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**PHYSICS
HIGHER LEVEL
PAPER 1**

Tuesday 20 May 2008 (afternoon)

1 hour

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.

1. An elephant has a life expectancy of 60 years. Which of the following gives the order of magnitude of this lifetime?

- A. 10^{11} s
- B. 10^9 s
- C. 10^7 s
- D. 10^5 s

2. The frequency f of waves of wavelength λ travelling on the surface of deep water is given by

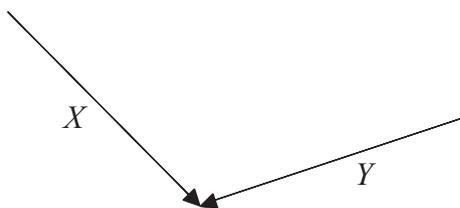
$$f = \sqrt{\frac{g}{2\pi\lambda}}$$

where g is the acceleration of free fall.

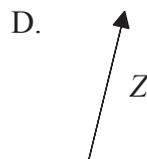
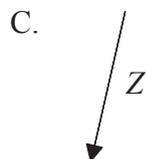
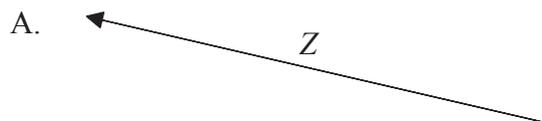
Which of the following will yield a straight-line graph?

	y-axis	x-axis
A.	f^2	$\frac{1}{\lambda}$
B.	f^2	λ
C.	f	λ
D.	f	$\frac{1}{\lambda}$

3. The diagram below shows two vectors X and Y .



Which of the following best represents the vector $Z = X - Y$?

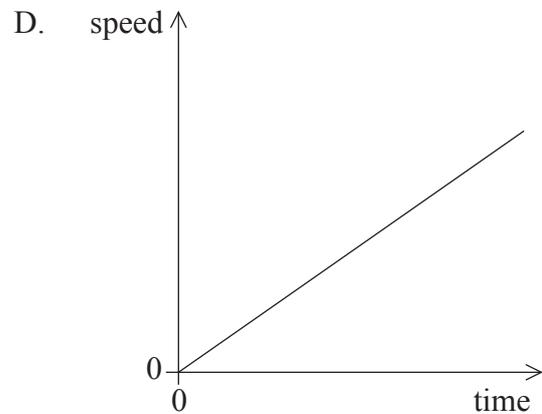
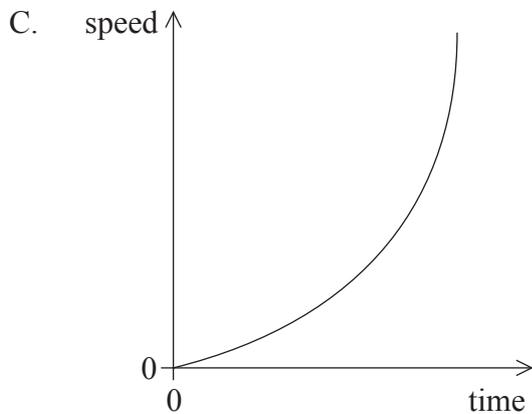
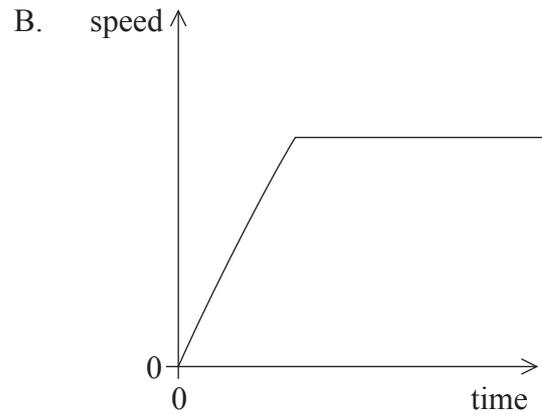
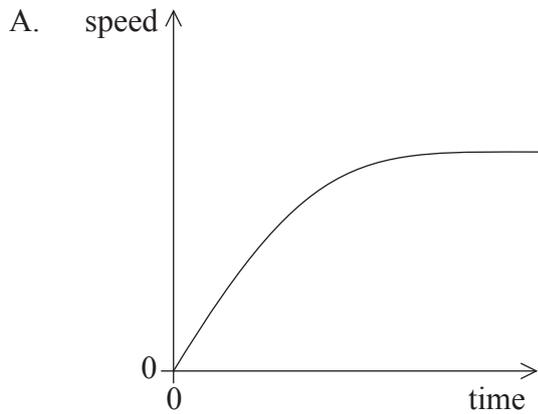


