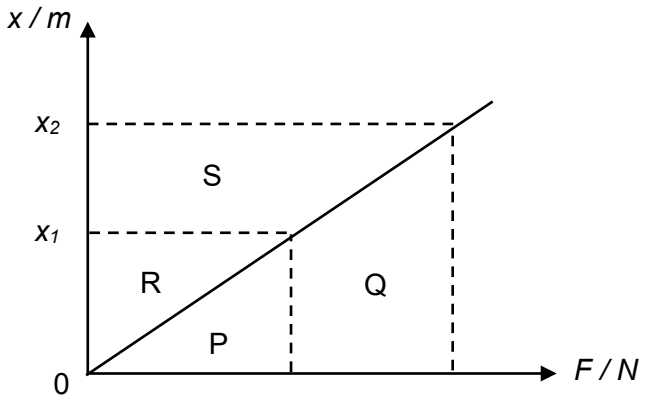
A F

B $F\left(\frac{M_3}{M_2}\right)$

C $F\left(\frac{M_3}{M_1+M_2}\right)$

D $F\left(\frac{M_3}{M_1+M_2+M_3}\right)$

6 The variation with force of the extension of a spring is shown in the figure below. The work done in stretching the spring from x_1 to x_2 is given by the area



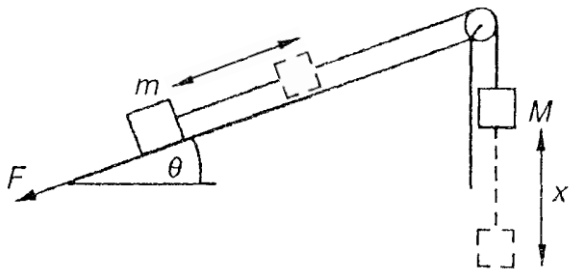
A P + Q

B S

C R + S

D Q

7 A mass m moves on a rough plane inclined at an angle θ to the horizontal and, when moving, experiences a constant frictional force F. Mass M is attached to it by means of a light inelastic cord running over a smooth pulley. Mass M is allowed to fall a vertical distance x, causing m to move up the plane as shown.



How much heat is generated by friction in this process?

A Fx

B $mgx\sin\theta$

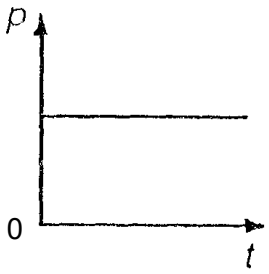
C $mgx\sin\theta - Fx$

D $mgx\sin\theta + Fx$

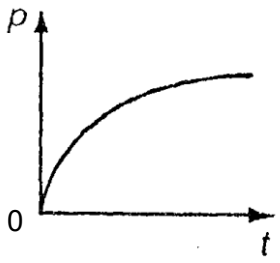
8 A constant force is applied to a body which is initially stationary but free to move in the direction of the force.

Assuming that the effects of friction are negligible, which of the following graphs best represents the variation of p, the power supplied, with time t?

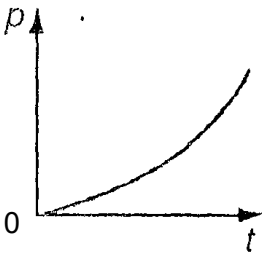
A



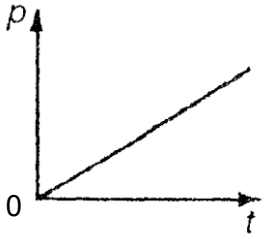
B



C



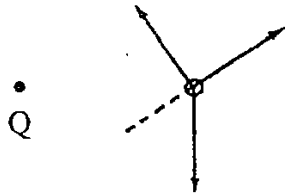
D



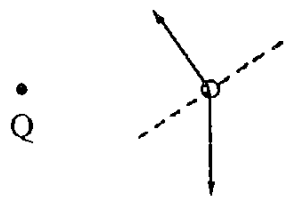
9 An aircraft is travelling at constant speed in a horizontal circle, centre Q. Each diagram shows a tail-view of the aircraft, the dotted line representing the orientation of the wings and the circle representing the centre of gravity of the aircraft.

