IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

M05/4/PHYSI/HPM/ENG/TZ2/XX+

22056513

PHYSICS
HIGHER LEVEL
PAPER 1

Thursday 19 May 2005 (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. The ratio $\frac{\text{diameter of hydrogen atom}}{\text{diameter of hydrogen nucleus}}$ to the nearest order of magnitude is

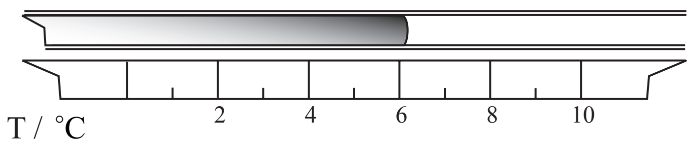
A. 10^2.

B. 10^5.

C. 10^{10}.

D. 10^{15}.

2. The diagram below shows the position of the meniscus of the mercury in a mercury-in-glass thermometer.



Which of the following best expresses the indicated temperature with its uncertainty?

A. (6.0 ± 0.5)°C

B. (6.1 ± 0.1)°C

C. (6.2 ± 0.2)°C

D. (6.2 ± 0.5)°C

3. Which of the following represents two vector quantities?

A. distance, acceleration

B. kinetic energy, work

C. force, momentum

D. electric field strength, electric potential

4. The radius of a loop is measured to be (10.0 ± 0.5) cm. Which of the following is the best estimate of the uncertainty in the calculated area of the loop?

A. 0.25 %

B. 5 %

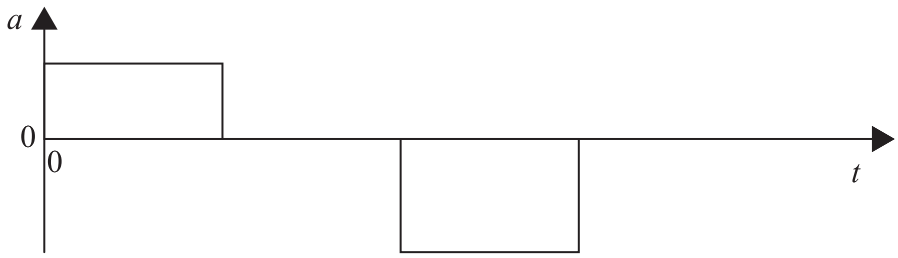
C. 10 %

D. 25 %

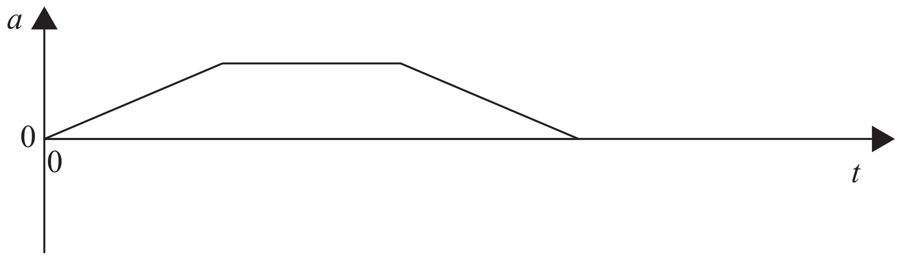
5. A car accelerates uniformly from rest. It then continues at constant speed before the brakes are applied, bringing the car to rest.

Which of the following graphs best shows the variation with time t of the **acceleration** a of the car?

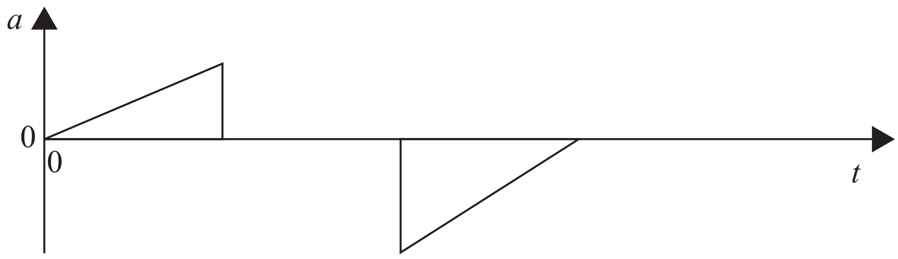
A.



