UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

General Certificate of Education Advanced Level

PHYSICS   9243/1

PAPER 1   Multiple Choice

Tuesday	**8 JUNE 1999**	Afternoon	1 hour

Additional materials:
     Multiple Choice answer sheet
     Soft clean eraser
     Soft pencil (Type B or HB is recommended)

TIME   1 hour

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your name, Centre number and candidate number on the answer sheet in the spaces provided unless this has already been done for you.

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

**Read very carefully the instructions on the answer sheet.**

INFORMATION FOR CANDIDATES

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

Any rough working should be done in this booklet.

This question paper consists of 16 printed pages.

                 [Turn over

1   Which pair includes a **scalar** quantity and a **vector** quantity?

   A   kinetic energy and momentum

   B   potential energy and work

   C   velocity and acceleration

   D   weight and force

2   A student attempts to measure the diameter of a steel ball by using a metre rule to measure four similar balls in a row.
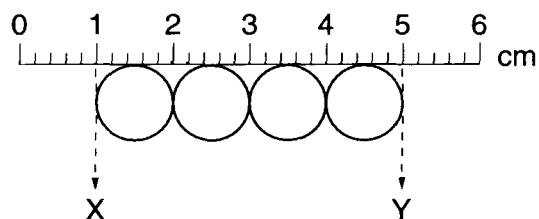
The student estimates the positions on the scale to be as follows.
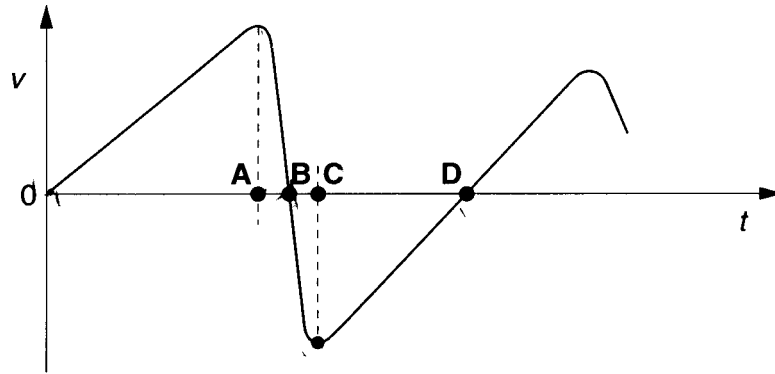
X (1.0 ± 0.2) cm

Y (5.0 ± 0.2) cm

What is the diameter of a steel ball together with its associated uncertainty?

   A (1.0 ± 0.05) cm

   B (1.0 ± 0.1) cm

   C (1.0 ± 0.2) cm

   D (1.0 ± 0.24) cm

3 The graph shows the variation with time *t* of the velocity *v* of a bouncing ball, released from rest. Downward velocities are taken as positive.

At which time does the ball reach its maximum height after bouncing?


4 A crane has a maximum safe working load of 1.2×10^4 N and is used to lift a concrete block of mass 1000 kg.

What is the maximum safe upward acceleration of the block while being lifted?

A $0.83 \, \text{m s}^{-2}$

B $1.1 \, \text{m s}^{-2}$

C $1.2 \, \text{m s}^{-2}$

D $2.2 \, \text{m s}^{-2}$

5 An object is acted on by two forces *P* and *Q*. A frictional force *F* holds the object in equilibrium.

Which vector triangle could represent the relationship between these forces?

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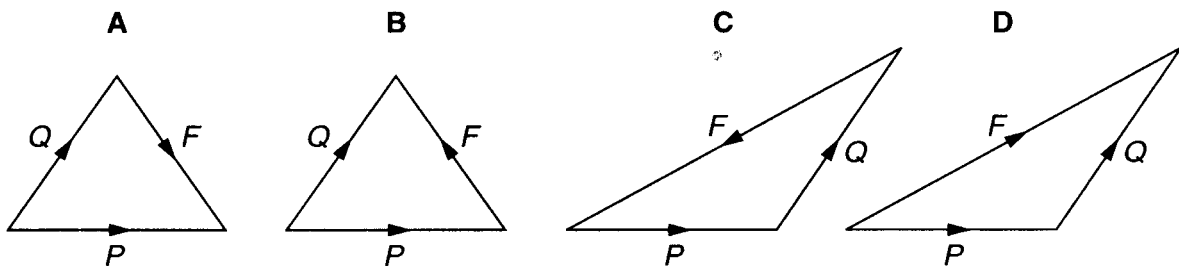
6 A crate is pushed 10 m along a horizontal surface by a force of 80 N. The frictional force opposing the motion is 60 N.

