CONFIDENTIAL *

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PERCUBAAN STPM 2009

PHYSICS

PAPER 1

MULTIPLE - CHOICE JSYH

One hour and forty-five minutes

($1\frac{3}{4}$ Hours)

Instructions to candidates:

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

There are **fifty** *questions in this paper. For each question, four suggested answers are given. Choose one correct answer and indicate it on the multiple-choice answer sheet provided.*

Read the instructions on the multiple-choice answer sheet very carefully.

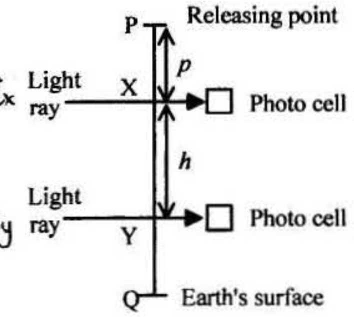
Answer **all** *questions. Marks will not be deducted for wrong answers.*

This question paper consists of 30 printed pages and 2 blank page.

1 If u and v, x and y, t and a represent speeds, distances , time and acceleration respectively. which of the following equations is dimensionally ***incorrect***?

A $x^2 + y^2 = uvt^2$
B $v^2 - u^2 = ax$
C $v = at + y/t$
D $ux = (x + y)/t$

2 The acceleration of a free falling object can be determined by a photoelectric experiment as follows. The object is released at point P and passing through point X and point Y at time t_x and t_y respectively.



The acceleration of free falling object is

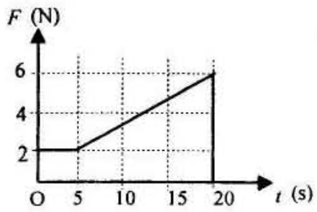
A $2h(t_x - t_y)$

B $\dfrac{h}{t_y^2 - t_x^2}$

C $\dfrac{h^2}{(t_y - t_x)}$

D $\dfrac{2h}{t_y^2 - t_x^2}$

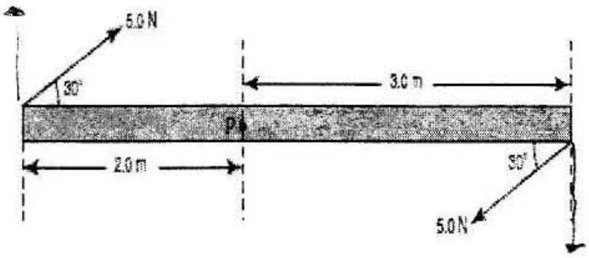
3 The graph below shows how force F which acts on an object changes with time t.



If the object moves in a straight line, calculate the change in linear momentum of the object.

A 15 kg m s^{-1}
B 45 kg m s^{-1}
C 65 kg m s^{-1}
D 70 kg m s^{-1}

4 The figure shows a rod pivoted at point P on a smooth horizontal surface.



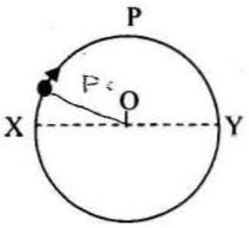
Two forces each of magnitude 5.0 N acting in opposite directions are applied at the two ends of the rod. The resultant torque on the rod is

A 2.5 N m **B** 12.5 N m **C** 21.7 N m **D** 25.0 N m

5 Two objects of mass m_1 and m_2 have the same kinetic energy. If the momentum of the two objects are p_1 and p_2 respectively, then the ratio $p_1 : p_2$ equals the ratio of

A $m_1 : m_2$
B $m_2 : m_1$
C $\sqrt{m_1} : \sqrt{m_2}$
D $\sqrt{m_2} : \sqrt{m_1}$

6 The figure below shows a particle moving in a circle with a constant speed 3.0 m s^{-1}. The centripetal force is 100 N. The diameter XY of the circle is 2.0 m.