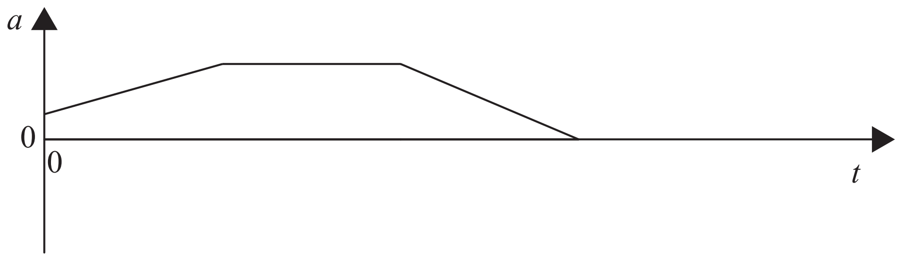
B.



C.

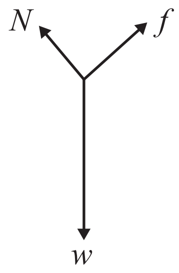


D.

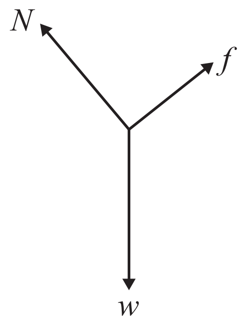


6. A friction force f is acting on a block of weight w sliding down an incline at a constant speed. The force N is the normal reaction of the incline on the block. Which of the following free-body diagrams best represents the forces acting on the block?

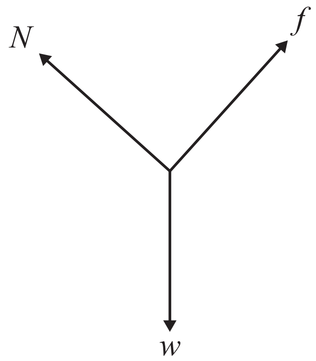
A.



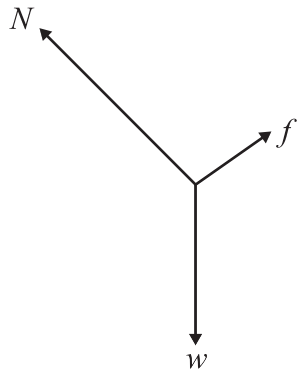
B.



C.



D.



7. The momentum of a system is conserved if

A. no external forces act on the system.

B. no friction forces act within the system.

C. no kinetic energy is lost or gained by the system.

D. the forces acting on the system are in equilibrium.

8. A box of mass m is moved horizontally against a constant frictional force f through a distance s at constant speed v. The work done on the box is

A. 0.

B. mgs.

C. $\frac{1}{2}mv^2$.

D. fs.

9. A stone is thrown at an angle to the horizontal. Ignoring air resistance, the horizontal component of the initial velocity of the stone determines the value of

A. range only.

B. maximum height only.

C. range and maximum height.

D. range and time of flight.

10. A satellite of mass m and speed v orbits the Earth at a distance r from the centre of the Earth. The gravitational field strength due to the Earth at the satellite is equal to

A. $\frac{v}{r}$.

B. $\frac{v^2}{r}$.

C. $\frac{mv}{r}$.

D. $\frac{mv^2}{r}$.

11. A rocket of mass m stands on the surface of planet Mars. Mars has mass M and radius R. The gravitational potential energy of the rocket due to Mars is

A. $\frac{-GM}{R}$.

B. $\frac{+GM}{R}$.

C. $\frac{-GMm}{R}$.

D. $\frac{+GMm}{R}$.

12. A block is sliding down a rough slope. The force of sliding friction between the block and the slope depends on

A. the speed of the block.

B. the surface area of the block.

C. the normal reaction between the block and the slope.

D. the acceleration of the block.

13. For a body to be in rotational 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 acting on the body must equal the net torque acting on the body.

14. The specific latent heat of vaporisation of a substance is defined as the amount of thermal energy required to

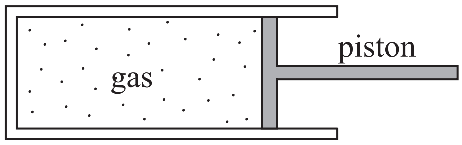
A. change a liquid to vapour at constant pressure.