What are the correct values for the increase in internal energy of the system and the additional kinetic energy of the crate?

	increase in internal energy /J	additional kinetic energy /J
A	200	600
B	200	800
C	600	200
D	600	800

7 The Earth experiences gravitational forces from the Sun, mass M_s, and from the Moon, mass M_m. The distance of the Sun from the Earth is r_s and the distance of the Moon from the Earth is r_m.

What is the ratio $\dfrac{\text{force on the Earth due to the Sun}}{\text{force on the Earth due to the Moon}}$?

A $\dfrac{M_s}{M_m}\left(\dfrac{r_s}{r_m}\right)$

B $\dfrac{M_s}{M_m}\left(\dfrac{r_m}{r_s}\right)$

C $\dfrac{M_s}{M_m}\left(\dfrac{r_s}{r_m}\right)^2$

D $\dfrac{M_s}{M_m}\left(\dfrac{r_m}{r_s}\right)^2$

8 An object of mass of 2 kg rotates at constant speed in a horizontal circle of radius 5 m. The time for one complete revolution is 3 s.

What is the magnitude of the resultant force acting on the object?

A $\dfrac{4\pi^2}{9}$ N

B $\dfrac{40\pi^2}{9}$ N

C $\dfrac{100\pi^2}{9}$ N

D $\dfrac{400\pi^2}{9}$ N

9 Two objects P and Q are given the same initial displacement and are then released. The graphs show the variation with time t of their displacements x.
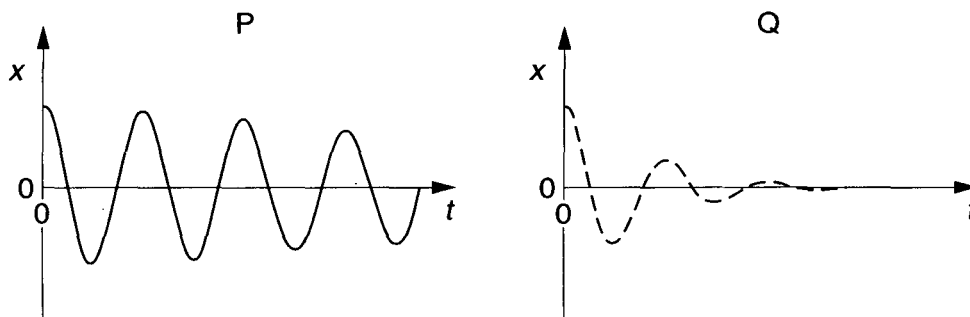
P and Q are then subjected to driving forces of the same constant amplitude and of variable frequency f.

Which graph represents the variation with f of the amplitudes A of P and of Q?

[Turn over
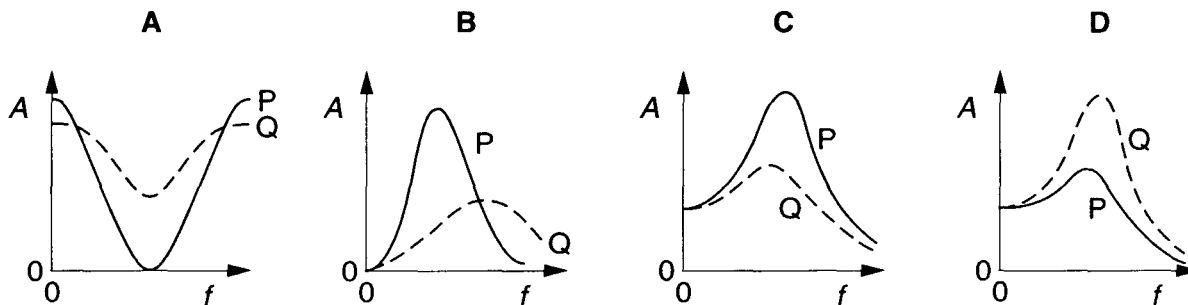
10 A light wave of frequency f travelling in air enters a block of glass of refractive index n.

