1. A signal has a frequency of 2.0 MHz.

    What is the period of the signal?

    A 2 µs   **B** 5 µs   **C** 200 ns   **D** 500 ns

2. A metal sphere of radius r is dropped into a tank of water. As it sinks at speed v, it experiences a drag force F given by $F = kr\,v$, where k is a constant.

    What are the S*I* base units of k ?

    A $kg\ m^2 s^{-1}$ **B** $kg\ m^{-2} s^{-2}$ **C** $kg\ m^{-1} s^{-1}$ **D** $kg\ m\ s^{-2}$

3. Which physical quantity would result from a calculation in which a potential difference is multiplied by an electric charge?

    A electric current
    B electric energy
    C electric field strength
    D electric power

4. Repeated measurements of a quantity can reduce the effects of

    A both random and systematic errors.
    B only random errors.
    C only systematic errors.
   **D** neither random nor systematic errors.

5. A student makes measurements from which she calculates the speed of sound as $327.66\ m\ s^{-1}$.

    She estimates that her result is accurate to ±3 %.

    Which of the following gives her result expressed to the appropriate number of significant figures?

    A $327.7\ m\ s^{-1}$ **B** $328\ m\ s^{-1}$

    C $330\ m\ s^{-1}$ **D** $300\ m\ s^{-1}$
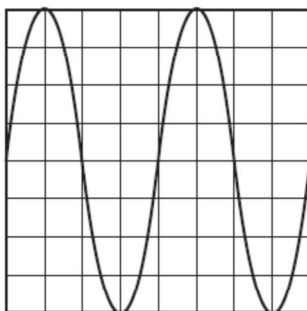
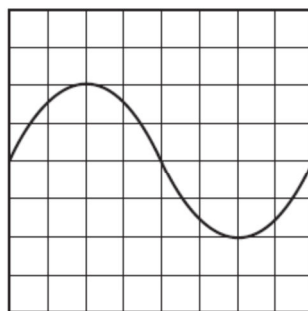**6.** The following trace is seen on the screen of a cathode-ray oscilloscope.
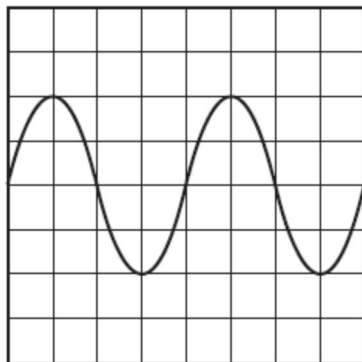
The setting of the time base is then changed from 10 ms cm^{-1} to 20 ms cm^{-1} and the Y-sensitivity is unaltered.
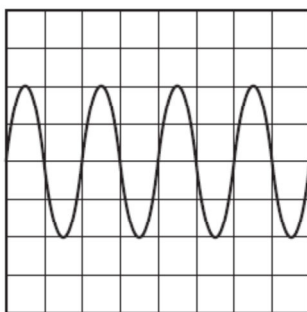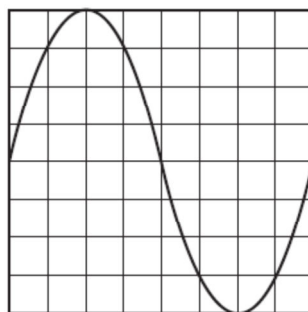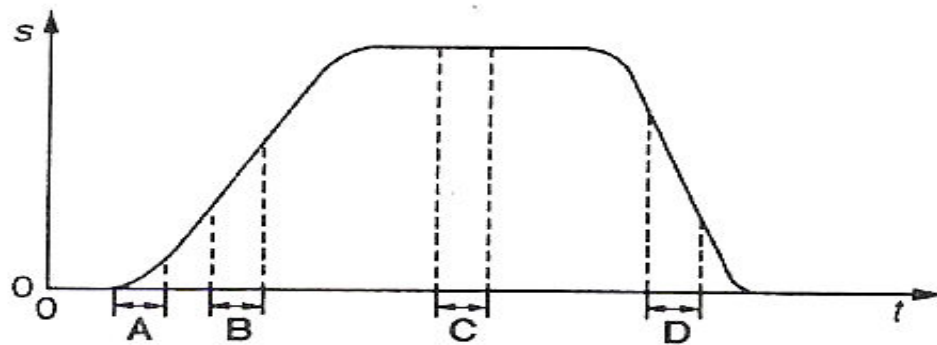
Which trace is now seen on the screen?