B. change a liquid to vapour at constant temperature.

C. change unit mass of liquid to vapour at constant pressure.

D. change unit mass of liquid to vapour at constant temperature.

15. A gas is contained in a cylinder fitted with a piston as shown below.



When the gas is compressed rapidly by the piston its temperature rises **because** the molecules of the gas

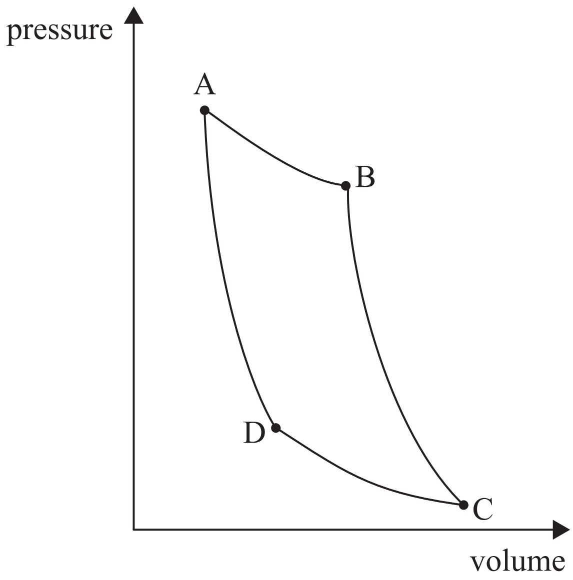
A. are squeezed closer together.

B. collide with each other more frequently.

C. collide with the walls of the container more frequently.

D. gain energy from the moving piston.

16. The diagram below represents the four stages of a Carnot Cycle.



Which of the following describes the process A$\rightarrow$B?

A. Isothermal expansion

B. Isothermal compression

C. Adiabatic expansion

D. Adiabatic compression

17. The second law of thermodynamics states that the entropy of the universe is

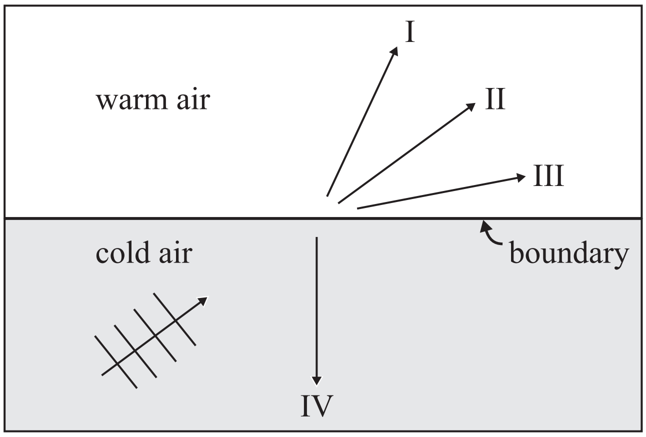
A. increasing.

B. decreasing.

C. zero.

D. constant but not zero.

18. Sound waves move faster in warm air than in cold air. The diagram below shows plane waves in cold air moving towards a boundary with warm air.



Which of the arrows shows the possible direction of waves after reaching the boundary?

A. I

B. II

C. III

D. IV

19. The speed of sound in still air is c. A source of sound moves away from an observer at speed v. What will be the speed of sound as measured by the observer?

A. c

B. $c + v$

C. $c - v$

D. $v - c$

20. For a standing wave, all the particles between two successive nodes have the same

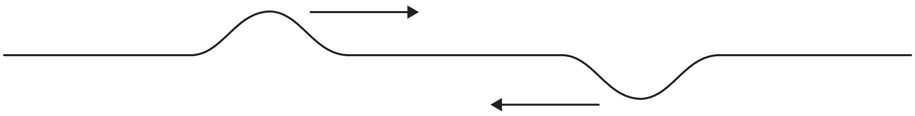
A. amplitude only.