What is the frequency of the light wave in the glass?

A $\dfrac{f}{n}$ **B** f **C** $f \sin n$ **D** nf

11 A sound wave of frequency 400 Hz is travelling in a gas at a speed of 320 m s^{-1}.

What is the phase difference between two points 0.2 m apart in the direction of travel?

A $\dfrac{\pi}{4}$ rad

B $\dfrac{\pi}{2}$ rad

C $\dfrac{2\pi}{5}$ rad

D $\dfrac{4\pi}{5}$ rad

12 Coherent monochromatic light illuminates two narrow parallel slits and the interference pattern that results is observed on a screen some distance beyond the slits.

Which modification increases the separation between the dark lines of the interference pattern?

A decreasing the distance between the screen and the slits

B increasing the distance between the slits

C using monochromatic light of higher frequency

D using monochromatic light of longer wavelength

13 Two monochromatic radiations X and Y are incident normally on a diffraction grating. The second order intensity maximum for X coincides with the third order intensity maximum for Y.

What is the ratio $\dfrac{\text{wavelength of X}}{\text{wavelength of Y}}$?

A $\dfrac{1}{2}$

B $\dfrac{2}{3}$

C $\dfrac{3}{2}$

D $\dfrac{2}{1}$

14 An insulated charged rod R is to be used to give a permanent charge to an isolated conducting sphere S by induction.
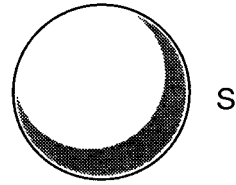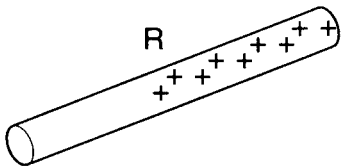

What is the required sequence of events?

A Move R close to S; connect S to earth; remove R; remove earth connection from S.

B Move R close to S; connect S to earth; remove earth connection from S; remove R.

C Move R to make contact with S; remove R.

D Move R to make contact with S; connect S to earth; remove R; remove earth connection from S.

15 The diagram shows a model of an atom in which two electrons move round a nucleus in a circular orbit. The electrons complete one full orbit in 1.0×10^{-15} s.
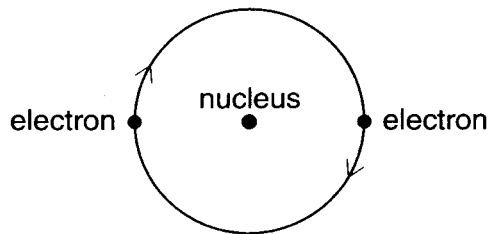
What is the current caused by the motion of the electrons in the orbit?