Which diagram correctly shows the direction of forces acting on the aircraft?

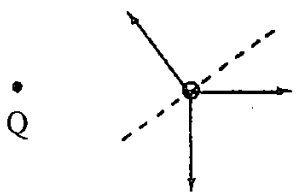
A



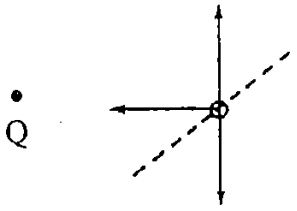
B



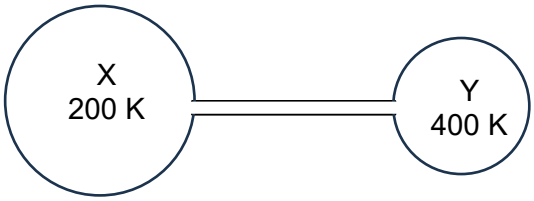
C



D



10 In the diagram, the volume of bulb X is twice that of bulb Y. The system is filled with an ideal gas and a steady state is established with the bulbs X and Y at temperature 200 K and 400 K respectively.



If the mass of gas in X is m, what is the mass of gas in Y?

A $\frac{m}{4}$

B $\frac{m}{2}$

C m

D $4m$

11 One mole of ideal gas is contained within a cylinder by a frictionless piston and is initially at temperature T. The pressure of the gas is kept constant while it is heated and its volume doubles.

If R is the molar gas constant, what is the work done by the gas in increasing its volume?

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

B RT

C $\frac{3}{2}RT$

D $2RT$

12 Which of the following statements about internal energy is correct?

A The internal energy of a system depends only on its temperature.

B When the internal energy of a system is increased, its temperature always rises.

C The internal energy of a system can be increased without transfer of energy by heating.

D When two systems have the same internal energy, they must be at the same temperature.

13 The acceleration of free fall on the surface of the surface of the Earth is about 6 times its value on the surface of the Moon. The mean density of the Earth is about $\frac{5}{3}$ times the mean density of the Moon.

Using the data, what is the best value of the ratio of the radius of the Earth to the radius of the Moon?

A 1.9 **B** 3.2

C 3.6 **D** 6.0

14 A satellite of mass 50 kg moves from a point where the gravitational potential due to the Earth is -20 MJ kg^{-1}, to another point where the gravitational potential is -60 MJ kg^{-1}.

In which direction does the satellite move and what is its change in potential energy?

A closer to the Earth and loss of 40 MJ of potential energy

B further from the Earth and a gain of 40 MJ of potential energy

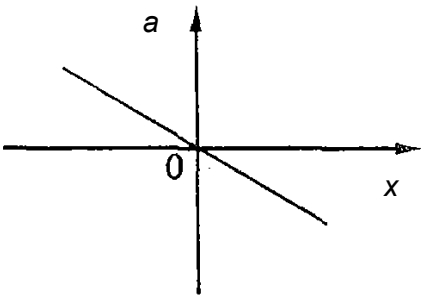
C closer to the Earth and a loss of 2000 MJ of potential energy

D further from the Earth and a gain of 2000 MJ of potential energy

15 In which group below do all three quantities remain constant when a particle moves in simple harmonic motion?

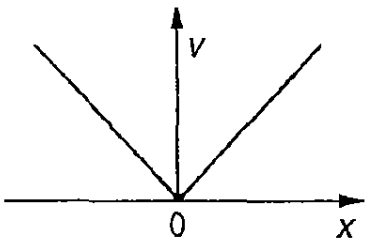
A	restoring force	total energy	amplitude
B	total energy	amplitude	angular frequency
C	displacement	angular frequency	restoring force
D	angular frequency	restoring force	amplitude

16 A particle moves such that its acceleration a is related to its displacement x from a fixed position as shown in the graph below.