A

B

C

D

**7.** Which feature of a graph allows acceleration to be determined?

    A the area under a displacement-time graph
    B the area under a velocity-time graph
    C the slope of a displacement-time graph
    D the slope of a velocity-time graph

8. The graph represents how displacement varies with time for a vehicle moving along a straight line.

During which time interval does the acceleration of the vehicle have its greatest numerical value?

9. A projectile is launched at point **O** and follows the path **OPQRS**, as shown. Air resistance may be neglected.
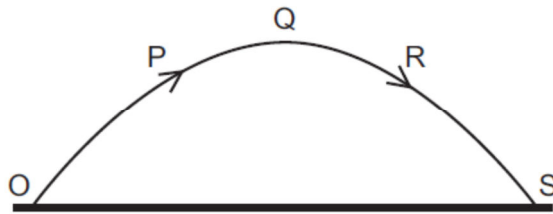
Which statement is true for the projectile when it is at the highest point **Q** of its path?

A The horizontal component of the projectile's acceleration is zero.
B The horizontal component of the projectile's velocity is zero.
C The kinetic energy of the projectile is zero.
D The momentum of the projectile is zero.

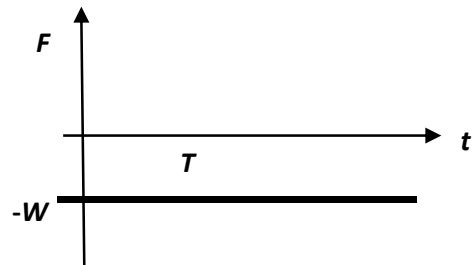**10.** A ball of weight W slides along a smooth horizontal surface until it falls off the edge at time T.
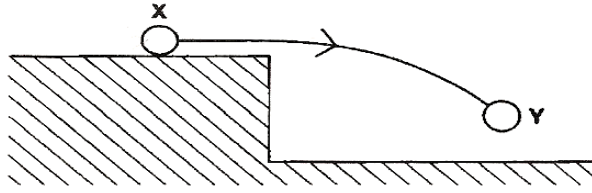
Which graph represents how the resultant vertical force F, acting on the ball, varies with time t as the ball moves from position **X** to position **Y**?
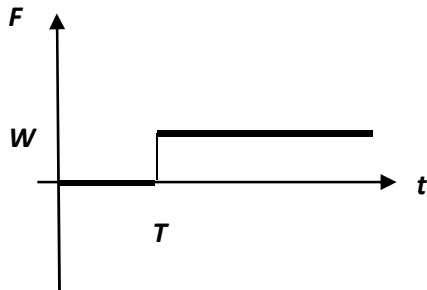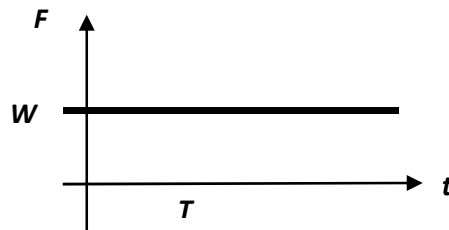
A
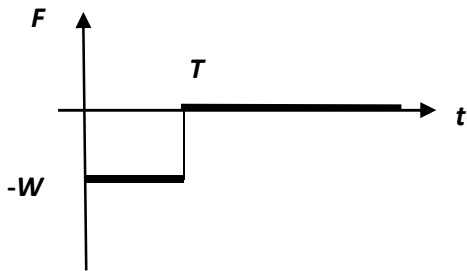
C

B

D

11. In perfectly elastic collisions between two atoms, it is always true to say that

A the initial speed of one atom will be the same as the final speed of the other atom.
B the relative speed of approach between the two atoms equals their relative speed of separation.
C the total momentum must be conserved, but a small amount of the total kinetic energy may be lost in the collision.
**D** whatever their initial states of motion, neither atom can be stationary after the collision.

12. The diagram shows the masses and velocities of two trolleys about to collide.

After the impact they move off together.

What is the total kinetic energy of the trolleys after the collision?

