1. Which of the following is a scalar quantity?

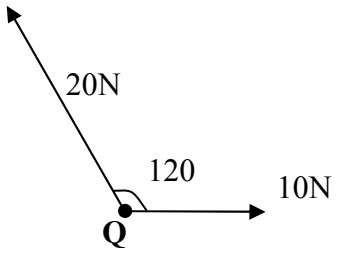
   A electric field strength
   B momentum
   C torque
   D pressure

2. In a simple electrical circuit, the current in a resistor is measured as (3.2 ± 0.1) mA. The resistor is marked as having a value of $4.7\Omega \pm 3\%$.

   If these values were used to calculate the power dissipated in the resistor, what would be the percentage uncertainty in the value obtained?

   A 1% B 3% C 6% D 9%

3. Two forces, 20N and 10N, act at a point Q as shown in the diagram. The angle between the directions of the forces is 120^{o}.



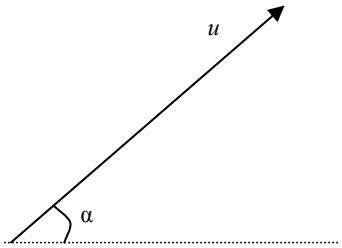
   What is the magnitude of the resultant force?

   A 10N B 17N C 22N D 26N

4. An aircraft in level flight is moving with constant velocity relative to the ground. The resultant force acting on the aircraft is equal to

   A the weight of the aircraft
   B the resultant of the air resistance and the thrust of the engine
   C the resultant of the air resistance and the weight of the aircraft
   D zero

5. A projectile is fired at an angle α to the horizontal at a speed *u* as shown.

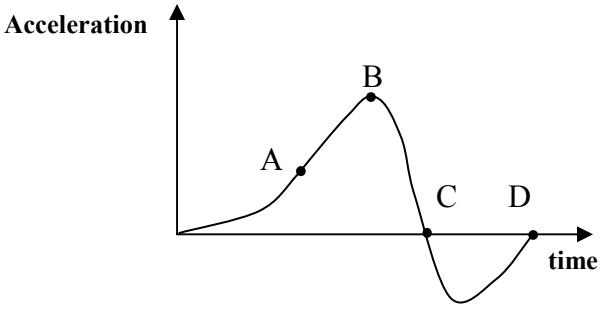


What will be the vertical and horizontal components of its velocity after a time t? Assume that air resistance is negligible. The acceleration of free fall is g.

	Vertical component	Horizontal component
A	$u \sin \alpha$	$u \cos \alpha$
B	$u \sin \alpha - gt$	$u \cos \alpha - gt$
C	$u \sin \alpha - gt$	$u \cos \alpha$
D	$u \cos \alpha$	$u \sin \alpha - gt$

6. A car is traveling along a straight road. The graph shows the variation with time of its acceleration during part of the journey.

At which point on the graph does the car have its greatest velocity?



7. A particle X (of mass 4 units) and a particle Y (of mass 2 units) move directly towards each other, collide and then separate. If Δv_x is the change of velocity of X and Δv_y is the change of velocity of Y, what is the magnitude of the ratio $\Delta v_x / \Delta v_y$?

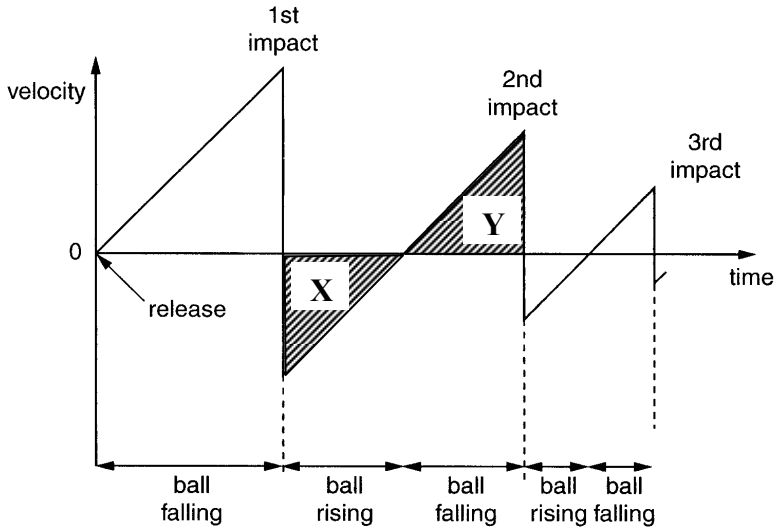
A $\frac{1}{2}$

B $\frac{1}{\sqrt{2}}$

C $\sqrt{2}$

D 2

8. A ball is released from rest above a horizontal surface. The graph shows the variation with time of its velocity.



Area X and Y are equal.
This is because

A the ball's acceleration is the same during its upward and downward motion.

B the speed at which the ball leaves the surface after an impact is equal to the speed at which it returns to the surface for the next impact.

C for one impact, the speed at which the ball hits the surface equals the speed at which it leaves the surface.

D the ball rises and falls through the same distance between impacts.

9. A thrust of 80000N is applied to an aircraft of total mass 12000kg for it to take off from rest. How far has it moved if it takes off at a speed exceeding $60ms^{-1}$?

A 270m B 350m C 400m D 540m

10. Which of the following expressions defines power?

A force × distance moved in the direction of the force

B force × velocity

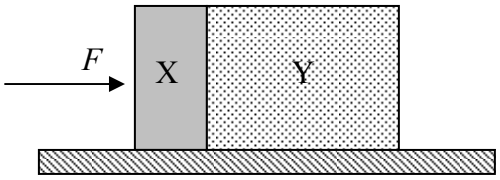
C work ÷ time taken

D work × time taken

11. A force of 1000 N is needed to lift the hook of a crane at a steady velocity. A load of mass 1000kg is attached at the hook and is lifted up at a constant speed of 0.50 ms^{-1}. How much is power needed to do the work?