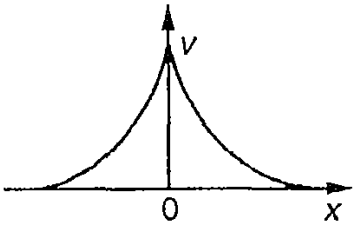


Which of the following best illustrates how the speed v varies with x?

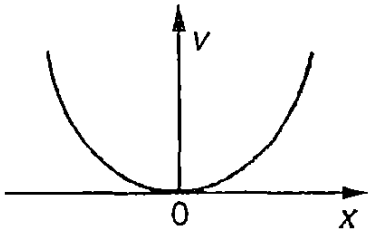
A



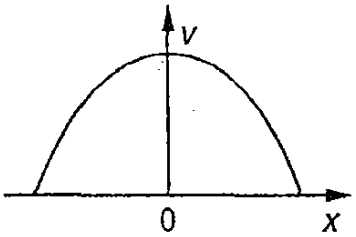
B



C



D



17 Which one of the following effects provides direct evidence that light is a transverse, rather than a longitudinal wave?

A The brightness of the illuminated smartphone screen changes when looking at it through a polarising sheet.

B Light is diffracted in a Young's Double slit experiment.

C Lightning is seen before thunder is heard.

D Light can cause emission of electrons from the surface of a metal.

18 A student draws a diagram to show different regions of air molecules for a progressive sound wave moving to the right at a certain instant. P, Q, R, S and T are particles at the centres of these regions.

Which of the following statement is *true*?

A R is moving towards the right at the next instant.

B Distance between P and T is one wavelength.

C After a period of time, Q moves to the position of S.

D The amplitude of R is always zero.

19 A single-slit diffraction pattern is formed on a screen 2.0 m away from the slit. The slit width is 0.30 mm, and light of wavelength 600 nm is used.

What is the linear distance between the first and third minima on one side of the central maximum?

A 2.0 mm **B** 4.0 mm

C 8.0 mm **D** 12.0 mm

20 A battery has e.m.f. E = 12 V and internal resistance r = 3.0 Ω. The load resistor R is initially set for maximum power transfer P. If R is doubled, what is the power delivered to the load?

A 0.44P

B 0.67P

C 0.89P

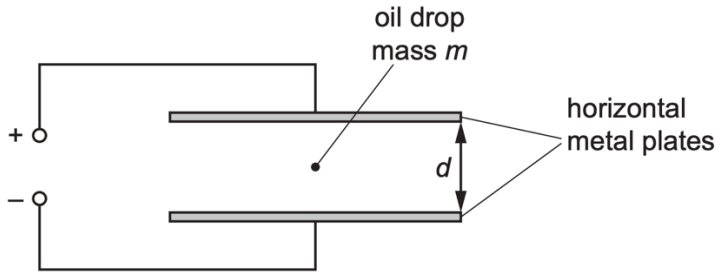
D 1.0P

21 In a wire, the drift velocity of electrons is 2.0×10^{-4} m s^{-1} when a current of 3.0 A flows. If the cross-sectional area of the wire is doubled and the current remains the same, what is the new drift velocity?

A 4.0×10^{-4} m s^{-1} **B** 1.0×10^{-4} m s^{-1}

C 2.0×10^{-4} m s^{-1} **D** 0.5×10^{-4} m s^{-1}

22 A negatively charged oil drop of mass m is between two horizontal parallel metal plates a distance d apart.



When the potential difference (p.d.) between the plates is V_1 the oil drop rises at a constant speed. When the p.d. is decreased to a value V_2 the oil drop falls at the same constant speed.

Air resistance acts on the drop when it is moving. The upthrust on the drop is negligible.

The acceleration of free fall is g.