4. The period T of oscillation of a mass m on a spring, having spring constant k is $T = 2\pi\sqrt{\frac{m}{k}}$.

The uncertainty in k is 11% and the uncertainty in m is 5%. The approximate uncertainty in T is

- A. 4%.
- B. 6%.
- C. 8%.
- D. 16%.

5. A steel sphere is dropped from rest in oil. Which of the following graphs best represents the variation with time of the speed of the sphere?

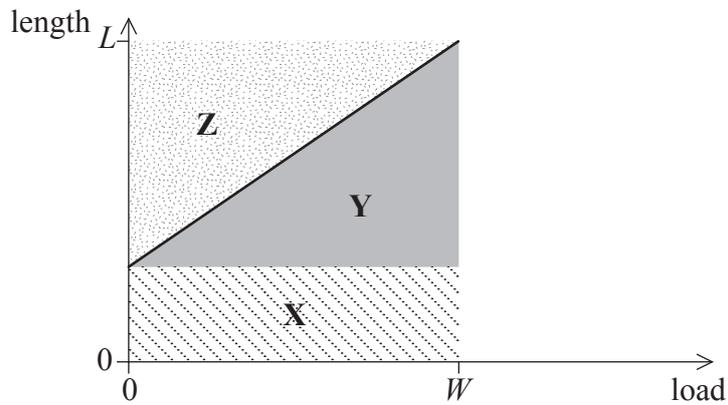


6. An electric motor has an input power of 160 W. In raising a load, 120 W of power is dissipated. The best estimate for the efficiency of the motor is

- A. 25%.
- B. 33%.
- C. 57%.
- D. 75%.

Questions 7 and 8 both refer to the following information and graph.

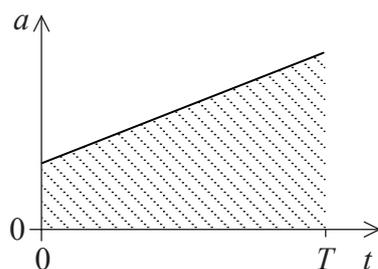
The graph below shows the variation with load of the length of a spring.



For a load W the length of the spring is L .

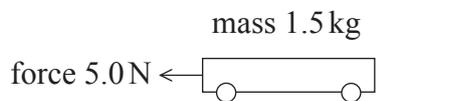
7. Which of the following areas on the graph represents the energy stored in the spring when it is stretched to a length L ?
- A. X
 - B. $Y - X$
 - C. Z
 - D. $X + Y$
8. The spring constant of the spring is given by
- A. the gradient of the graph.
 - B. $\frac{1}{\text{gradient of the graph}}$.
 - C. $\frac{W}{L}$.
 - D. $\frac{L}{W}$.

9. The graph below shows the variation with time t of the acceleration a of an object from $t=0$ to $t=T$.



The shaded area under the graph represents change in

- A. displacement.
 - B. velocity.
 - C. momentum.
 - D. kinetic energy.
10. A trolley of mass 1.5 kg is pulled along a horizontal table by a force of 5.0 N.



The frictional force acting on the trolley is 0.50 N.

The acceleration of the trolley is

- A. 0.30 ms^{-2} .
- B. 0.33 ms^{-2} .
- C. 3.0 ms^{-2} .
- D. 3.3 ms^{-2} .