The work done when the particle has moved through a semicircle XPY is

A 0 J **B** 300 J **C** 314 J **D** 628 J

7 Two rigid bodies P and Q are rotating about the same fixed axis and have angular velocities ω_P and ω_Q, and angular momentum L_P and L_Q respectively. If the values of the ratio $\frac{\omega_P}{\omega_Q}$ and $\frac{L_P}{L_Q}$ are 1:2 and 2:3 respectively, find the value of

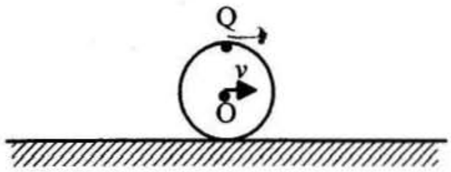
$$\frac{\text{kinetic energy of object P}}{\text{kinetic energy of object Q}}.$$

A $\frac{1}{6}$ **B** $\frac{2}{9}$ **C** $\frac{1}{3}$ **D** $\frac{3}{4}$

8 An ice skater is rotating with his arms folding inwards. Later the ice skater stretches his arms outwards. Which of the following pairs of quantities will increase ?

A Period of rotation and moment of inertia.
B Kinetic energy and moment of inertia.
C Angular momentum and period of revolution.
D Angular momentum and kinetic energy.

9 A sphere rolls along a straight horizontal platform without sliding as shown in the figure below.



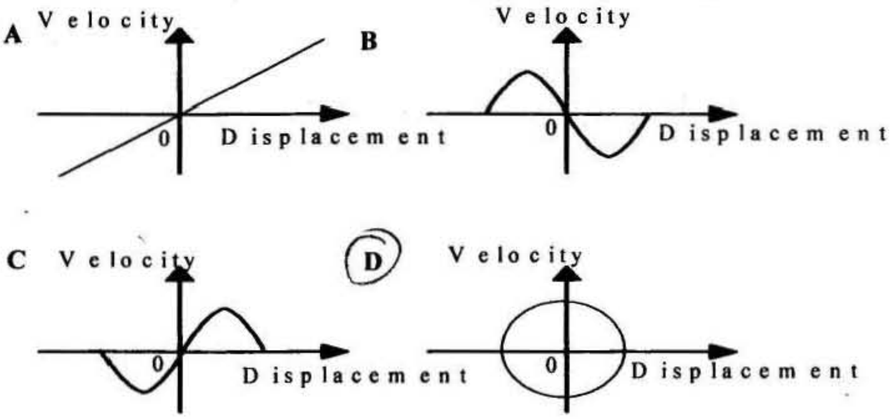
If the centre of mass O of the sphere moves with velocity v m s^{-1} relative to the platform, then the velocity of the point Q on the surface of the sphere relative to the platform is

A $\frac{1}{2}v$ **B** v **C** $2v$ **D** $3v$

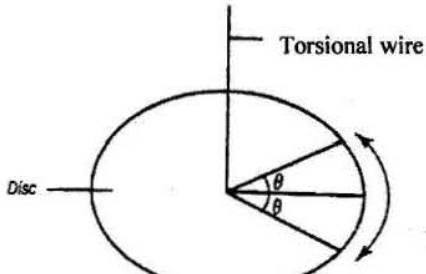
10 The escape velocity (that is the minimum velocity for an object to escape to infinity from the Earth) for an oxygen molecule from the surface of the Earth is 1.1×10^4 m s^{-1}. What is the escape velocity at a height of $0.2R_E$ above the surface of the Earth, where R_E is the radius of the Earth ?

A 0.5×10^4 m s^{-1}
B 1.0×10^4 m s^{-1}
C 1.1×10^4 m s^{-1}
D 1.2×10^4 m s^{-1}

11 An object moves with simple harmonic motion. Which of the following graphs shows the correct variation of velocity with displacement of the object ?



12 The figure below shows a torsional pendulum which performs simple harmonic motion with angular displacement θ.



If I is the moment of inertia of the disc about the torsional wire and c is the torque per unit angular displacement acted by the torsional wire to the disc, the period of oscillation of the disc can be expressed as

A $2\pi\sqrt{\dfrac{I}{c\theta}}$ **B** $2\pi\sqrt{\dfrac{I\theta}{c}}$ **C** $2\pi\sqrt{\dfrac{I}{c}}$ **D** $2\pi\sqrt{\dfrac{c}{\theta}}$

13 Which of the following statements is true concerning an object undergoes simple harmonic motion in a straight line between two points X and Y?

- **A** Speed is minimum at the middle of the line XY.
- **B** The total energy is maximum at X or Y.
- **C** The magnitude of the restoring force is maximum at X or Y.
- **D** The magnitude of the linear momentum is maximum at X or Y.

14 A progressive wave is represented by the equation

$$y = 0.20\sin(100\pi t - \frac{\pi x}{2}) \ ,$$

with x and y are measured in meter, and t is measured in second. What is the speed of the wave?

