INTERNATIONAL BACCALAURÉAT BACHILLERATO
BACCALAUREATE INTERNATIONAL INTERNACIONAL

N99/430/H(1)

PHYSICS

Higher Level

Friday 5 November 1999 (afternoon)

Paper 1 — 1 hour

This examination paper consists of 40 questions.

Each question offers 4 suggested answers.

The maximum mark for this paper is 40.

INSTRUCTIONS TO CANDIDATES

Do NOT open this examination paper until instructed to do so.

Answer ALL questions.

For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.

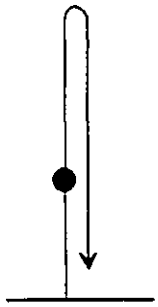
Calculators are NOT permitted for this examination paper.

EXAMINATION MATERIALS

Required:
Optically Mark Read (OMR) answer sheet
Physics HL Data Booklet

Allowed:
A simple translating dictionary for candidates not working in their own language

1. *Velocity and acceleration of a ball in the air.* A ball is thrown vertically upwards and then comes back down.



During the ball's flight, its **velocity** and **acceleration** vectors are

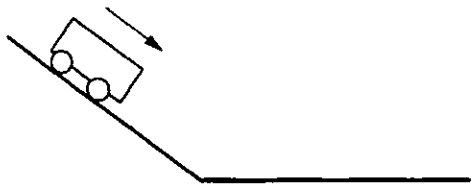
A. always in opposite directions.

B. always in the same direction.

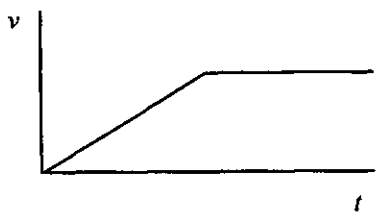
C. first in opposite directions and then in the same direction.

D. first in the same direction and then in opposite directions.

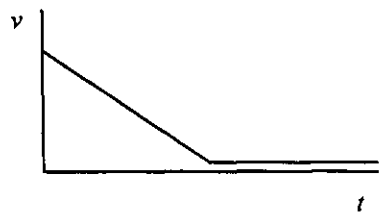
2. *Graph of motion on track sections.* A trolley runs from rest down a sloping track section onto a level section as shown. Friction is negligible.



Which velocity-time graph best represents the motion on both sections?



A.



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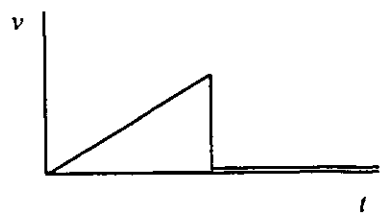

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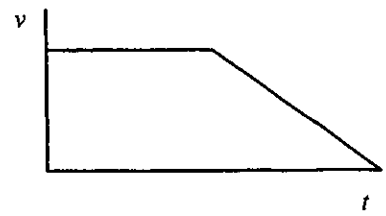


D.

3. *Force at the top.* A ball is thrown vertically upwards. At the **top** of its path, what forces, if any, act on the ball?

A. No forces

B. Only a downward force

C. Only an upward force

D. Both an upward and a downward force

4. *Acceleration on a marked track.* A racing car accelerates uniformly from rest along a straight track. The track has markers spaced at equal distances along it from the start, as shown below. The car reaches a speed of 140 $km\,h^{-1}$ as it passes Marker 2.

At what part of the track would the car have been travelling at an instantaneous speed of 70 $km\,h^{-1}$?

A. Before Marker 1

B. At Marker 1

C. Between Marker 1 and Marker 2

D. After Marker 2

5. *Distance between two falling objects.* Two identical stones are dropped from a tall building, one after the other. While both stones are falling, what will happen to the **distance between them**? Assume air resistance is negligible.

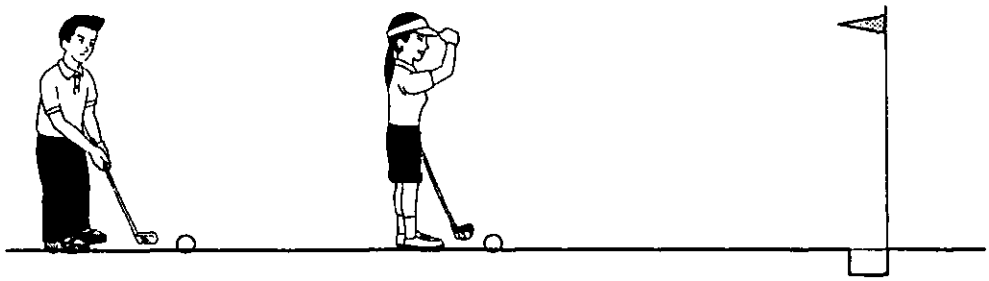
A. It will increase

B. It will decrease

C. It will remain the same

D. It will first increase and then remain constant

6. *Two golf putts.* A golfer plays a putt stroke on a level green of fine grass. She strikes the ball so that it has the right minimum initial speed v to ensure that after slowing on the grass, the ball just reaches the hole and falls into it.