A 1.3 J
B 12 J
C 18 J
D 19 J

13. A height shelf is held horizontally against a wall by a chain **PQ.** The forces acting on the shelf are its weight, the force exerted by the chain and the force exerted by the hinge H.
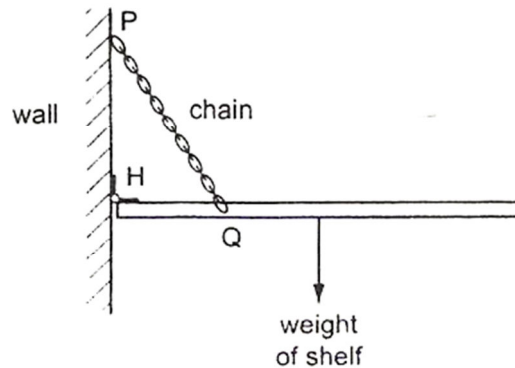

Which arrow could represent the direction of the force the hinge exerted on the shelf?
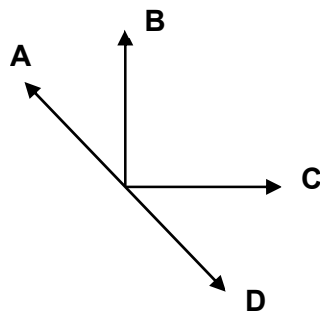
14. A uniform ladder rests against a vertical wall where there is negligible friction. The bottom of the ladder rests on rough ground where there is friction. The top of the ladder is at a height h above the ground and the foot of the ladder is at a distance $2a$ from the wall.

The diagram shows the forces which act on the ladder.
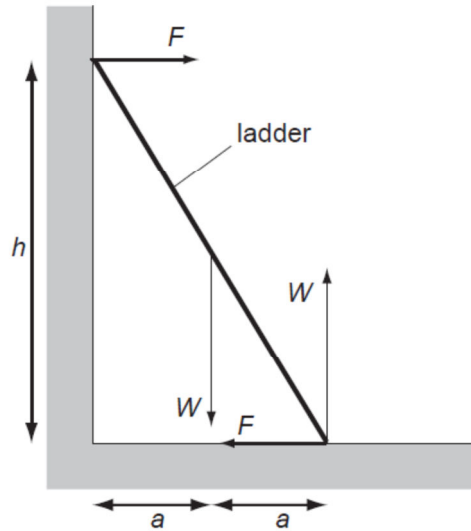
Which equation is formed by taking moments?

A $W\,a + F\,h = 2W\,a$
B $F\,a + W\,a = F\,h$
C $W\,a + 2W\,a = F\,h$
D $W\,a - 2W\,a = 2F\,h$

15. An object, immersed in a liquid in a tank, experiences an upthrust.

What is the physical reason for this upthrust?

A The density of the body differs from that of the liquid.
B The density of the liquid increases with depth.
C The pressure in the liquid increases with depth.
D The value of g in the liquid increases with depth.

[Turn Over

16. Initially, four identical uniform blocks, each of mass *m* and thickness *h*, are spread on a table.
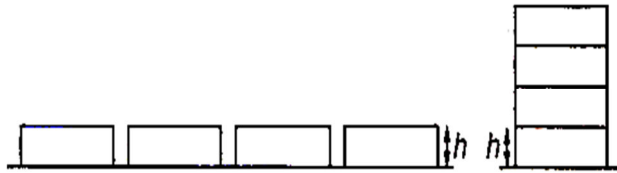

How much work is done on the blocks in stacking them on top of one another?

A 2 *mgh*　　　　B 3 *mgh*　　　　C 4 *mgh*　　　　D 6 *mgh*

17. A mass *m* moves on a rough plane inclined at an angle θ to the horizontal and when moving, experiences a constant frictional force *F*. Mass *M* is attached to it by means of a light inelastic cord running over a smooth pulley. Mass *M* is allowed to fall a vertical distance *x*, causing m to move up the plane as shown in the diagram.
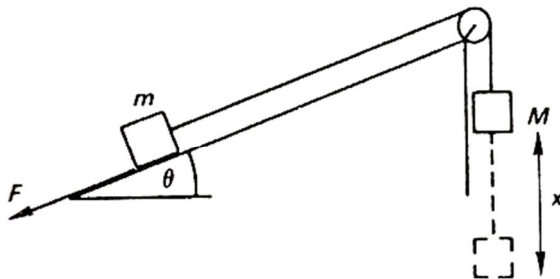
How much heat is generated by friction in this process?