B. frequency only.

C. amplitude and frequency.

D. frequency and energy.

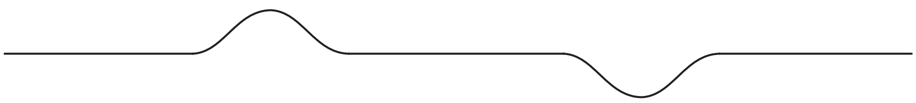
21. The diagram below shows two pulses on a string travelling toward each other.

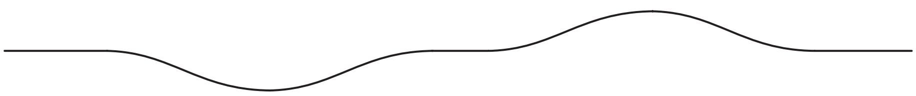


Which of the following diagrams best shows the shape of the string after the pulses have passed through each other?

A.

B. 

C. 

D. 

22. The **necessary** condition for two sources of waves to be coherent is that they vibrate

A. in phase.

B. with a constant phase difference.

C. with the same amplitude.

D. with the same frequency.

23. In a double-slit experiment using light of wavelength λ, 3 fringe spacings are observed per centimetre on the screen. When light of wavelength $\frac{\lambda}{2}$ is used, the number of fringe spacings observed per centimetre is

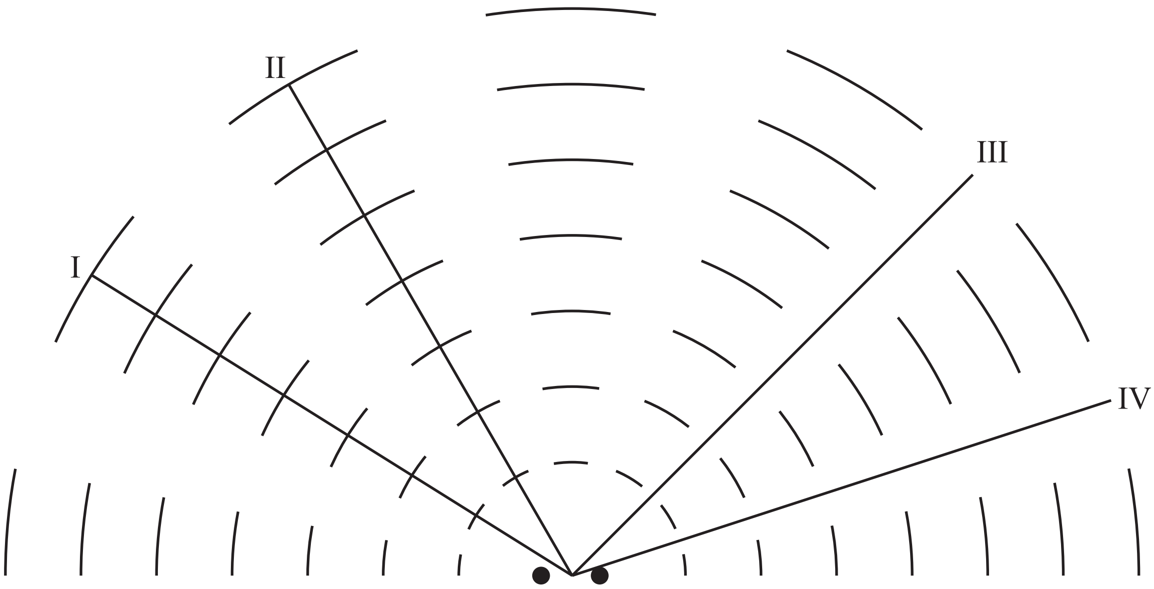
A. $\frac{2}{3}$.

B. $\frac{3}{2}$.

C. 3.

D. 6.

24. Two identical sources in a ripple tank generate waves of wavelength λ. The interfering waves produce the wave pattern shown below.



Along which of the labelled lines is the path difference between the waves from the sources equal to 1.5 λ?