Her partner's ball is exactly **twice** as far from the hole. In order for this ball to just reach the hole, at what speed must it be travelling immediately after being struck? Assume a constant retarding force on the grass.

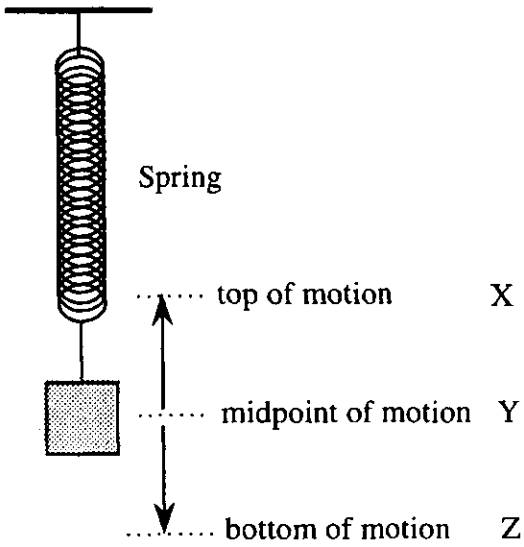
A. v

B. $\sqrt{2}$ v

C. 2 v

D. 4 v

7. *Force on an oscillating mass.* A mass oscillates up and down at the end of a spring. The extent of the motion of its centre of mass is indicated by the arrows.



At what point(s) of the motion is there a **zero** resultant force on the mass?

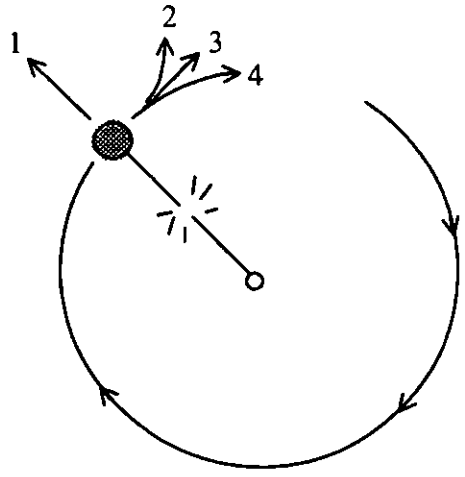
A. Only at the top (point X)

B. At the midpoint of the motion (point Y)

C. Only at the bottom (point Z)

D. At both the top (point X) and the bottom (point Z)

8. *String snaps during circular motion.* A puck (flat disc) is undergoing frictionless circular motion on a **horizontal** air table at the end of a string. The string snaps when the puck is in the position shown.



Top view of motion, which is in the horizontal plane

Which labelled path best represents the motion of the puck after the string snaps?

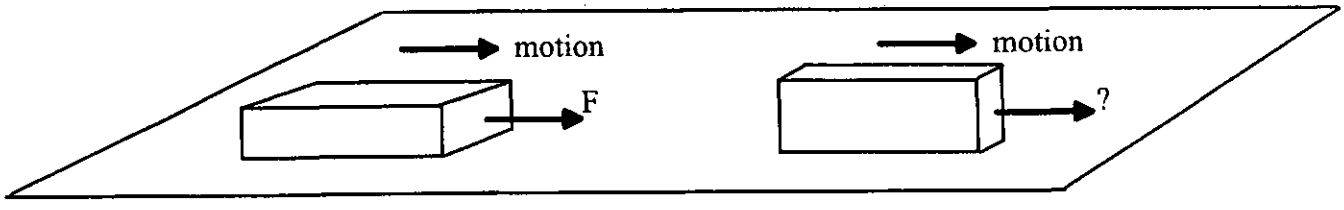
A. Path 1

B. Path 2

C. Path 3

D. Path 4

9. *Friction on different brick faces.* A brick initially has its largest-area face in contact with a rough surface as shown on the left in the figure. A force F is required to pull the brick along the surface at constant speed.



The brick is now turned so that a face of smaller area is in contact as on the right in the figure. What force is required to pull it along at constant speed? The material of the brick is uniform on all faces.

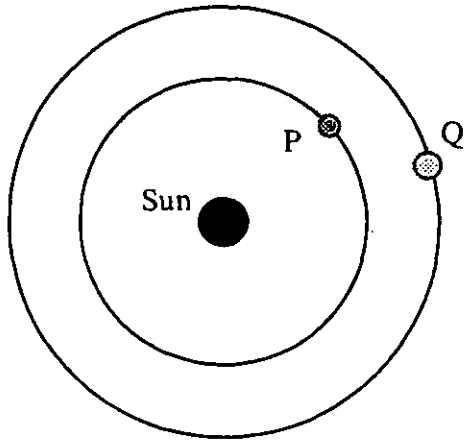
A. A smaller force

B. The same force

C. A greater force

D. One cannot say without knowing the coefficient of friction

10. *Speeds of two planets.* Suppose planets P and Q are in circular orbits around their sun, with Planet Q further from the sun, as shown.



What must be true of the comparative speeds of P and Q in their orbits?

A. The speed of P must be greater than that of Q.

B. The speed of P must be less than that of Q.

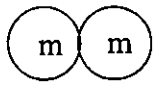
C. The speeds of P and Q must be the same.