A. *Fx*　　　　　　　　**B.** *Mgx*
C. *Mgx* sinθ - *Fx*　　　**D.** *Mgx* sinθ + *Fx*

18. A power station has an efficiency of 40% and generates 1000MW of electric power. What is the input power and the wasted power?

	Input power/ MW	**Wasted power/ MW**
A.	1000	400
B.	1000	600
C.	1400	400
D.	2500	1500

19. Gases have densities of about one thousandth of those of solids.
If the distance between neighboring molecules of a solid is d, the approximate average distance between neighboring molecules of a gas is

A $10^6 d$ **B** $10^3 d$ **C** $10^2 d$ **D** $10 d$

20. When ice melts, it contracts.

Which row is correct for ice turning into water?

	Distance between atoms	Density
A	Decreases	Decreases
B	Decreases	Increases
C	Increases	Decreases
D	increases	increases

21. Figure below shows how the extension e of a wire varies with the force F applied. If the original length of the wire is l, its cross-sectional area A and its Young modulus is E, the gradient of the graph is
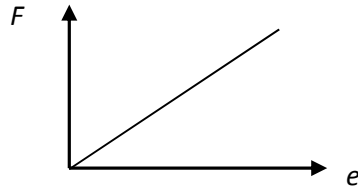

A $\dfrac{El}{A}$ **B** $\dfrac{EA^2}{l}$ **C** $El^2 A$ **D** $\dfrac{EA}{l}$

22. Which of the following explains why a concrete is brittle?

   A. It does not undergo elastic deformation before fracture
   B. It is made of long chains of molecules which are entangled
   C. It has crystal imperfection known as edge dislocation that makes crack growth
   D. It does not undergo plastic deformation before fracture.

23. The figure below represents a particular instant of a transverse wave traveling along a string with a speed of 500 ms^{-1}.
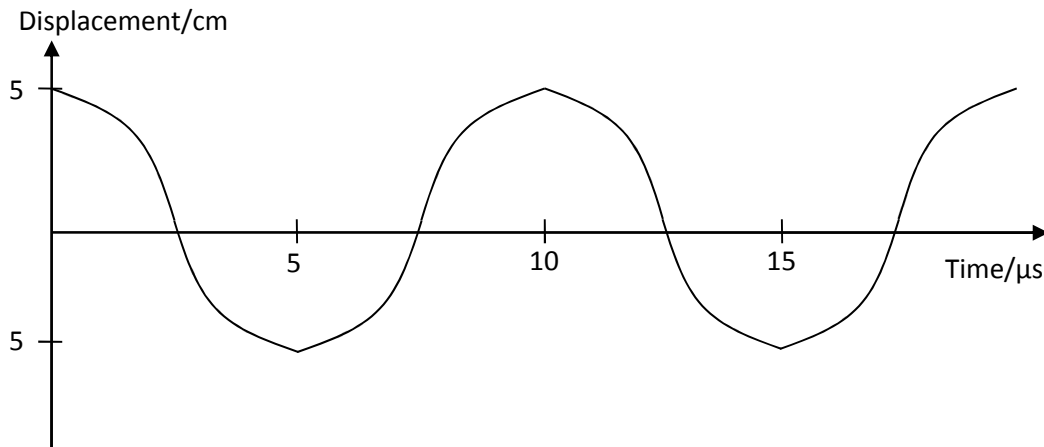

The wavelength is

   A. 0.005 mm   B. 0.100 mm   C. 0.005 m   D. 0.100 m

24. When blowing through an open ended narrow tube, the fundamental frequency is f. Then, the narrow tube is sealed at one end, and air with same speed is passed into the tube. The tone produced will have a frequency of

   A. $f/3$ B. $f/2$ C. $2f$ D. $3f$

25. Continuous water waves are diffracted through a gap in a barrier in a ripple tank. Which of the following changes will cause the diffraction of the waves to increase?

   A   Increasing the width of the gap

   B   Increasing the frequency of the waves

   C   Reducing the wavelength of the waves

   D   Reducing the width of the gap

26. The metre was defined in terms of the wavelength λ of the orange light of 606 nm emitted by excited atoms of Krypton–86. Thus 1 metre = $n\lambda$, where n is the number of wavelengths in 1 metre of vacuum. What is the best value of n?