- **A** 20 m s^{-1}
- **B** 50 m s^{-1}
- **C** 100 m s^{-1}
- **D** 200 m s^{-1}

15 Which of the following statements is **not** true concerning transverse wave?

- **A** Transverse wave can be polarized.
- **B** γ-ray and radio wave are transverse wave.
- **C** Transverse wave is produced when air is blown across the end of a resonance tube.
- **D** Transverse wave is produced when a stretched string vibrates.

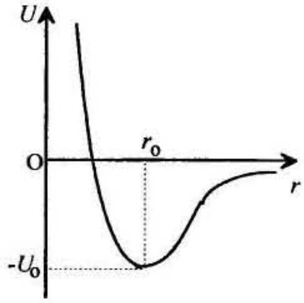
16 The length of a pipe which is opened at both ends is 35.5 cm. If the sound speed is 330 m s^{-1} and the end correction for each end of the pipe is 1.0 cm, what is the fundamental frequency of the pipe?

A 440 Hz **B** 452 Hz **C** 465 Hz **D** 478 Hz

17 A source emits sound of frequency 500 Hz is fixed to the end of a rod of 0.5 m long. The rod is rotated in a horizontal circle with angular velocity 50 rad s^{-1}. What is the maximum frequency received by a stationary observer? [The velocity of sound in air = 340 m s^{-1}.]

A 500 Hz **B** 537 Hz **C** 540 Hz **D** 579 Hz

18 The graph below shows the variation of potential energy U for an diatomic atom with interatomic separation r.



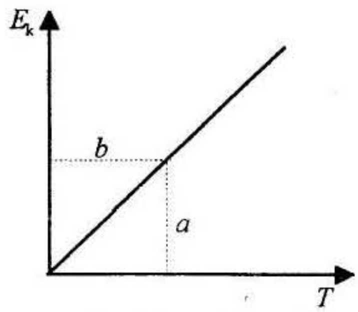
Which of the following is **not** a correct deduction from the graph above?

A At absolute zero, the atomic separation is r_o.
B For small displacement from the position of $r = r_o$, atoms vibrate with simple harmonic motion.
C The positive gradient shows that atoms repel each other for $r > r_o$.
D If a quantity of heat U_o is supplied , the atomic bond will be broken.

19 A mass of 2.0 kg is tied to the end of a steel wire which has an original length of 1.0 m, and the other end of the wire is fixed at point O. Later the mass is rotated about O in a vertical plane with constant angular speed of 4π rad s^{-1}. If the cross-sectional area of the wire is assumed constant with a value of 1.0 mm^2, what is the minimum extension produced by the steel wire?
[Young's modulus of steel =2.0 x 10^{11} Pa]

A 0.40 mm **B** 0.50 mm **C** 1.48 mm **D** 1.58 mm

20 The figure below shows the relationship between the average translational kinetic energy E_k of a monoatomic molecule of an ideal gas at absolute temperature T.



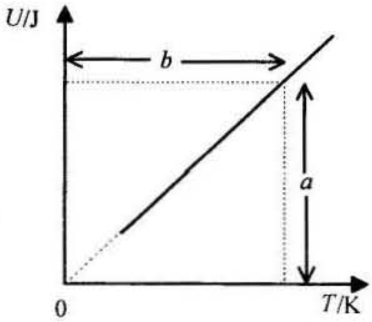
A value for Boltzmann constant can be deduced from the graph above is

A $\frac{a}{b}$ **B** $\frac{a}{3b}$ **C** $\frac{2a}{b}$ **D** $\frac{2a}{3b}$

21 The principal molar heat capacity at constant pressure $C_{p,m}$ for an ideal gas is $\frac{7}{2}R$.
The degrees of freedom for the gas molecules is

A 3 **B** 4 **C** 5 **D** 6

22 The figure below represents the variation of internal energy U with temperature T when 5 moles of an ideal gas is heated at constant volume.



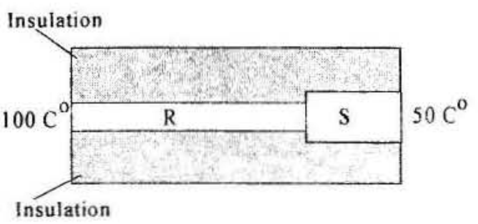
What is the value of the molar heat capacity of the gas at constant volume?