D. The comparative speeds cannot be predicted without knowing the comparative masses.

11. *Possible collision situations.* Two balls of equal mass are travelling at the same speed 'v' in opposite directions as shown below.

The balls then collide head-on. They may be made of various materials, soft or hard. The diagrams below show three hypothetical situations **after** the collision.

1.



(both stationary)

2.

3.

Which of the situations shown above is/are **physically possible**, for suitable ball materials?

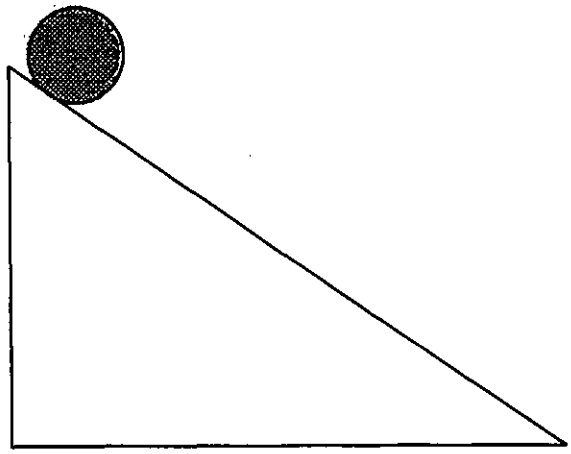
A. 1 only

B. 2 only

C. 1 and 2 but not 3

D. 1, 2 and 3

12. *Slipping or rolling down a plane.* A cylinder is placed on an inclined plane as shown. If the surface is frictionless the cylinder will slip down the plane without rotating, while if there is friction the cylinder will roll down.



How will the times taken to reach the bottom of the plane compare for slipping and for rolling?

A. The time will be shorter for slipping.

B. The time will be shorter for rolling.

C. Times for slipping and rolling will be the same.

D. Times cannot be compared without knowing the angle of inclination.

13. *Variables for a straight line plot.* The properties of an electrical component called a 'thermistor' are being investigated. A fixed potential difference is applied across the thermistor, and the current through it is measured at various temperatures. The following relationship is proposed for the dependence of thermistor current I on temperature T:

$$I = K e^{-A/T}, \text{ where K and A are constants for the thermistor}$$

If the proposed relationship is correct, which variables would give a straight line graph when plotted against each other?

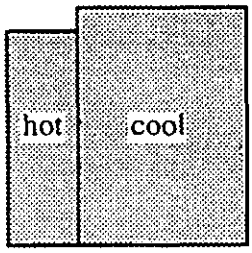
A. I against $\ln T$

B. $\ln I$ against T

C. $\ln I$ against $\ln T$

D. $\ln I$ against $\frac{1}{T}$

14. *Temperature changes of blocks in contact.* A small hot copper block is placed in thermal contact with a larger cool copper block.



How will the temperature **changes** of the two blocks compare in coming to thermal equilibrium? Assume negligible heat is lost to the surroundings.

A. The temperature changes of the blocks will be equal.

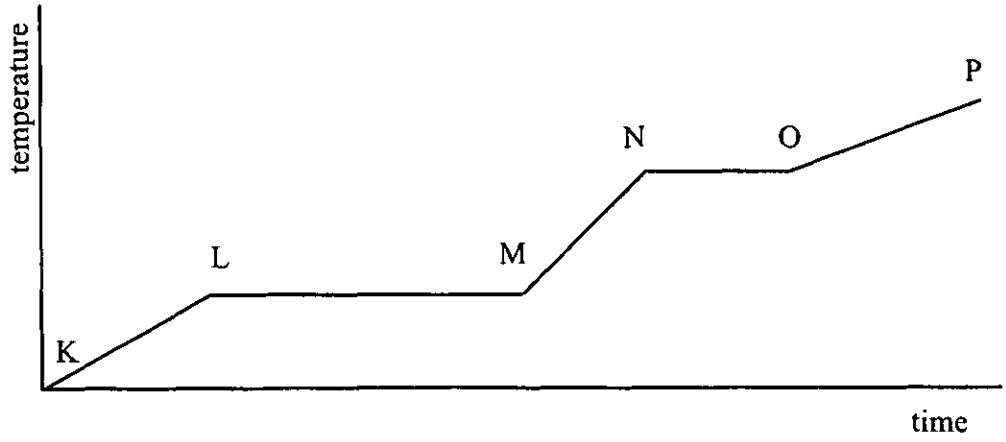
B. The temperature of the small block will change the most.

C. The temperature of the large block will change the most.

D. The temperature changes cannot be compared without more data about the blocks.

The following information relates to questions 15 and 16 below.

A substance is heated at a constant rate of energy transfer. A graph of its temperature against time is shown below.



15. *Mixture of two phases.* Which regions of the graph correspond to the substance existing in a mixture of two phases?

A. KL, MN and OP

B. LM and NO

C. All regions

D. No regions

16. *Greatest specific heat capacity.* In which region of the graph is the specific heat capacity of the substance greatest?