   A. 10^4 B. 10^6 C. 10^{12} D. 10^{15}

27. Two continuous waves moving in opposite direction to each other meet at a point. If the waves have similar frequency but the sources of the waves are vibrating at anti phase to each other, what is the phase difference of these waves to produce a complete destructive interference at the meeting point?

   A. 90°, 180°, 270°, 360° …………

   B. 180°, 540°, 900°, 1260° ….…...

   C. 180°, 360°, 540°, 720° ……….

   D. 360°, 720°, 1080°, 1440°…..….

28. A parallel beam of white light is incident normally on a diffraction grating. It is noted that the second-order and third-order spectra partially overlap. What wavelength in the third-order spectrum will appear at the angle corresponding to a wavelength of 600 nm in the second-order spectrum?

   A. 300 nm   B. 400 nm   C. 600 nm   D. 900 nm

29. Which graph best represents the way in which the current I through a thermistor depends upon the potential difference, V across it?
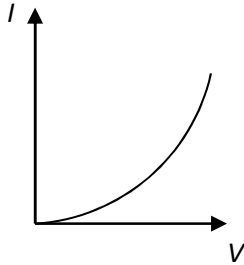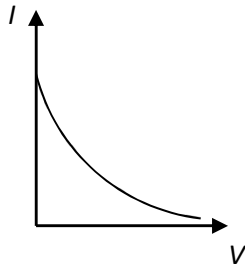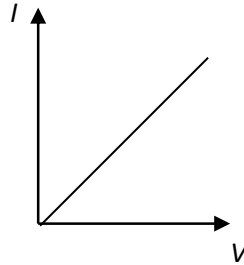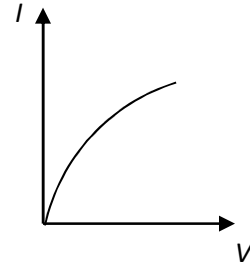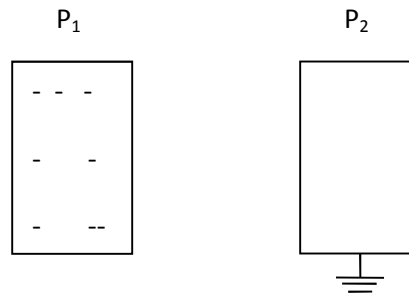
A.   B.   C.   D.

30. A negatively-charged plate P_1 is brought close to a co-planar and earthed metal plate P_2 which is initially uncharged.

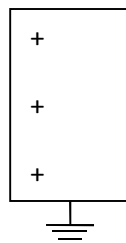Which diagram shows the induced charges on P_2? (note: the distribution of charge on P_2 is just a sketch, this is not an exact diagram)
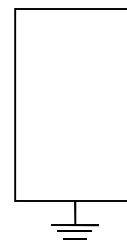

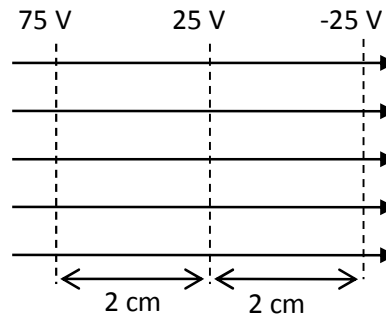A   B   C   D

31. The diagram shows the direction of a uniform electric field in which the lines of equal potential are spaced 2.0 cm apart.

75 V   25 V   -25 V

2 cm   2 cm

What is the value and direction of the electric force which is exerted on a charge of -10 μC when placed in the field?