What is the charge on the oil drop?

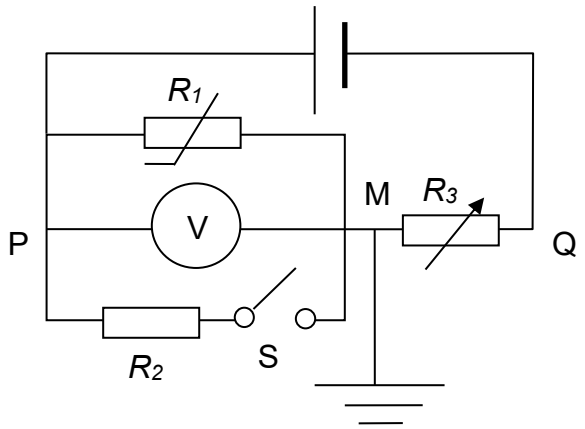
A $\dfrac{mdg}{V_1 - V_2}$

B $\dfrac{mdg}{V_1 + V_2}$

C $\dfrac{2mdg}{V_1 - V_2}$

D $\dfrac{2mdg}{V_1 + V_2}$

23 A thermistor R_1 is connected to a battery of constant e.m.f. with negligible internal resistance as shown in the figure.



Which of the following actions will cause an increase in the potential difference measured by the voltmeter? Assume that the voltmeter has infinite resistance.

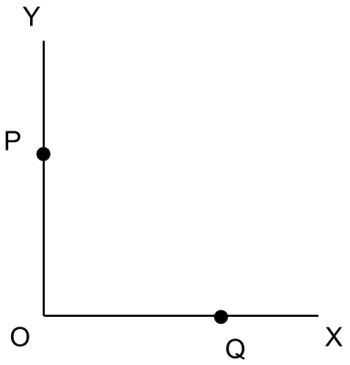
A Increase the temperature of the thermistor with S open.

B Remove the earth connection at M with S open.

C Close switch S.

D Decrease resistance R_3 with S open.

24 The diagram shows a plane OXY with axes OX and OY at right angles.



Which of the following currents in a straight conductor will produce a magnetic field at O in the direction OX?

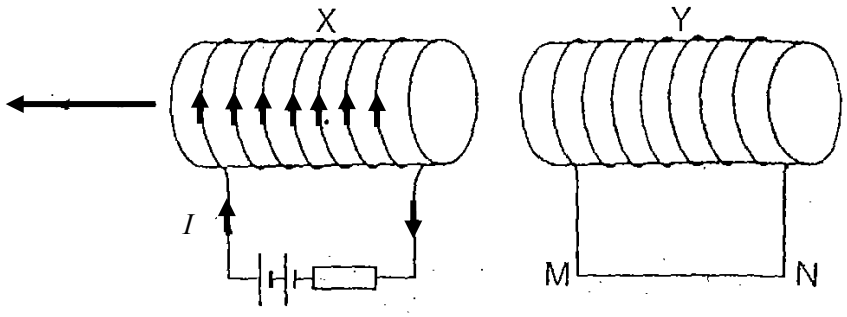
A at P into the plane of the diagram

B at P out of the plane of the diagram

C at Q into the plane of the diagram

D at Q out of the plane of the diagram

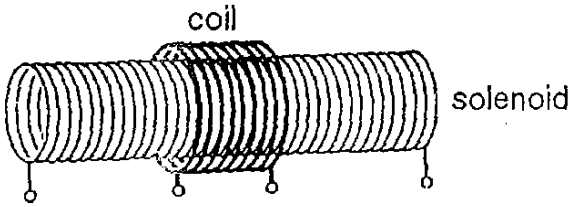
25 X and Y are solenoids wound on cardboard tubes. X carries constant current I as shown below and moves with constant speed away from Y along the common axis of the two tubes.