A 1.6×10^{-34} A

B 3.2×10^{-34} A

C 1.6×10^{-4} A

D 3.2×10^{-4} A

[Turn over

**16** In the circuit, two 3 V cells are connected to resistors of resistance 3 kΩ and 6 kΩ.
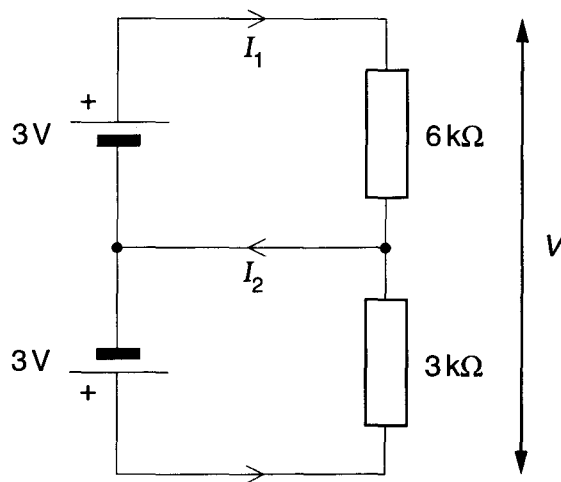
What are the correct values for the currents I_1 and I_2, and the total potential difference V across the pair of resistors?
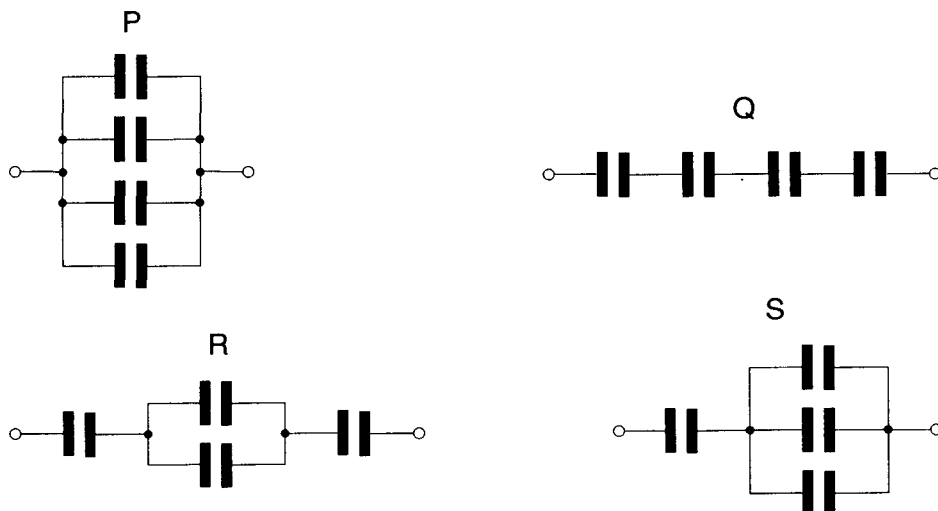
	I_1 / mA	I_2 / mA	V / V
A	0.5	0.5	6
B	0.5	0.5	0
C	0.5	1.5	0
D	0.5	1.5	6

17 A constant electric field is to be maintained between two large parallel plates for which the separation d can be varied.

Which graph shows how the potential difference V between the plates must be adjusted to keep the field strength at a constant value?
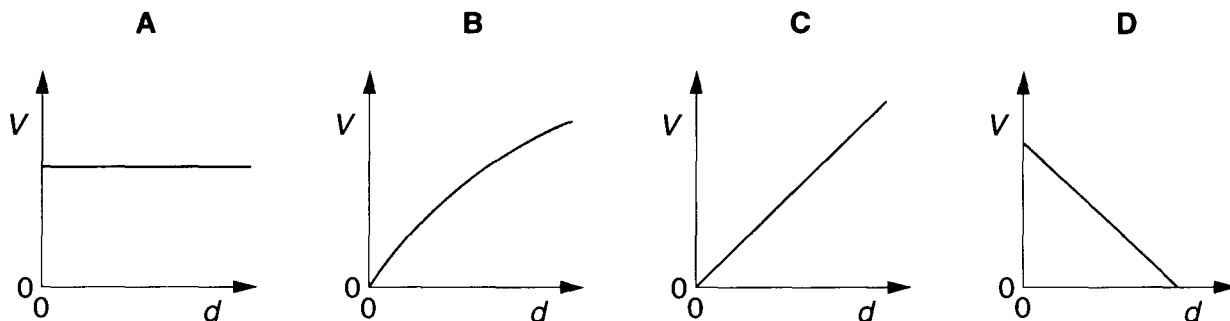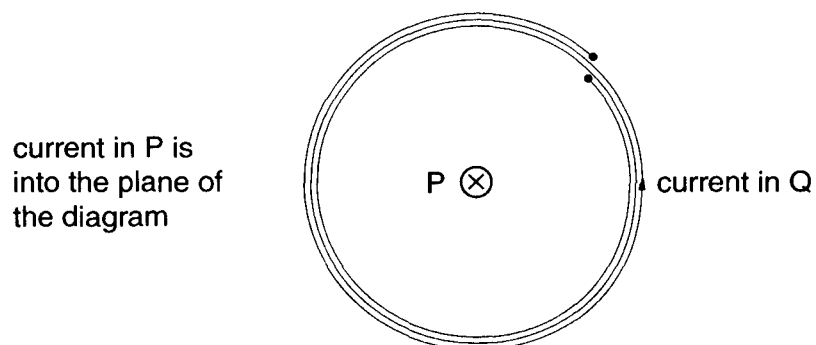
18 Four identical capacitors are connected as shown.

P

Q

R

S

Which of the following lists the arrangements in order of **decreasing** capacitance?