A. KL

B. LM

C. MN

D. OP

17. *Explanation of gas pressure increase.* When the volume of a gas is isothermally compressed to a smaller volume, the pressure exerted by the gas on the container walls increases. The best microscopic explanation for this pressure increase is that at the smaller volume

A. the individual gas molecules are compressed.

B. the gas molecules repel each other more strongly.

C. the average velocity of gas molecules hitting the walls is greater.

D. the frequency of collisions of gas molecules with the walls is greater.

18. *Pressures of two gas samples.* Two identical vessels contain the same number of moles of CO_2 gas and H_2 gas at room temperature. Which **one** of the following is true of the gas pressures?

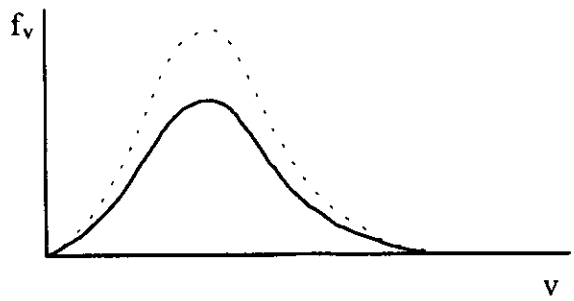
A. The pressures in both containers will be the same.

B. The CO_2 gas will be at a higher pressure than the H_2 gas.

C. The H_2 gas will be at a higher pressure than the CO_2 gas.

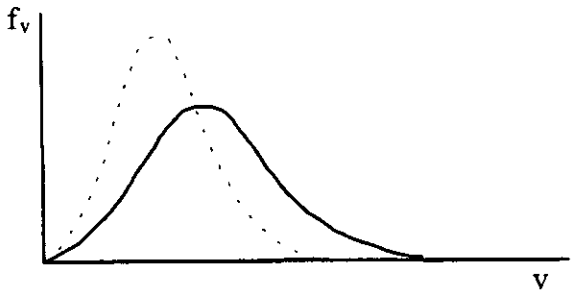
D. The pressures cannot be compared without more information.

19. *Molecular speed distributions at different temperatures.* The **solid** curve in each diagram below represents the Maxwell-Boltzmann distribution of molecular speeds in a sample of gas at a particular temperature. In which of the diagrams does the **dotted** curve correctly represent the speed distribution if the temperature is increased?



A.

B.



C.

D.

20. *Thermal expansion of long and short rods.* One iron rod is longer than another as shown. Both are at the same temperature.

Their temperatures are now increased by the same amount. What will be true of the **changes in length** of the two rods?

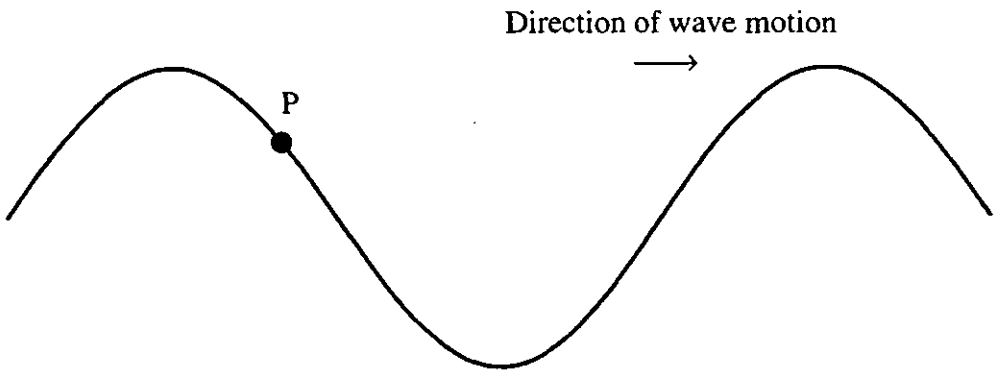
A. The changes will be the same.

B The change will be greater for the longer rod.

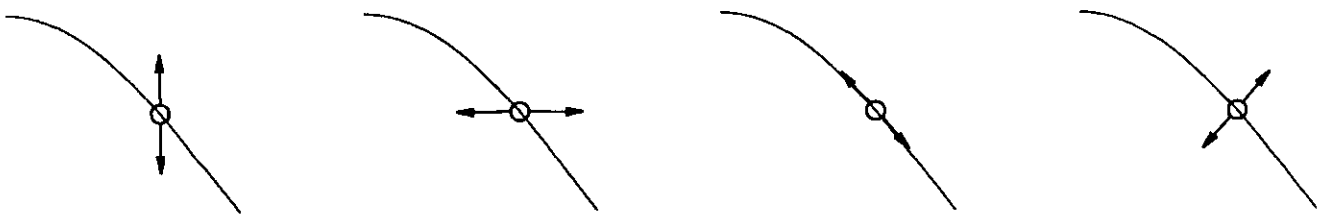
C. The change will be greater for the shorter rod.

D. Neither rod will change in length.

21. *Transverse wave: motion of a rope segment.* The diagram represents a transverse wave travelling from left to right along a rope, at a particular instant of time.



A segment of rope is marked P. Which diagram below best represents how P oscillates as the wave travels?



A. B. C. D.

22. *Wave pulse reaching a fixed end.* A wave pulse is propagating along a rope under tension. The end of the rope is fixed as shown.