A $\frac{a}{5}$ **B** $\frac{a}{b}$ **C** $\frac{a}{5b}$ **D** $\frac{ab}{2}$

23 A monoatomic gas with volume V and pressure p is compressed isothermally until its pressure becomes $3p$. The gas later is allowed to expand adiabatically until its volume becomes $9V$. If γ of the gas is $\frac{5}{3}$, what is the final pressure of the gas?

A p **B** $\frac{p}{3}$ **C** $\frac{p}{9}$ **D** $\frac{p}{81}$

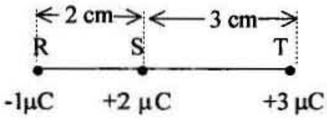
24 Two uniform copper rods R and S are joined and perfectly insulated as shown in the figure below. The length of rod R is twice the length of rod S but the cross-sectional area of rod R is half the cross-sectional area of rod S.



If the free ends of rod R and rod S are maintained at temperatures 100 °C and 50 °C respectively, what is the temperature at the junction of rod R and rod S ?

A 60 °C **B** 67 °C **C** 75 °C **D** 90 °C

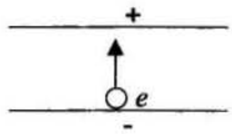
25 Three point charges -1μC, +2μC, and +3μC are placed on a straight line respectively as shown in the figure below.



The resultant force acting on S due to R and T is

A 11 N towards T
B 15 N towards T
C 15 N towards R
D 105 N towards R

26 The figure below shows a positive plate and a negative plate which are parallel. One electron is released near the negative plate.



Which of the following is true concerning the force F acting on the electron and the kinetic energy E_k of the electron along its motion from the negative plate to the positive plate?

	F	E_k
A	Increases	Increases
B	Increases	Constant
C	Constant	Constant
D	Constant	Increases

27 Two identical metal solid spheres X and Y which are charged positively with Q_1 and Q_2 ($Q_1 > Q_2$) respectively. Which of the following statements is true concerning sphere X and sphere Y?

A The electric field intensities on the surface of sphere X and sphere Y are zero.
B The electric field intensities inside sphere X and sphere Y are zero.
C The electric field intensity inside sphere X is more than the electric field intensity inside sphere Y.
D The electric potentials inside sphere X and sphere Y are zero.

28 Which of the following statements concerning an isolated charge conductor which is stationary and non-uniform in shape is **not** true?

A The surface charge density of the conductor is uniform.
B The charge of the conductor only resides on the surface of the conductor.
C There is no electric field inside the conductor.
D There is no magnetic field surrounding the conductor.

29 A 100 μF capacitor is charged and later the charge acquired is discharged through a 10 kΩ resistor. What is the value of the ratio $\dfrac{\text{charge of capacitor after 1 s}}{\text{initial charge of capacitor}}$?

A 2 **B** ln 2 **C** 1 − ln 2 **D** $\dfrac{1}{e}$

30 A capacitor of 5 μF and a capacitor of 10 μF are connected in series with a battery of 12 V. What is the charge at each of the capacitor?

	5 μF	10 μF
A	10 μF	20 μF
B	20 μF	40 μF
C	40 μF	20 μF
D	40 μF	40 μF

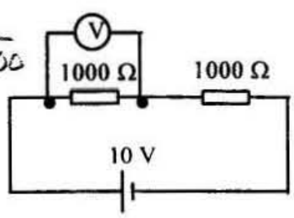
31 When potential difference V is applied across the ends of a copper wire which has a diameter d and length l, the drift velocity of electrons in the wire is v. What is the drift velocity of the electrons, in terms of v, in a copper wire which has diameter $\dfrac{d}{2}$ and length $\dfrac{l}{4}$, and is applied with potential difference $2V$ across its ends?

A v **B** $2v$ **C** $4v$ **D** $8v$

32 If the order of magnitudes for current density and number of free electrons per unit volume in a metal are 10^6 A m^{-2} and 10^{28} m^{-3} respectively, what is the order of magnitude for the drift velocity of free electrons in the metal?

A 10^4 m s^{-1}
B 10^2 m s^{-1}
C 10^{-2} m s^{-1}
D 10^{-4} m s^{-1}

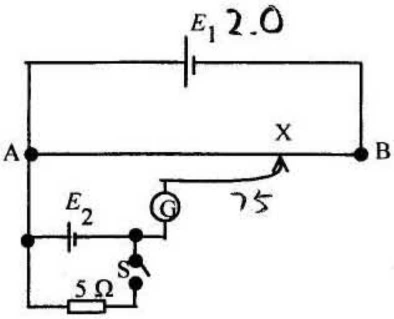
33 In the circuit as shown in the figure below, the resistance of the voltmeter is 500 Ω.