A PQRS   **B** PSRQ   **C** QRSP   **D** QSRP

19 A long straight wire P is placed along the axis of a flat circular coil Q. The wire and the coil each carry a current as shown.

current in P is
into the plane of
the diagram

P $\otimes$

current in Q

What can be deduced about the force acting on each part of Q due to the current in P?

A The force is away from P.

B The force is towards P.

C The force is perpendicular to the plane of the diagram.

D There is no force in any direction.

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20 Diagram 1 shows an aluminium rod, moving at right angles to a uniform magnetic field. Diagram 2 shows the variation with time t of the distance s from O.
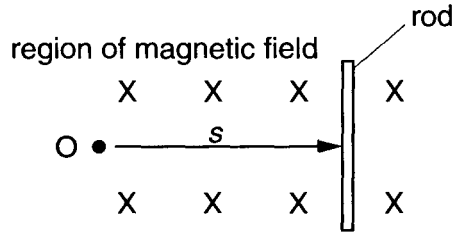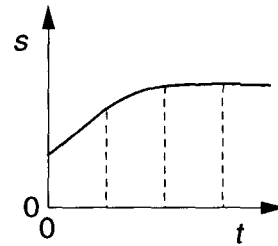
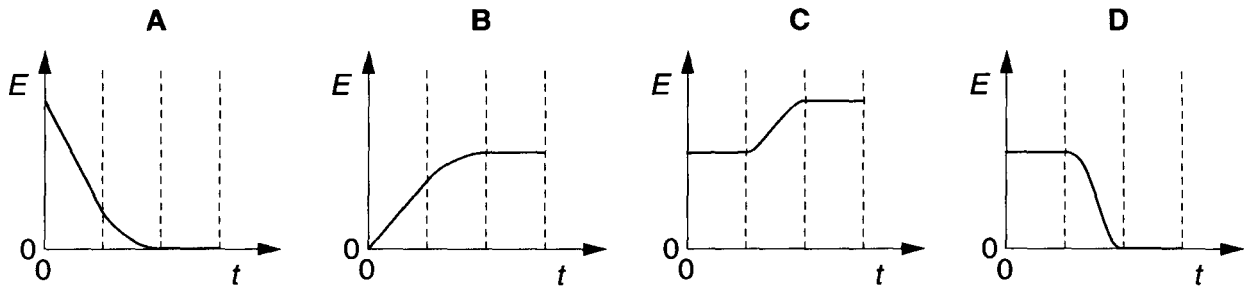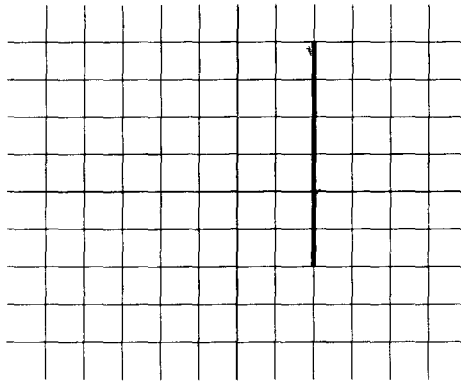region of magnetic field

rod

diagram 1

diagram 2

Which graph best shows the variation with t of the e.m.f. E induced in the rod?
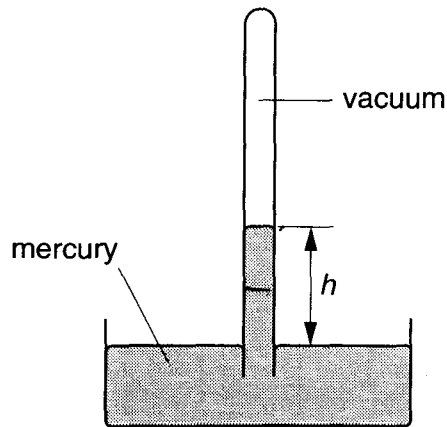
A

B

C

D

21 The diagram shows the display on a cathode-ray oscilloscope when a sinusoidal potential difference is applied to the Y-input. The Y-sensitivity is set at 2.00 V per division and the timebase is switched off.

What is the root-mean-square value of the applied p.d.?

A 4.24 V   **B** 6.00 V   **C** 8.49 V   **D** 12.00 V

22 The height *h* of the mercury in the barometer is recorded.

vacuum

mercury

h

The barometer is set up on another planet where the atmospheric pressure is half that on Earth and the gravitational field strength is double that on Earth.