11. Planets A and B orbit the same star. The orbital radius of planet B is four times that of planet A.

Which of the following is the magnitude of the ratio

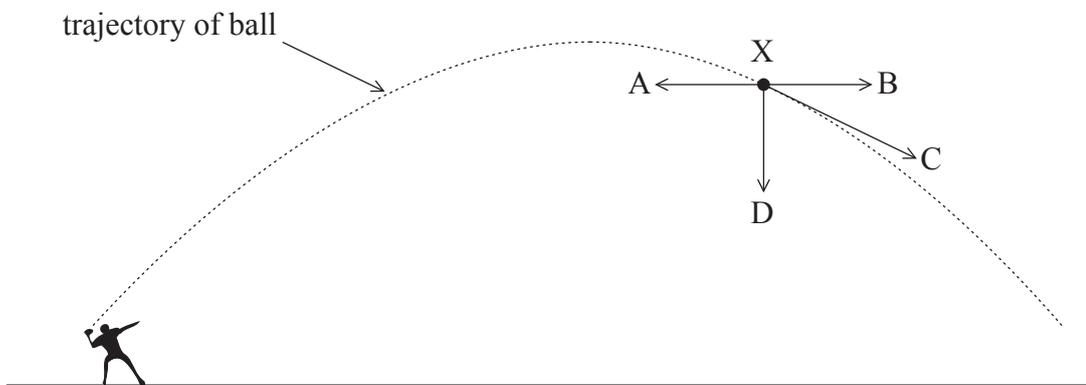
$$\frac{\text{orbital period for planet B}}{\text{orbital period for planet A}}?$$

- A. 4
- B. 8
- C. 16
- D. 64
12. The escape speed of an object of mass m from a planet of mass M and radius r depends on the gravitational constant and
- A. M and r .
- B. m and r .
- C. M only.
- D. M , m , and r .
13. For a body to be in equilibrium
- A. the net force acting on the body must be zero.
- B. the net torque acting on the body must be zero.
- C. both the net force and the net torque acting on the body must be zero.
- D. the net force must be equal and opposite to the net torque acting on the body.

14. A block rests on a rough horizontal plane. The plane is gradually tilted at one end until the block begins to slide. The block accelerates down the plane.

Which of the following is a true statement.

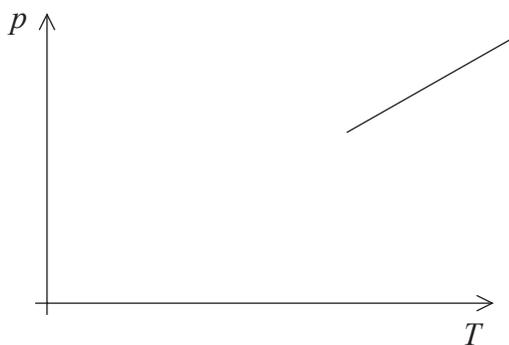
- A. The weight of the block equals the dynamic friction force.
 - B. The weight of the block equals the static friction force.
 - C. The dynamic friction force is greater than the static friction force.
 - D. The dynamic friction force is less than the static frictional force.
15. The diagram below shows the trajectory of a ball thrown into the air. There is no air resistance.



Which arrow gives the direction of the resultant force on the ball at the point X?

- A. A
- B. B
- C. C
- D. D

16. Gas leaks slowly out of a cylinder of constant volume. The temperature of the gas in the cylinder does not change. Which of the following is constant for the gas molecules in the cylinder?
- A. The number striking unit area of surface in unit time
 - B. The number of the collisions between molecules per unit time
 - C. The number per unit volume
 - D. The average speed
17. The graph below shows the variation with absolute temperature T of the pressure p of one mole of an ideal gas having a volume V . R is the molar gas constant.



Which of the following is the best interpretation of the intercept on the temperature axis and the gradient of the graph?