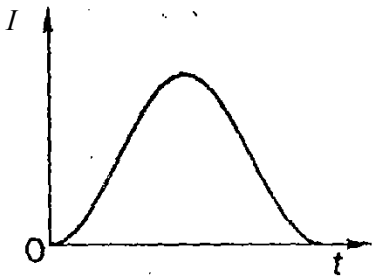
As a result of electromagnetic induction, a current will flow in the straight wire MN and there will be a force between X and Y. Which one of the following correctly describes both the current and the force?

	Nature and direction of current in straight wire MN	Nature of force
A	diminishing, N to M	attraction
B	diminishing, M to N	repulsion
C	constant, N to M	attraction
D	constant, M to N	repulsion

26 The diagram shows a short coil wound over the middle part of a long solenoid.



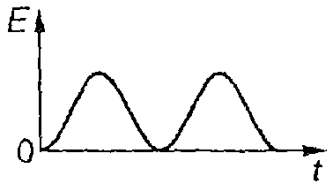
The solenoid current I is varied with time t as shown in the sketch graph.



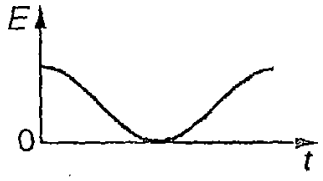
Which graph shows how the e.m.f. E induced in the short coil varies with t?

A

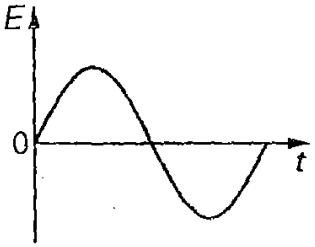
B



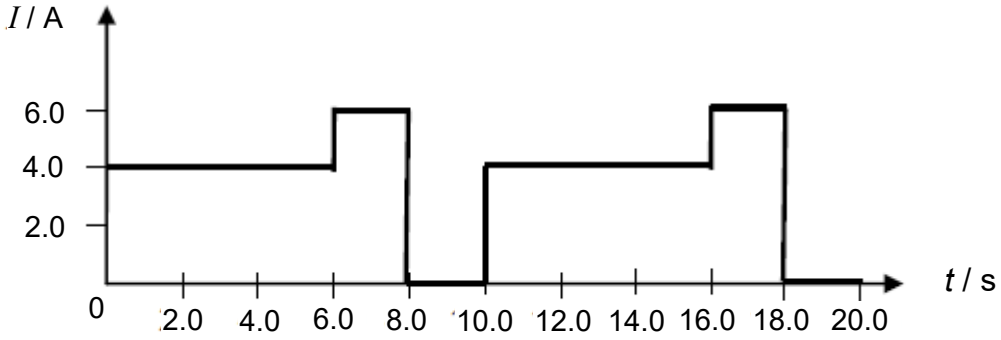
C



D



27 A varying d.c. current is passed through a certain resistor as shown below.



The r.m.s value of the given current is

A 2.12 A

B 4.10 A

C 4.58 A

D 16.8 A

28 A sinusoidal current of peak value I_o is passed through a resistor R with a diode connected in series with it. The average rate of heat dissipated in R is

A 0.25 I_o^2R

B 0.50 I_o^2R

C 0.71 I_o^2R

D 1.0 I_o^2R

29 What is the de Broglie wavelength of a particle of mass m and kinetic energy E, where h is the Planck constant?

A $h\sqrt{2mE}$

B $\sqrt{2mE}\,/\,h$

C $h\,/\sqrt{mE}$

D $h\,/\sqrt{2mE}$

30 A nucleus of uranium-238, $^{238}_{92}U$, decays in a series of steps to form a nucleus of lead-206, $^{206}_{82}Pb$ as shown.

$$^{238}_{92}U \rightarrow \ldots\ldots\ldots \rightarrow {}^{206}_{82}Pb$$

An α-particle or a β^-particle is emitted during each step.

What is the total number of β^-particles that are emitted?

A 6

B 8

C 10

D 16

END OF PAPER

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