Which height is recorded?

A $\dfrac{h}{4}$ **B** $\dfrac{h}{2}$ **C** *h* **D** 2*h*

23 A sample is placed in a tensile testing machine. It is extended by known amounts and the tension is measured.

tension/N

80

60

40

20

0

0 1 2 3 4 5 6 7 8 9 10
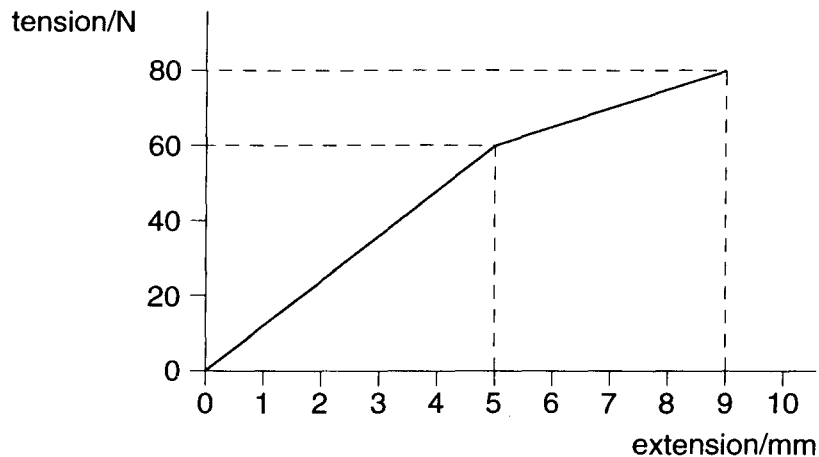
extension/mm

What is the work done on the sample when it is given a total extension of 9 mm?

A 0.31 J **B** 0.36 J **C** 0.43 J **D** 0.72 J

[Turn over

24 In an experiment to find its specific latent heat of vaporisation, water is vaporised using an immersion heater as shown.
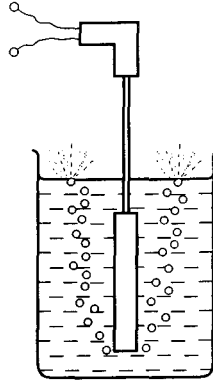
Two sources of error in this experiment are :

error 1   water splashing out of the container;
error 2   vapour condensing on the handle of the heater and dripping back into the container.

What is the effect of these two experimental errors on the calculated value for the specific latent heat?

	error 1	error 2
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

25 Two vessels X and Y, of volumes V_X and V_Y, are kept at temperatures T_X and T_Y. They are filled with the same ideal gas and are connected by a narrow tube.

What is the ratio $\dfrac{\text{number of molecules in X}}{\text{number of molecules in Y}}$?

A $\dfrac{T_X V_X}{T_Y V_Y}$

B $\dfrac{T_Y V_Y}{T_X V_X}$

C $\dfrac{T_X V_Y}{T_Y V_X}$

D $\dfrac{T_Y V_X}{T_X V_Y}$

26 Thermal energy can be transferred by different processes, including

   (i) transfer in a fluid by a process which is a consequence of a change in density of the fluid;

   (ii) transfer in a non-metallic solid by a process of lattice vibrations.

   What are the names of these processes?

|	process (i)	process (ii)
A	evaporation	conduction
B	evaporation	radiation
C	convection	conduction
D	convection	radiation

27 In Millikan's experiment, oil drops are used to measure the elementary charge *e*.

   Which statement about the behaviour of the oil drops during the experiment is correct?

   A When an oil drop becomes charged, the size of the charge must equal *e*.

   B When an oil drop is stationary, it must carry a charge.

   C When an oil drop moves upwards, only the electric force is acting on it.

   D When no electric field acts, all drops move downwards with the same constant velocity.

28 In a photoelectric emission experiment using light of a certain frequency, the maximum kinetic energy E_k of the emitted photoelectrons is measured.

   Which graph represents the way in which E_k depends on the intensity I of the light?