	Intercept on temperature axis / K	Gradient of graph
A.	-273	$\frac{R}{V}$
B.	0	$\frac{R}{V}$
C.	0	$\frac{V}{R}$
D.	-273	$\frac{V}{R}$

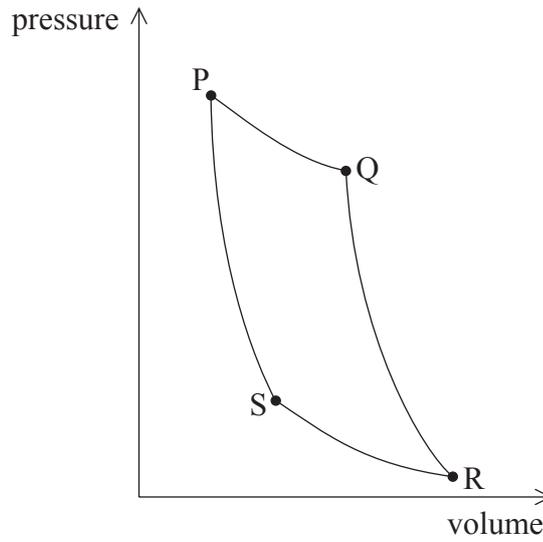
18. A block of metal at a temperature of 90°C is placed in a beaker of water at a temperature of 0°C . The mass of the metal block and the mass of the water are equal. The final temperature of the water and the metal block is 9°C .

Which of the following is the best estimate of the ratio

$$\frac{\text{specific heat of water}}{\text{specific heat of metal}}?$$

- A. $\frac{1}{10}$
- B. $\frac{1}{9}$
- C. 9
- D. 10
19. For any natural process, the second law of thermodynamics states that the total entropy of the universe
- A. always decreases.
- B. usually decreases but may increase.
- C. always increases.
- D. usually increases but may decrease.

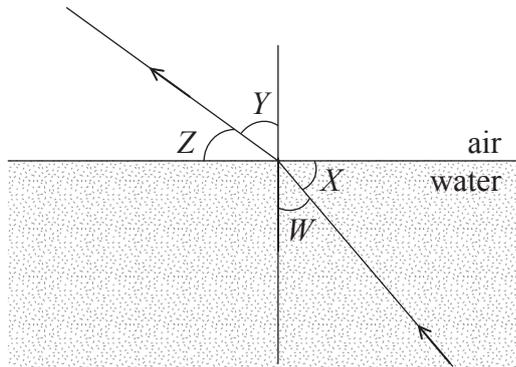
20. The diagram below shows the pressure-volume changes for one cycle PQRS of a Carnot engine.



During which part of the cycle is thermal energy transferred to the surroundings?

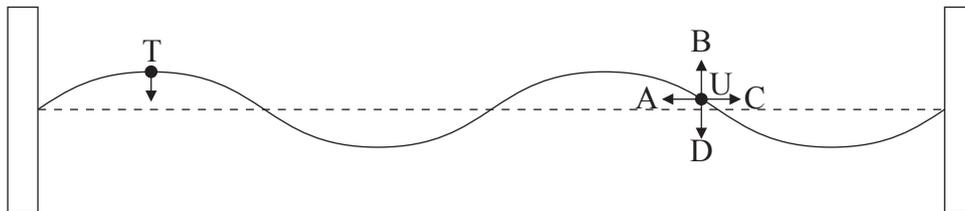
- A. P → Q
- B. Q → R
- C. R → S
- D. S → P

21. Light travelling from water to air is incident on a boundary.



Which of the following is a correct statement of Snell's law for this situation?

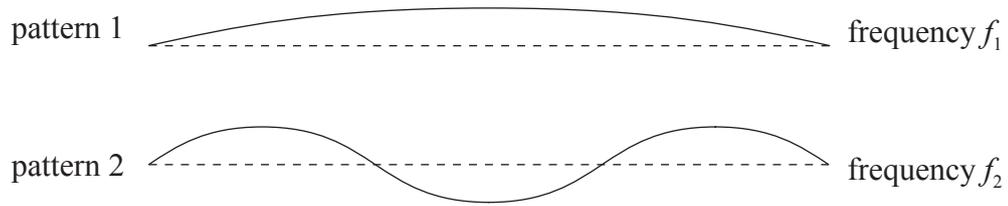
- A. $\sin Z = \text{constant} \times \sin Y$
 - B. $\sin W = \text{constant} \times \sin Z$
 - C. $\sin X = \text{constant} \times \sin Z$
 - D. $\sin W = \text{constant} \times \sin Y$
22. A standing wave is established on a string between two fixed points.



At the instant shown, point T is moving downwards. Which arrow gives the direction of movement of point U at this instant?