A. 2.5×10^{-5} N to the right

B. 2.5×10^{-5} N to the left

C. 2.5×10^{-2} N to the right

D. 2.5×10^{-2} N to the left

32. In the diagram below, the variable resistor **R** can be adjusted over its full range from zero to 10^3 Ω.

10 Ω

P   R   Q

10^4 Ω
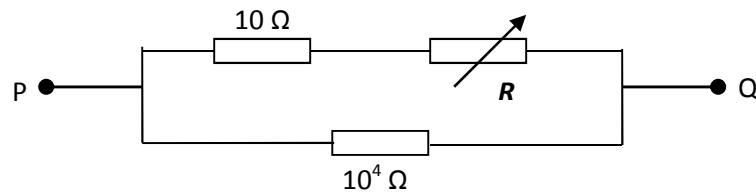
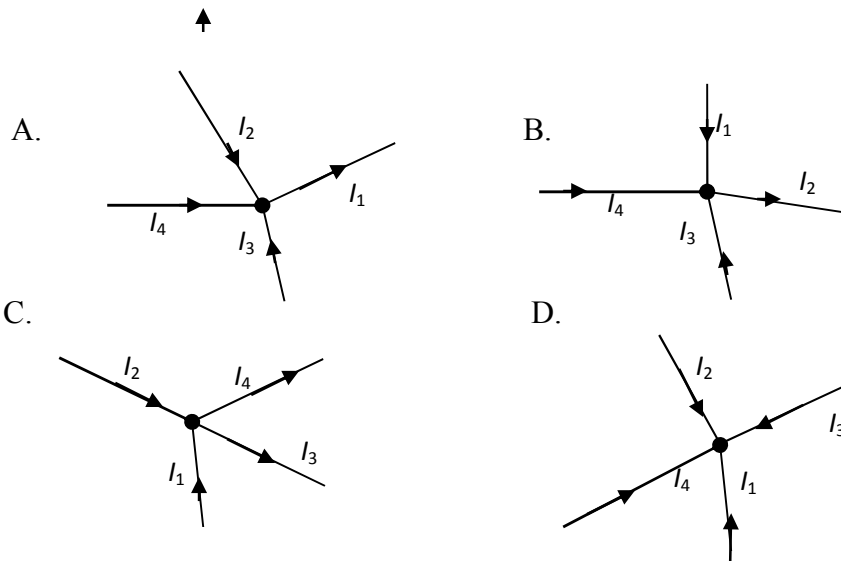What are the approximate limits for the resistance between P and Q?

A. zero to 10^3 Ω   B. zero to 10^4 Ω   C. 10 to 10^3 Ω   D. 10 to 10^4 Ω

33. What is the ratio of the reading of ammeter A_1 to the reading of ammeter A_2 in the figure below?
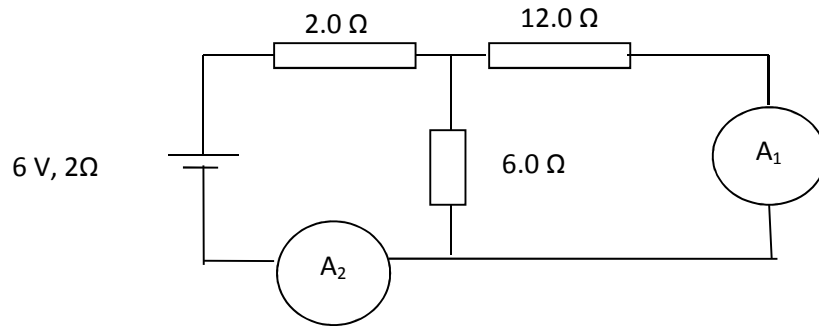
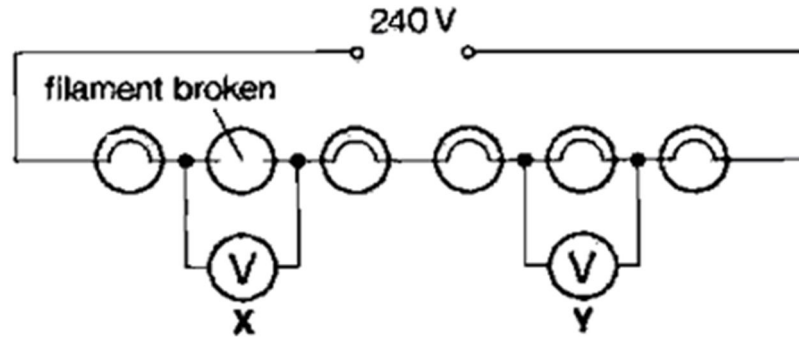A. 1:3   B. 1:2   C. 3:1   D. 6:11

34. The diagrams below shows four different ways in which current I_1, I_2, I_3 and I_4 can combine at a junction. Which diagram shows $I_1 + I_2 = I_3 + I_4$.

35. A main circuit contains six similar bulbs connected in series. One of the bulbs has a broken filament. Voltmeters **X** and **Y** of infinite resistance are placed in the circuit as shown.