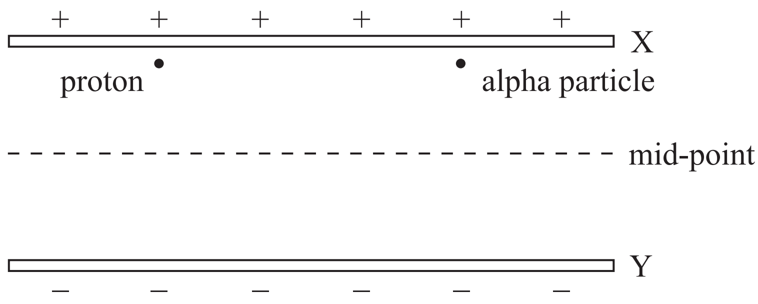
A. I

B. II

C. III

D. IV

25. A proton and an alpha particle are accelerated from rest from the positively charged plate X to the negatively charged plate Y.



At the mid-point between the plates, the proton has a kinetic energy E_K. At this point, the alpha particle has a kinetic energy

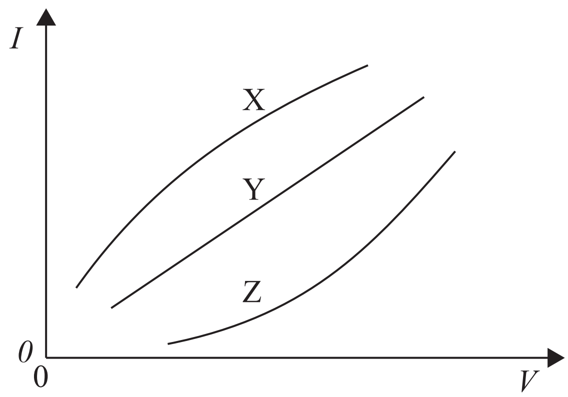
A. $\frac{E_K}{2}$.

B. E_K .

C. $2E_K$.

D. $4E_K$.

26. The graph below shows the variation with voltage V of the current I in three resistors X, Y and Z.



Which of the following corresponds to resistors for which the resistance increases with increasing current?

A. X only

B. Z only

C. X and Z

D. Y and Z

27. A magnetic force acts on an electric charge in a magnetic field when

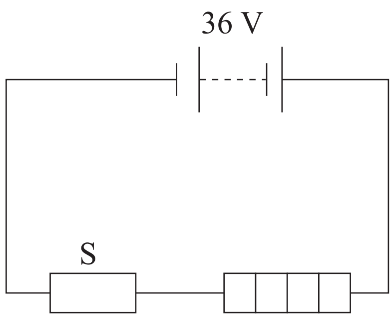
A. the charge is not moving.

B. the charge moves in the direction of the magnetic field.

C. the charge moves in the opposite direction to the magnetic field.

D. the charge moves at right angles to the lines of the magnetic field.

28. A heater has a resistance R when the potential difference across it is 12 V. In the circuit below, it is connected in series with a 36 V supply and a resistor S.



To ensure that the potential difference across the heater is 12 V, the resistance of the resistor S should be

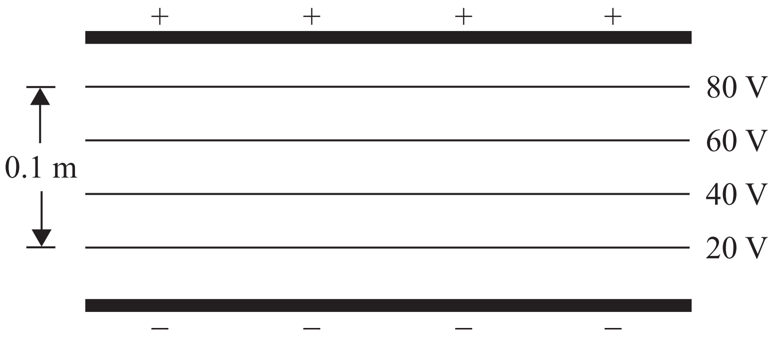
A. $\frac{R}{2}$.

B. $\frac{2R}{3}$.

C. $\frac{3R}{2}$.

D. $2R$.

29. The diagram below illustrates some equipotential lines between two charged parallel metal plates.



The electric field strength between the plates is

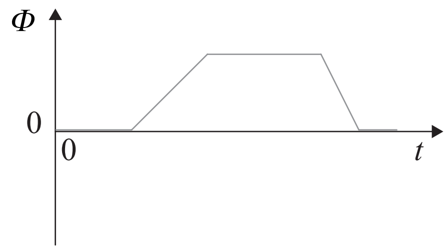
A. $6\,\mathrm{N\,C^{-1}}$.