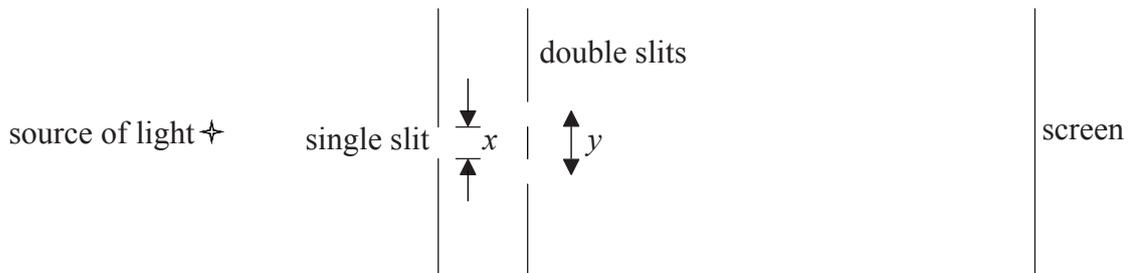
- A. A
- B. B
- C. C
- D. D

23. The diagrams below show two standing wave patterns that are set up in a stretched string fixed at both ends. The frequency of pattern 1 is f_1 and that of pattern 2 is f_2 .



The ratio $\frac{f_1}{f_2}$ is

- A. $\frac{1}{3}$.
 - B. $\frac{2}{3}$.
 - C. 3.
 - D. 6.
24. The diagram below shows an apparatus to demonstrate the interference of light.



The width of the single slit is x and the separation of the double slits is y . Which of the following changes to the apparatus will increase the spacing of the fringes?

	x	y
A.	unchanged	increase
B.	increase	unchanged
C.	unchanged	decreased
D.	decrease	unchanged

25. Sound of a constant frequency f_0 is being emitted by a sound source. An observer O travels in the direction shown at a speed of $0.1v$ where v is the speed of sound.



Which of the following gives the relationship between f_0 and the frequency f of observed sound?

- A. $f = 1.1f_0$
- B. $f_0 < f < 1.1f_0$
- C. $f = 0.9f_0$
- D. $f_0 > f > 0.9f_0$
26. Two sources of sound are heard simultaneously. Beats are heard when
- A. the sources are coherent.
- B. the sources are stationary.
- C. the amplitudes of the emitted sounds are equal.
- D. the frequencies of the emitted sounds are slightly different.
27. Which of the following is a unit for electrical resistance?
- A. W A^{-2}
- B. A V^{-1}
- C. $\text{V W}^{-2}\text{s}$
- D. W V^{-2}

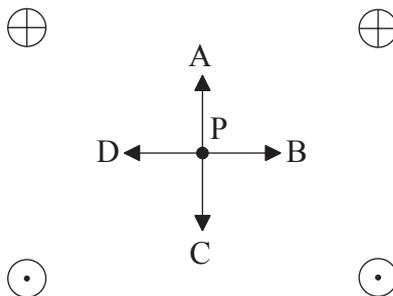
28. The diagram below shows two stationary point charges $+2Q$ and $-Q$.



At which point is the electric field strength greatest?

- A. A
- B. B
- C. C
- D. D

29. The diagram below represents four long straight wires perpendicular to the plane of the paper.

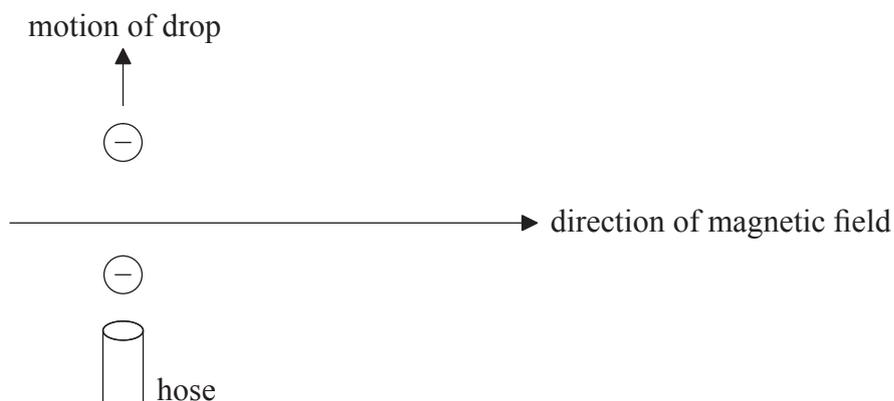


The magnitude of the direct current in each wire is the same. Wires with \oplus have current into the plane of the paper and wires with \odot have current out of the plane of the paper. Point P is the same distance from each wire.