What is the reading of the voltmeter?

A 2.5 V **B** 3.3 V **C** 5.0 V **D** 6.0 V

34 In a circuit as shown in the figure below, cell E_1 has e.m.f. of 2.0 V and internal resistance which can be neglected. The length of the potentiometer wire AB is 100 cm and when switch S is opened, the balance length AX is 75 cm. When switch S is closed, length AX is 60 cm.



What is the internal resistance of cell E_2 ?

A 0.75 Ω **B** 1.00 Ω **C** 1.25 Ω **D** 3.00 Ω

35 An electron moves in a straight line in vacuum where there is a magnetic field and an electric field acting perpendicular to each other. If the electric field is removed, the electron will move with

A same speed in a circle.
B same speed in a parabola.
C same speed in a straight line.
D a lower speed in a circle.

36 The magnetic field of Earth at the centre of a conductor circular coil of radius 5.0 cm is 7.0×10^{-5} T. The direction of the Earth's magnetic field is perpendicular to the plane of the coil. This magnetic field is cancelled by the magnetic field produced at the centre of the coil when a current flows in the coil. What is the magnitude of the current flow?

A 0.9 A **B** 1.4 A **C** 1.8 A **D** 5.6 A

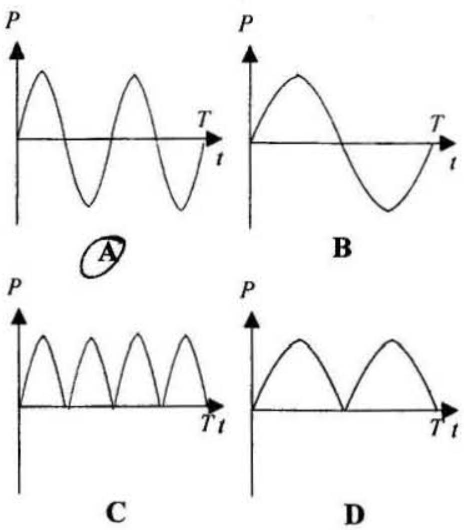
37 When a constant current flows in a moving coil galvanometer, the coil will be deflected by a constant torque because

A the coil is wound round a soft iron core.
B the coil undergoes critical damping.
C the coil is placed in a radial magnetic field.
D the coil is controlled by a helical spring.

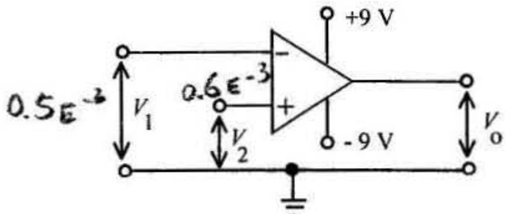
38 The magnetic flux density in a solenoid which has 400 turns and uniform cross-sectional area 1×10^{-4} m^2 is 5×10^{-5} T when the solenoid carries a current of 2 A. If the magnetic flux density of the solenoid is assumed uniform, what is the self-inductance of the solenoid?

A 0.5 μH **B** 1.0 μH **C** 2.0 μH **D** 2.5 μH

39 A sinusoidal a.c. source with period T is connected to a pure capacitor. Which of the following graphs best represents the variation of energy per unit time, P, stored in the capacitor with time t in a complete oscillation?



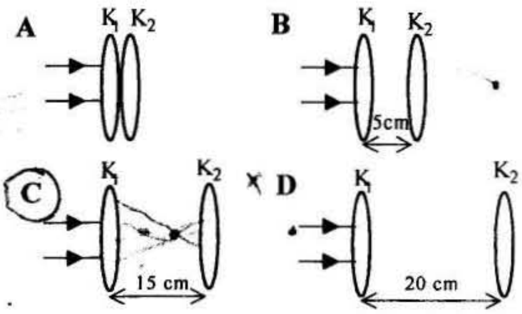
40 The figure below shows an operational amplifier with open loop voltage gain of 10^5.