What will happen to the pulse when it reaches the fixed end of the rope?

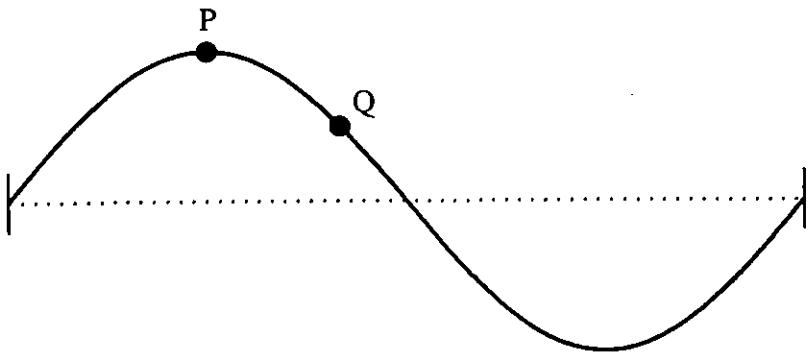
A. It will be absorbed and disappear.

B. It will be reflected, inverted.

C. It will be reflected, but not inverted.

D. It will stop, bunched against the wall.

23. *Standing wave.* A standing wave exists on a string fixed at each end. At one instant of time, the string is as shown. Two points on the rope are labelled P and Q.



Which point will reach the equilibrium position (dashed line) first?

A. P will reach the dashed line first.

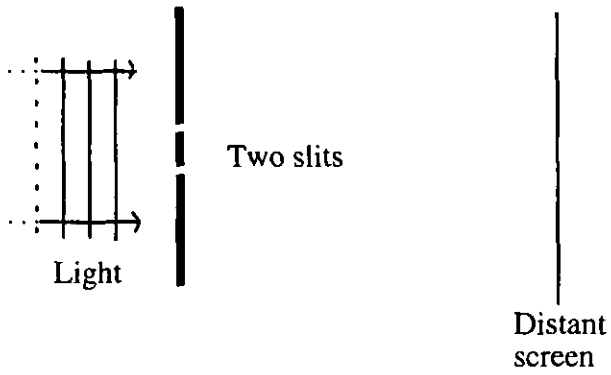
B. Q will reach the dashed line first.

C. P and Q will reach the dashed line at the same time.

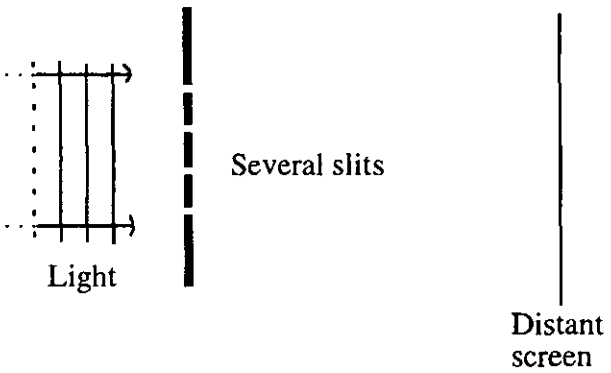
D. Neither P nor Q ever reach the dashed line.

24. *Fringe pattern for several slits*

Wavefronts of coherent light are incident on two closely spaced slits as shown alongside, giving rise to a pattern of bright and dark fringes on a screen beyond.



Suppose more slits are added with the same spacing, as shown.



Compared to the original pattern, the new fringe pattern produced will have

A. fringes spaced closer together.

B. fringes spaced further apart.

C. fringes spaced as before but more diffuse.

D. fringes spaced as before but sharper.

25. *Resonant frequencies of a pipe.* An organ pipe is open at one end and closed at the other. If the fundamental frequency of the pipe is f, then the next resonance will be at frequency

A. $\frac{3}{2}$ f

B. 2 f

C. 3 f

D. 4 f

26. *Sound with a wind blowing.* When sound travels in still air from a stationary source to a stationary listener, a certain frequency is heard. Suppose a strong wind now starts blowing from source to listener. The sound heard by the listener will

A. increase in frequency.

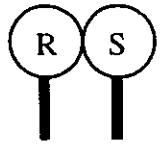
B. decrease in frequency.

C. display beats.

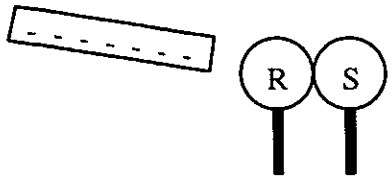
D. remain unchanged.

27. *Electrostatic induction process for two spheres*

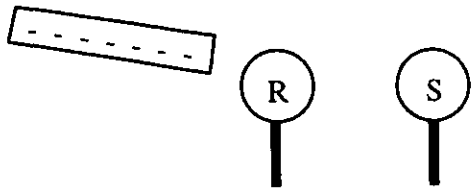
Two uncharged metal spheres R and S on insulating stands are touching as shown.



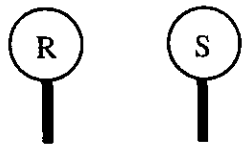
A negatively charged rod is brought close to R.



The spheres are then separated.



The charged rod is removed.