Which arrow shows the direction of the magnetic field at P?

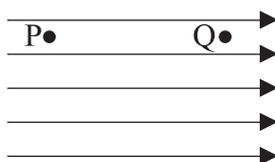
- A. A
- B. B
- C. C
- D. D

30. Drops of a liquid are being sprayed vertically upwards into the air by a hose in a region where the Earth's magnetic field is directed horizontally as shown in the diagram below.



As each drop leaves the hose it becomes negatively charged. Which of the following describes the direction of the magnetic force acting on the drops?

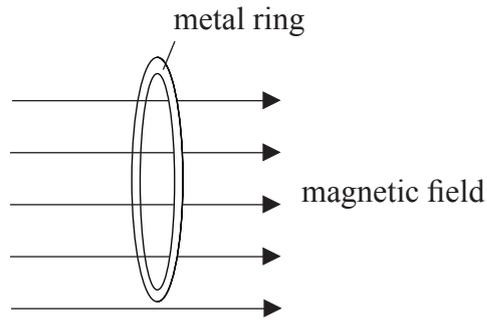
- A. Downwards
 - B. Upwards
 - C. Out of the paper
 - D. Into the paper
31. The diagram below shows the electric field lines in a region of space. A positively charged particle moves from P to Q.



Which of the following is correct?

	Change in potential energy of particle	Change in potential between P and Q
A.	decreases	zero
B.	decreases	negative
C.	increases	zero
D.	increases	negative

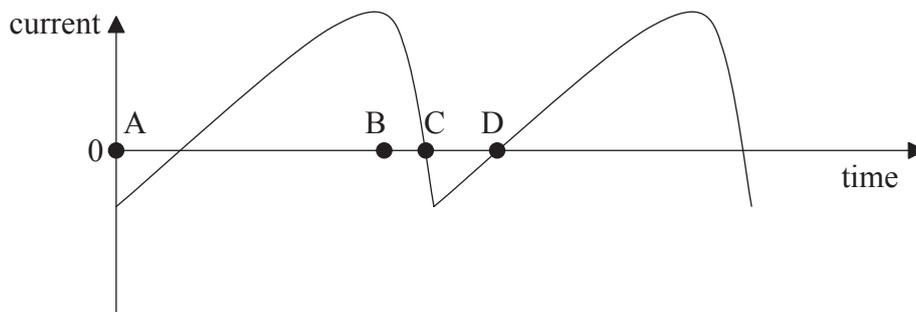
32. A metal ring has its plane perpendicular to a magnetic field.



The magnetic flux through the ring increases at a constant rate by 4.0×10^{-5} Wb in 5.0 s.

During this change the e.m.f. induced in the ring

- A. remains constant at $8 \mu\text{V}$.
 - B. remains constant at $20 \mu\text{V}$.
 - C. increases from zero to $8 \mu\text{V}$.
 - D. increases from zero to $20 \mu\text{V}$.
33. The variation with time of the current in the primary coil of an ideal transformer is shown below.



At which time will the magnitude of the induced e.m.f. in the secondary coil be maximum?

- A. A
- B. B
- C. C
- D. D

34. A nucleus ${}^{90}_{38}\text{Sr}$ decays by the emission of an electron. What are the mass (nucleon) number and the atomic (proton) number of the resulting nucleus?

	Mass number	Proton number
A.	89	38
B.	90	39
C.	91	38
D.	91	39

35. Radioactive element P has a half-life of 30 days and element Q has a half-life of 20 days. Initially a radioactive source contains equal numbers of each element.