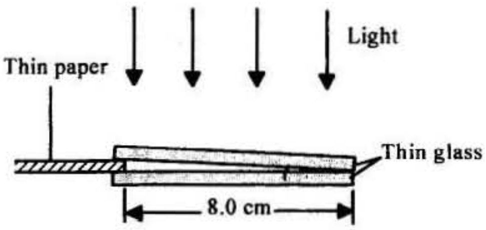
The voltage supplied is 9 V. If $V_1 = 0.50$ mV and $V_2 = 0.60$ mV, what is the output voltage V_o ?

A 9.0 V B 10.0 V C 19.0 V D 55.0 V

41 Lens K_1 and lens K_2 have focal length 10 cm respectively. Which of the following arrangements of the lenses will cause parallel light ray incident at K_1 becomes diverging after emerging from K_2 ?



42 The figure below shows an air wedge formed by placing a thin piece of paper between two thin glass plates at distance 8.0 cm from the line of contact of the glass. Monochromatic light of wavelength 5.89×10^{-7} m is incident normally at the air wedge.



If the separation between consecutive dark fringes is 1.5 mm, the thickness of the paper is

- **A** 0.79×10^{-5} m
- **B** 1.57×10^{-5} m
- **C** 4.71×10^{-5} m
- **D** 1.57×10^{-4} m

43 Which of the following characteristics will determine whether a wave is longitudinal wave or transverse wave?

- **A** Reflection
- **B** Refraction
- **C** Diffraction
- **D** Polarization

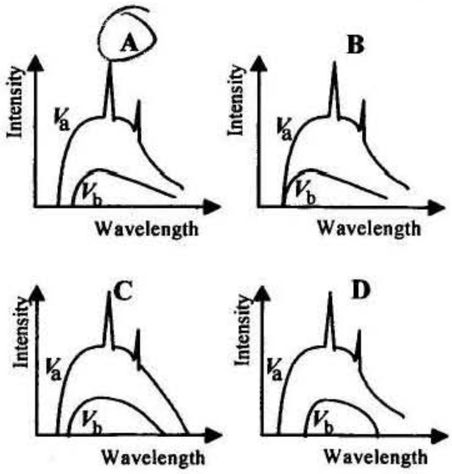
44 The optical path in a glass slide of thickness l_o is l_1. The refractive index of the glass can be expressed as

A $\frac{l_o}{l_1}$ **B** $\frac{l_1}{l_o}$ **C** $\frac{l_o}{l_1 - l_o}$ **D** $\frac{l_1 - l_o}{l_1}$

45 In a Young's double-slit experiment, the two slits are radiated from the same light source of so that light emerged from the two slits have

A the same speed
B the same path
C the same plane of polarization
D the same constant phase difference

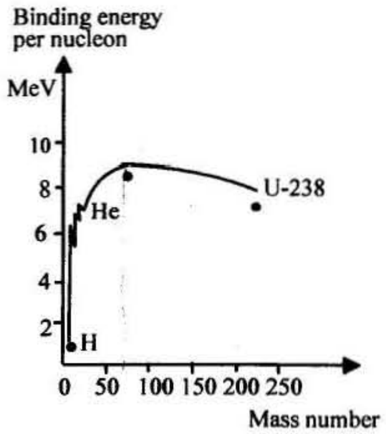
46 Which of the following graphs best represents the X-ray spectrum produced by an X-ray tube at two different potential differences of V_a and V_b ($V_a > V_b$) ?



47 Which of the following is **not** the application of laser light?

A To detect submarine.
B To cut metal.
C To measure the distance between Earth and Moon.
D To perform eye and brain surgery.

48 The stability of a nucleus can be determined by using binding energy per nucleon as a measurement.



For the most stable nuclide, the quantity is

A maximum for the nuclide in the periodic table.
B directly proportional to the ratio of proton/neutron.
C increases uniformly according to the increase of mass number in the periodic table.
D increases uniformly according to the increase of atomic number in the periodic table.

49 The radioisotopes of **P** and **Q** have half-lives T_1 and T_2 respectively with $T_1 = 2T_2$. The number of nuclei of **P** and **Q** in a sample is the same initially. How long does it take for the number of nuclei **P** becomes two times the number of nuclei **Q** ?

A T_2 **B** $2T_1$ **C** $2T_2$ **D** $3T_1$

50 A radioisotope of element Z experiences a series of decay until it becomes a stable isotope of element Z. In this process, the ratio of the number of β-particles emitted to the number of α-particles emitted is

A 1:1 **B** 1:2 **C** 1:4 **D** 2:1