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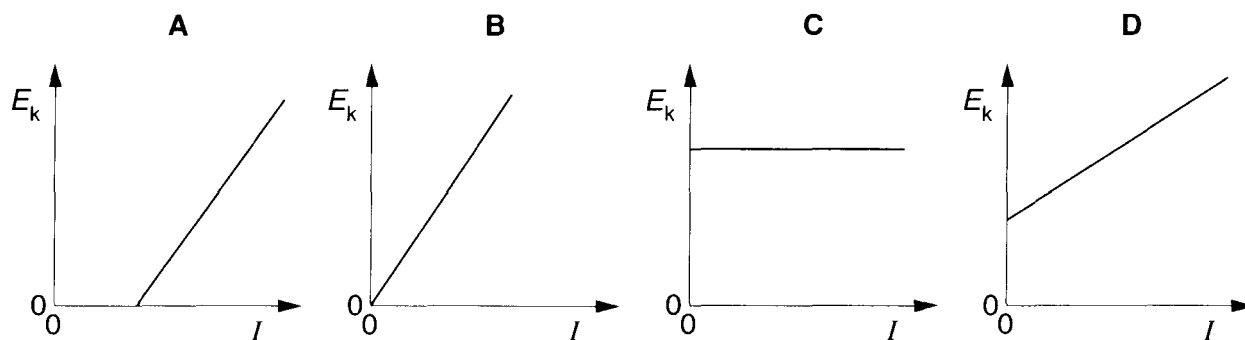
29 Which sketch graph best represents the variation with nucleon number of binding energy per nucleon?

A

binding
energy
per
nucleon

nucleon number

B

binding
energy
per
nucleon

nucleon number

C

binding
energy
per
nucleon

nucleon number

D

binding
energy
per
nucleon

nucleon number
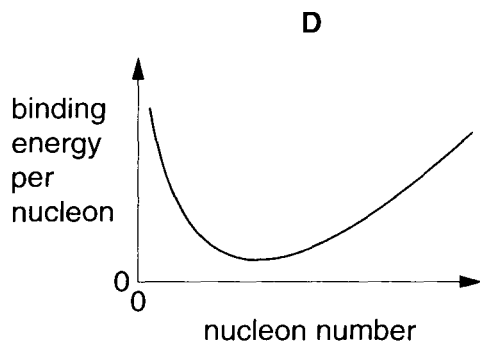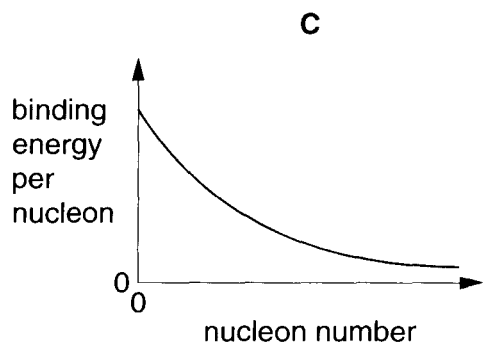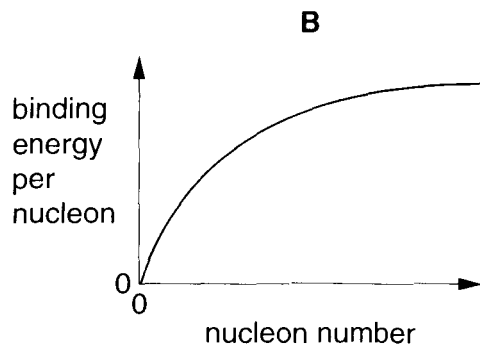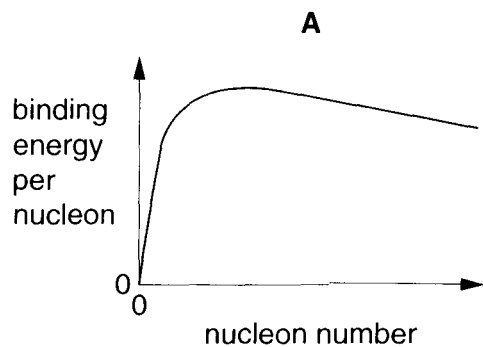
30 In order to trace the line of a water-pipe buried 0.4 m below the surface of a field, an engineer wishes to add a radioactive isotope to the water.

Which sort of isotope should be chosen?

	emitter	half-life
A	β	a few hours
B	β	several years
C	γ	a few hours
D	γ	several years