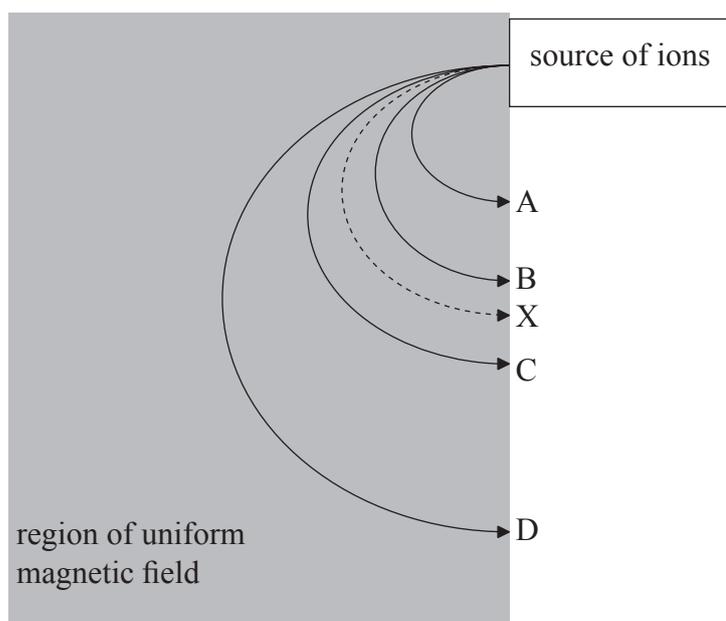
What is the ratio $\frac{\text{number of atoms of P}}{\text{number of atoms of Q}}$ after 60 days have elapsed?

- A. $\frac{1}{2}$
- B. $\frac{2}{3}$
- C. $\frac{3}{2}$
- D. 2
36. Monochromatic light is incident on a metal surface in a photocell. Which of the following statements is correct?
- A. The rate at which electrons are emitted from the surface is proportional to the intensity of the radiation.
- B. The rate at which electrons are emitted from the surface depends only on the frequency of the radiation used.
- C. The intensity of the radiation used must be greater than a threshold value in order to emit electrons.
- D. The wavelength of the radiation must be greater than a threshold value in order to emit electrons.

37. Which of the following is the correct relationship between the kinetic energy E_k of a particle and its associated de Broglie wavelength λ ?

- A. $\lambda \propto E_k$
- B. $\lambda \propto \frac{1}{E_k^2}$
- C. $\lambda \propto \frac{1}{E_k}$
- D. $\lambda \propto \frac{1}{\sqrt{E_k}}$

38. The diagram below shows the deflection chamber of a mass spectrometer.

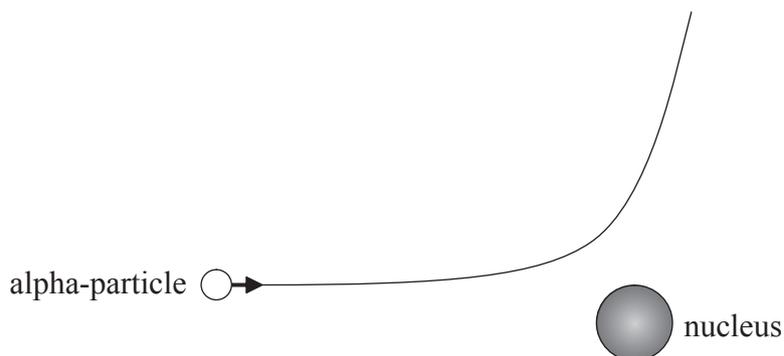


Track X shows the path of a singly-charged carbon-12 ion in the chamber.

Which track best shows the track of a singly-charged C-14 ion that has the same initial speed?

- A. A
- B. B
- C. C
- D. D

39. The diagram below shows the path followed by an alpha-particle in the vicinity of the nucleus of a gold atom.



Which of the following is correct for the alpha-particle?

- A. The force acting on it changes direction.
 - B. The force acting on it is smaller than that acting on the nucleus.
 - C. Its potential energy is constant.
 - D. Its kinetic energy is constant.
40. Which of the following interactions is responsible for β^+ -decay?
- A. Electromagnetic
 - B. Gravitational
 - C. Strong
 - D. Weak
-