Which **one** of the following will be true after this process?

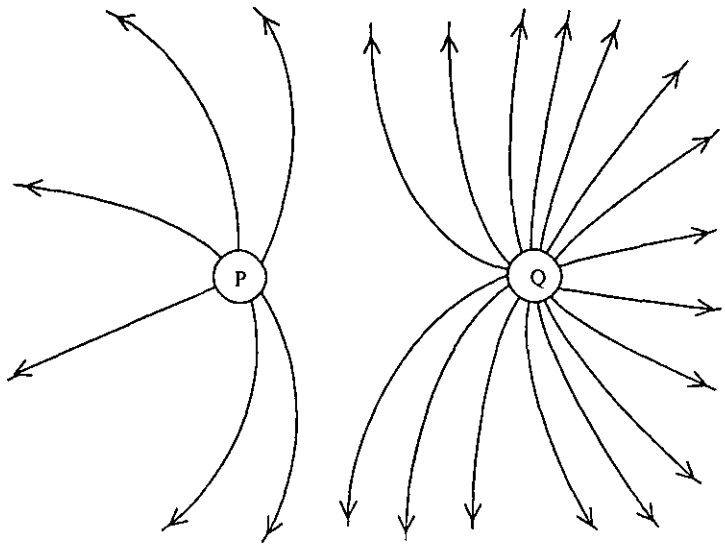
A. Neither R nor S will be charged.

B. R will be charged positively and S negatively.

C. R will be charged negatively and S positively.

D. Both R and S will be positively charged.

28. *Two charges – field, charge and force.* The diagram shows the field lines due to two small charged particles P and Q.



Consider the following statements:

I. The charge on P is smaller than the charge on Q.

II. The electrostatic force on P is smaller than the force on Q.

Which of these statements is/are true?

A. Only I

B. Only II

C. Both I and II

D Neither I nor II

29. *Accelerating two charged particles.* A helium nucleus ${}^{4}_{2}\mathrm{He}$ and a proton ${}^{1}_{1}\mathrm{H}$ are both accelerated from rest through the same potential difference. The ratio of the kinetic energy of the helium nucleus to that of the proton will be

A. 1:2

B. $1:\sqrt{2}$

C. $\sqrt{2}:1$

D. 2:1

30. *Resistance wire configurations.* A length of resistance wire (**Figure I**) has resistance R.

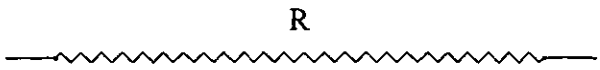


Figure I

Figure II

If the wire is cut in half and the two pieces connected in a circuit as shown in **Figure II**, what will be the effective resistance?

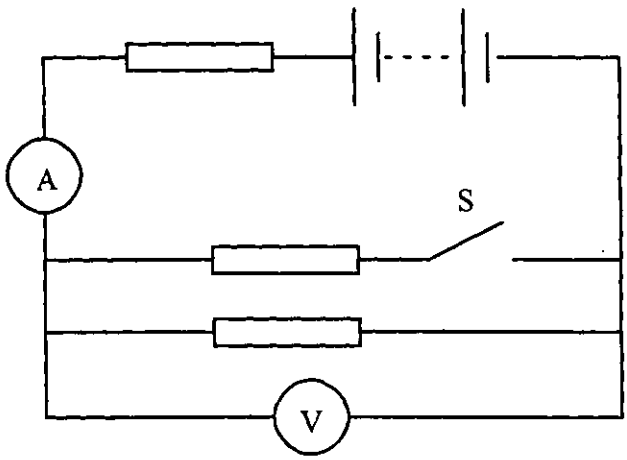
A. $\frac{R}{4}$

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

C. 2R

D. 4R

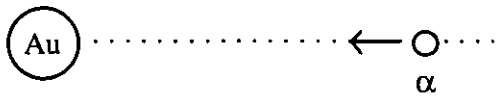
31. *Effect of switching in a resistor.* In the circuit shown below, the switch S is initially open.



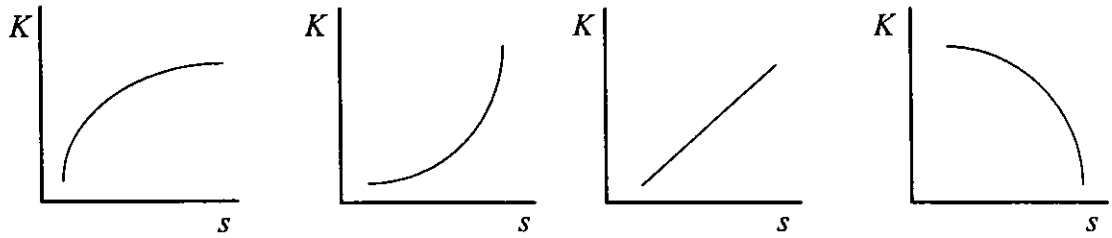
If the switch is now closed, how will the readings on the ammeter A and voltmeter V change, if at all?

	Ammeter reading	Voltmeter reading
A.	Increase	Remain the same
B.	Increase	Decrease
C.	Decrease	Remain the same
D.	Decrease	Decrease

32. *Energy of an alpha particle approaching a nucleus.* An alpha particle approaches a gold nucleus along a straight line as shown in the sketch below.