What are the voltmeter readings?

|	X reading (V)	Y reading (V)
A	0	0
B	0	240
C	40	40
D	240	0

36. A generator produces 50 kW of power at a potential difference of 10 kV. The power is transmitted through cables of total length of 3 km. If the mean resistance of the cable is 5 Ω per kilometer, what is the total power lost in the cables?

A. 3.8 W   B. 75 W   C. 125 W   D. 375 W

37. Which of this high speed particle will able to penetrate into the nucleus easier?

A. alpha nuclide   B. neutron   C. beta   D. hydrogen nuclide

38. In repeating Rutherford's α-particles scattering experiment, a student used the apparatus shown, in a vacuum to determine *n* the number of α-particles incident per unit time, on a detector held at various angular positions *θ*.
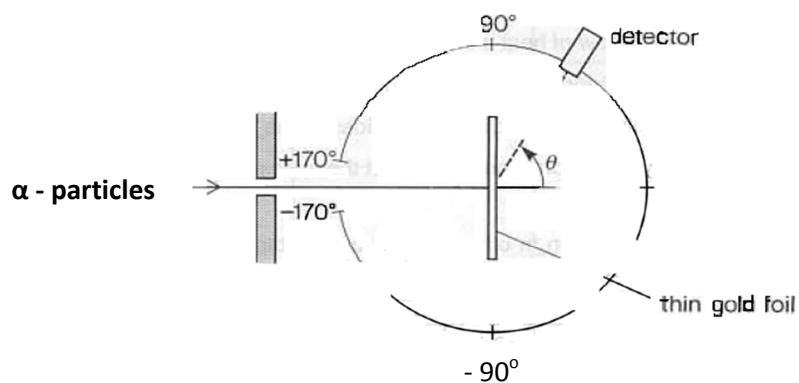
Which graph best represents the variation of *n* with *θ*?
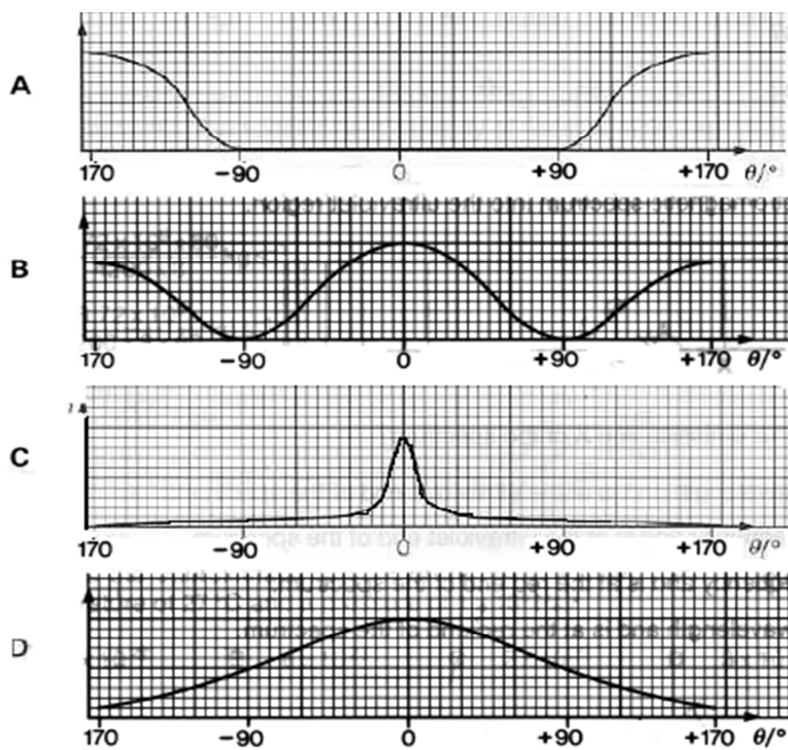
39. $^{238}_{92}U$ decays through a series of transformations to a stable nuclide. The particles emitted in the successive transformations are **α**, **β**, **β** and **α.** Which nuclide is not produced during these series of transformations?

A. $^{234}_{88}Ra$ B. $^{230}_{90}Th$ C. $^{234}_{91}Pa$ D. $^{234}_{92}U$

40. Two alpha – particles with equal energies are fired towards the nucleus of a gold atom. Which diagram could represent their paths (in the plane of the paper)?

A

gold nucleus

B

gold nucleus

C

gold nucleus

D

gold nucleus