B. $8\,\mathrm{N\,C^{-1}}$.

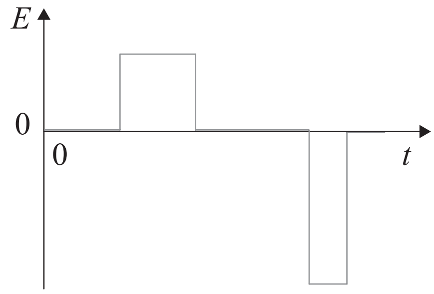
C. $600\,\mathrm{N\,C^{-1}}$.

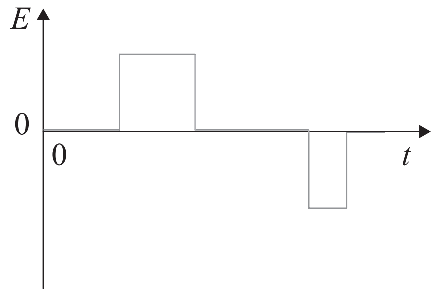
D. $800\,\mathrm{N\,C^{-1}}$.

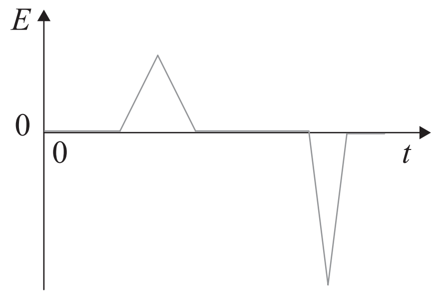
30. The variation with time t of the magnetic flux Φ through a coil is shown below.

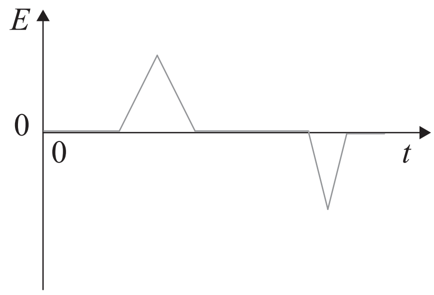


Which of the following diagrams best shows the variation with time t of the e.m.f. E induced in the coil?

A.


B.


C.


D.


31. An ideal transformer has N_p turns on the primary coil and N_s turns on the secondary coil. The input power of the primary coil is P. The output power at the secondary coil is

A. P.

B. $\left(\frac{N_p}{N_s}\right)P$.

C. $\left(\frac{N_s}{N_p}\right)P$.

D. $\left(1-\frac{N_s}{N_p}\right)P$.

32. The nucleus of an atom contains protons. The protons are prevented from flying apart by

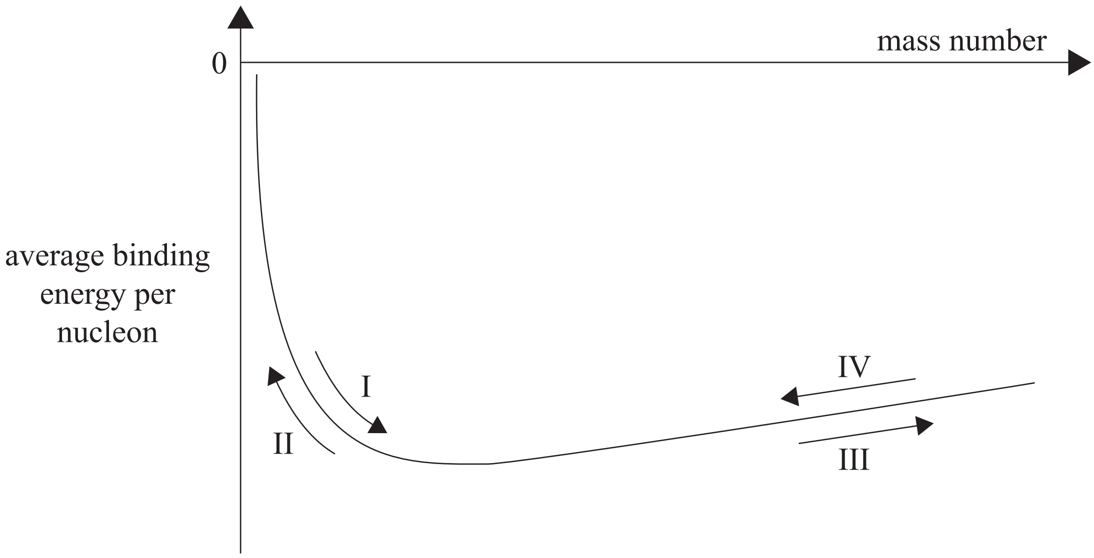
A. the presence of orbiting electrons.