Which of the following graphs best represents the variation in the **kinetic energy** K of the alpha particle as a function of its distance s from the centre of the nucleus?



33. *Magnetic forces on parallel wires.* The diagram represents the magnitude and direction of the magnetic forces on two parallel wires R and S carrying equal currents in opposite directions.

Suppose the current in wire R is now **doubled**, while that in S is unchanged. Which diagram below best represents the forces that now act on the two wires?

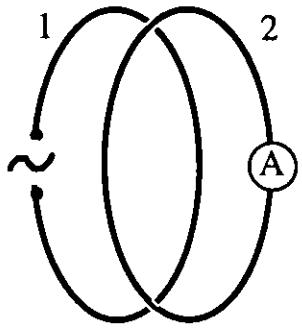
A.

B.

C.

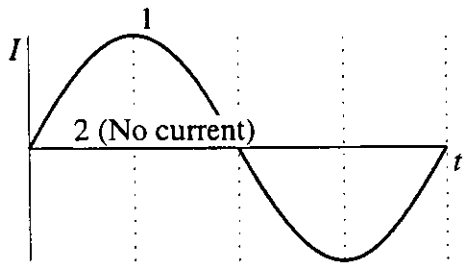
D.

34. *Electromagnetic induction between two loops.* Two loops of wire are next to each other as shown below. There is a source of alternating emf connected to loop 1 and an ammeter in loop 2.

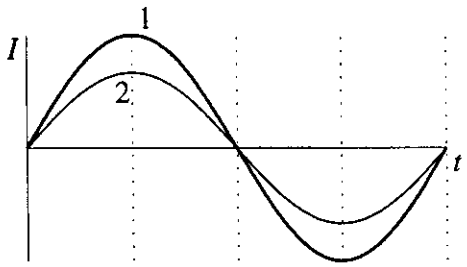


The variation with time of the current in loop 1 is shown as the solid line in each of the graphs below. In which graph does the **thin** line (line 2) best represent the current in loop 2?

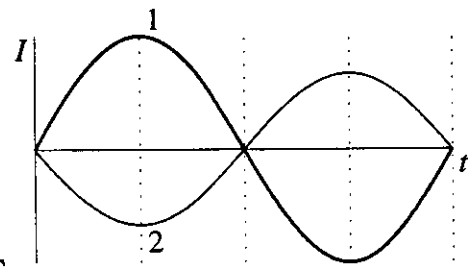
A.



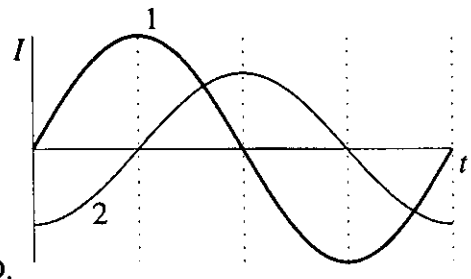
B.



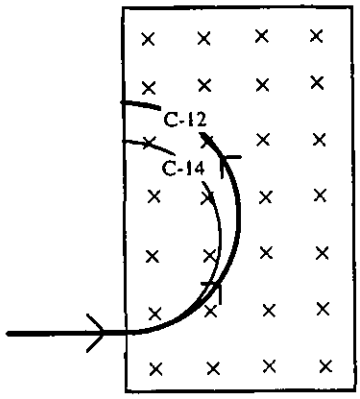
C.



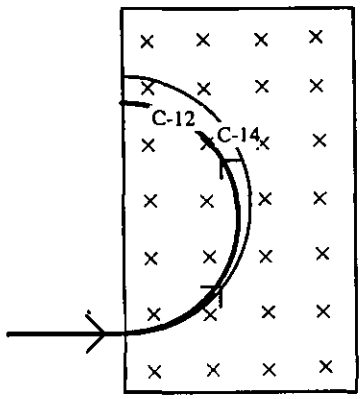
D.



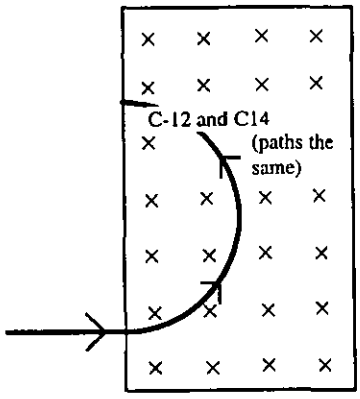
35. *Ion paths in a spectrometer.* Singly-ionised carbon–12 ions injected into a mass spectrometer travel in an arc of a circle in the magnetic field, as shown by the **thick** line in the diagrams below.



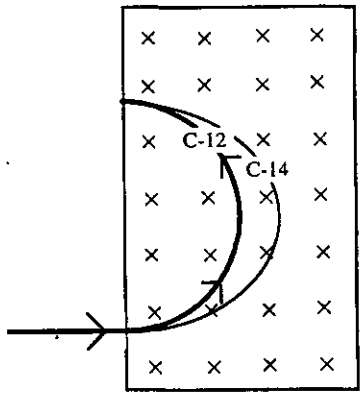
A.