B. the presence of gravitational forces.

C. the presence of strong attractive nuclear forces.

D. the absence of Coulomb repulsive forces at nuclear distances.

33. The graph below shows the variation with mass (nucleon) number of the average binding energy per nucleon.



Which direction indicates a fission reaction with a release of energy?

A. I

B. II

C. III

D. IV

34. Which of the following phenomena provides evidence for de Broglie's hypothesis?

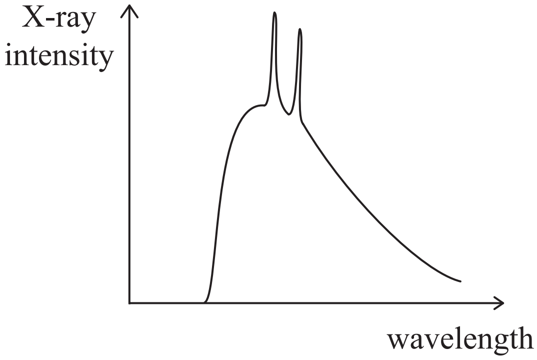
A. Electron diffraction

B. X-ray production

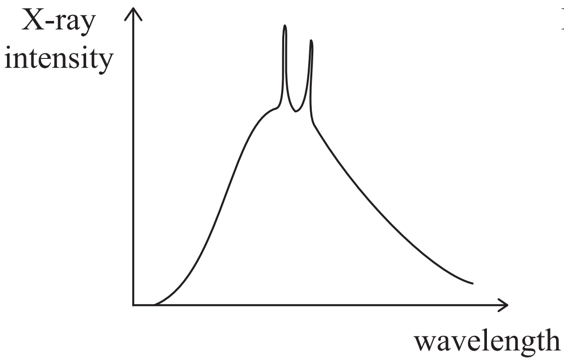
C. Line spectra

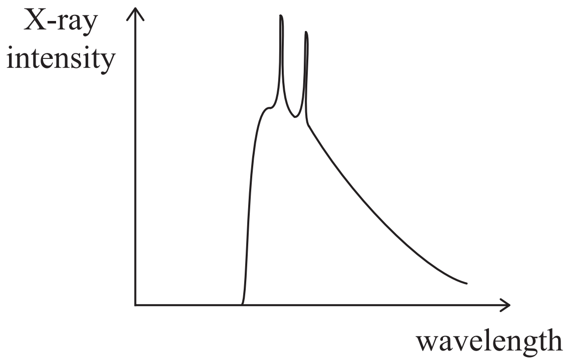
D. Nuclear energy levels

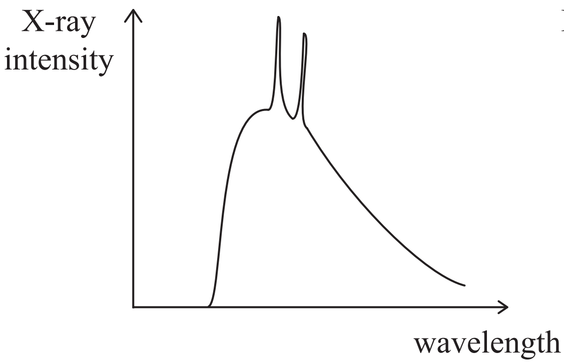
35. The diagram below shows the X-ray spectrum for a particular metal target.

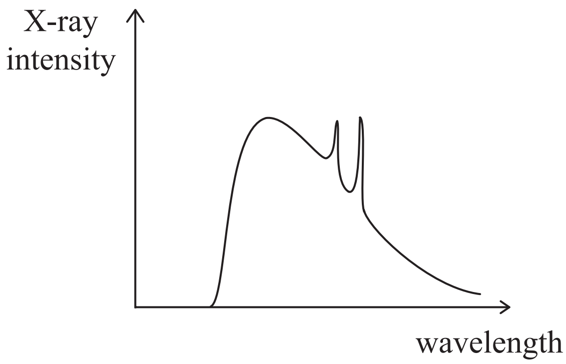


The bombarding electrons have been accelerated through a potential difference V. Which of the following diagrams best shows the X-ray spectrum for a different target metal when bombarded with electrons accelerated through the potential difference V?

A.


B.


C.


D.


36. The Bohr model of the hydrogen atom predicts

A. the line spectra of multi-electron atoms.

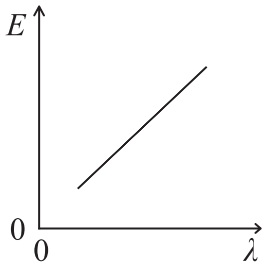
B. the wavelengths of the principal lines in the spectrum of atomic hydrogen.

C. the wavelengths in the spectrum of molecular hydrogen.

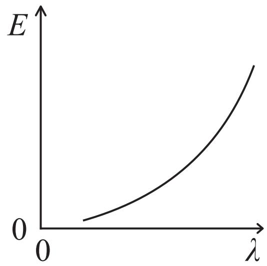
D. the relative intensities of the spectral lines of atomic hydrogen.

37. Which of the following graphs best shows how photon energy E varies with the wavelength λ of the light?

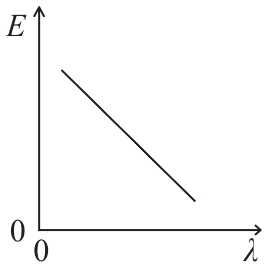
A.



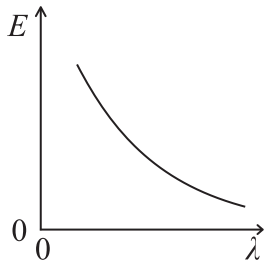
B.



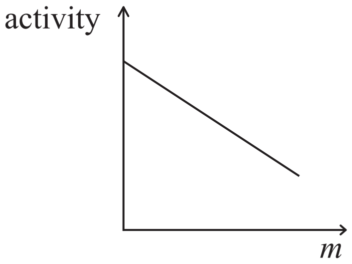
C.

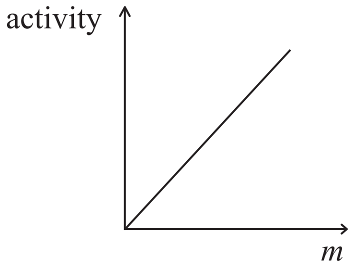


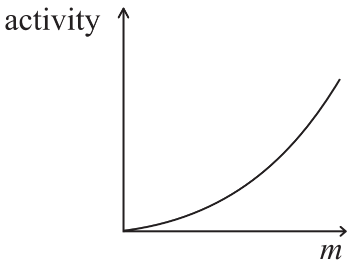
D.

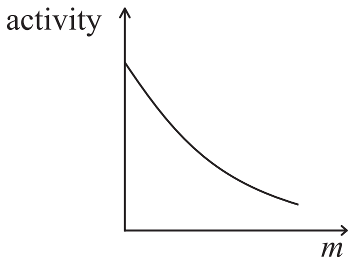


38. Which of the following graphs shows the variation with mass m of the activity of a sample of a radioactive material?

A.


B.


C.


D.


39. Which of the following correctly describes the nature of the energy spectra of alpha (α), beta (β) and gamma (γ) radiation?

	α	β	γ
A.	discrete	continuous	discrete
B.	continuous	discrete	discrete
C.	discrete	discrete	continuous
D.	continuous	continuous	discrete

40. Which of the following is **not** conserved when an electron and its anti-particle undergo mutual annihilation?

A. Lepton number

B. Electric charge

C. Linear momentum

D. Kinetic energy