B.



C.



D.

Suppose that some of the ions are the heavier isotope carbon–14, injected with the same velocity, and also singly ionised. In which diagram does the **thin** line best represent the path travelled by the carbon–14 ions?

A. Diagram A

B. Diagram B

C. Diagram C

D. Diagram D

36. *Matching spectral lines to transitions.* Figure 1 below shows five energy levels of an atom, with five transitions indicated. Figure 2 shows four possible sets of spectral lines.

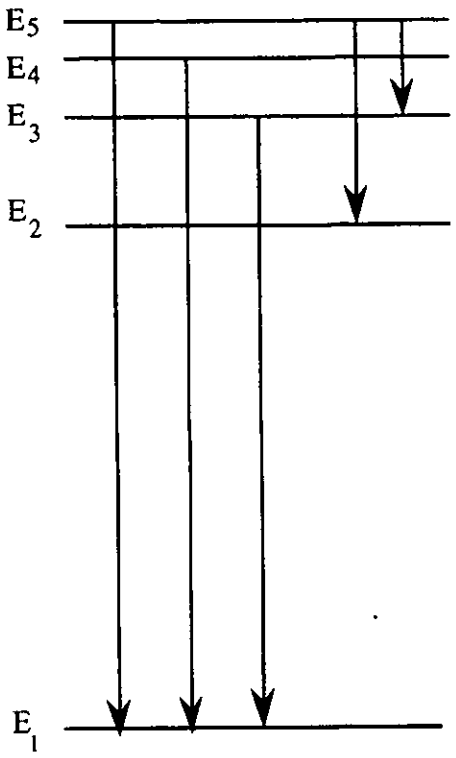


Figure 1

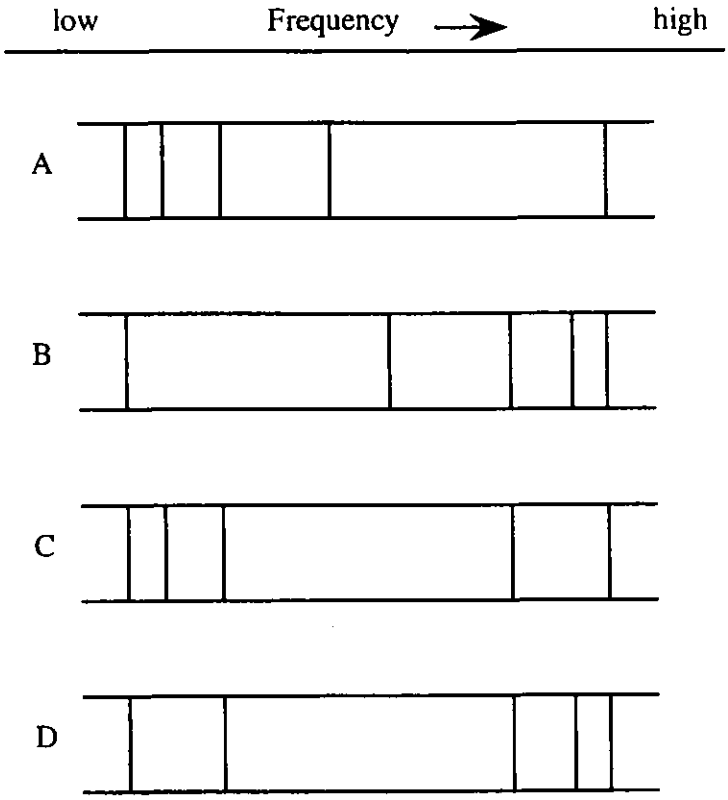


Figure 2

Which frequency spectrum in Figure 2 best corresponds to the transitions in Figure 1?

A. Spectrum A

B. Spectrum B

C. Spectrum C

D. Spectrum D

37. *Implications of the photoelectric effect.* For what concept does the photoelectric effect provide experimental evidence?

A. The particle nature of light

B. Matter waves

C. Energy levels in atoms

D. Equivalence of mass and energy

38. *Millikan experiment.* In a Millikan-type experiment, a tiny plastic sphere carrying charge Q remains stationary between parallel plates when there is a potential difference of 500 V between them. The sphere is replaced by another sphere of twice the mass and to keep it stationary the potential difference has to be adjusted to 2000 V.

What is the charge on the second sphere?

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

B. Q

C. 2Q

D. 4Q

39. *Radioactive decay product.* A radioactive nuclide of atomic number Z emits an electron followed by a gamma ray. What is the atomic number of the new nuclide?

A. $Z-4$

B. $Z-2$

C. $Z-1$

D. $Z+1$

40. *Comparative activities of two samples.* The half-life of cobalt–60 is 5.3 years, while that of strontium–90 is 28 years. Consider two samples containing **equal numbers of atoms** of each of these radioactive nuclides at a particular time. How will the activities (number of decays per unit time) of the samples compare at this time?

A. The activities cannot be compared without more information.

B. The activities will be equal.

C. The activity of the cobalt–60 sample will be greater.

D. The activity of the strontium–90 sample will be greater.