A 5 kW B 5.4 kW C 20 kW D 22 kW

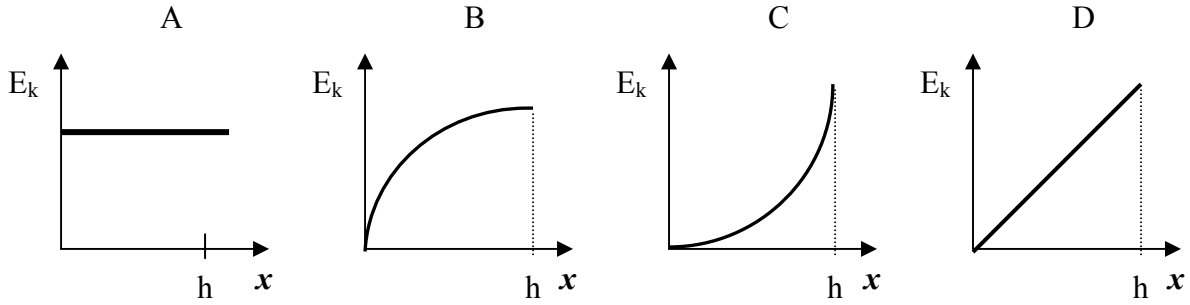
12. Two blocks X and Y of masses m and 3m respectively, are accelerated along a smooth horizontal surface by a force *F* applied to block X as shown:



What is the magnitude of the force exerted by the block Y on the block X during acceleration?

A F B $\frac{2F}{3}$ C $\frac{F}{2}$ D $\frac{3F}{4}$

13. A small steel sphere is released from rest at a height, h above the ground level. Which of the following graphs most closely represents the variation of kinetic energy of the sphere, E_k with the distance it moves, *x*? (Ignore the air resistance)

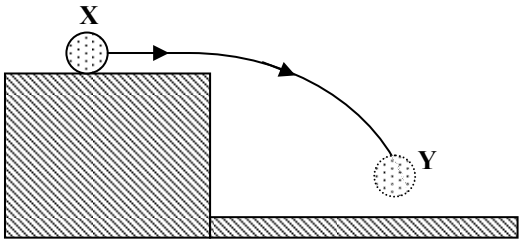


14. A child drinks a liquid of density ρ through a vertical straw.
Atmospheric pressure is p_o and the child is capable of lowering the pressure at the top of the straw by 10%. The acceleration of free fall is g.

What is the maximum length of straw that would still allow the child to drink the liquid?

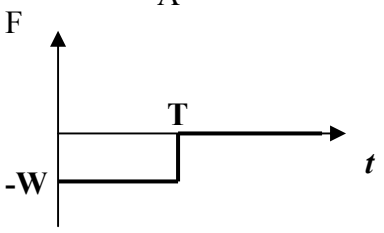
A $\frac{p_o}{10\rho g}$ B $\frac{9p_o}{10\rho g}$ C $\frac{p_o}{\rho g}$ D $\frac{10p_o}{\rho g}$

15. A ball of weight W slides along a smooth horizontal surface until it falls off the edge at time T.

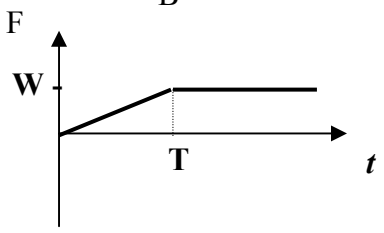


Which graph represents how the resultant vertical force F, acting on the ball, varies with time t as the ball moves from position X to Y?

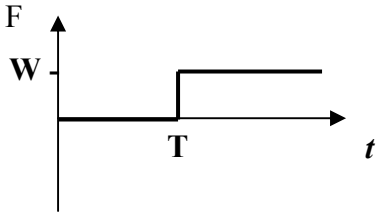
A



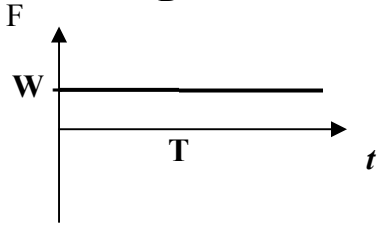
B



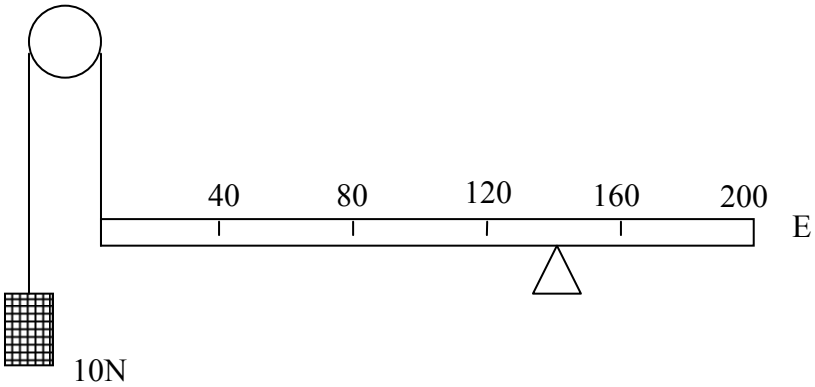
C



D



16. A uniform plank of weight 60N is 200cm long and rests on a support that is 60cm from end E. A load of 10N is tied to another end of the plank with a rope that runs through a frictionless pulley. At what distance from E must a 50N weight be placed in order to balance the plank?



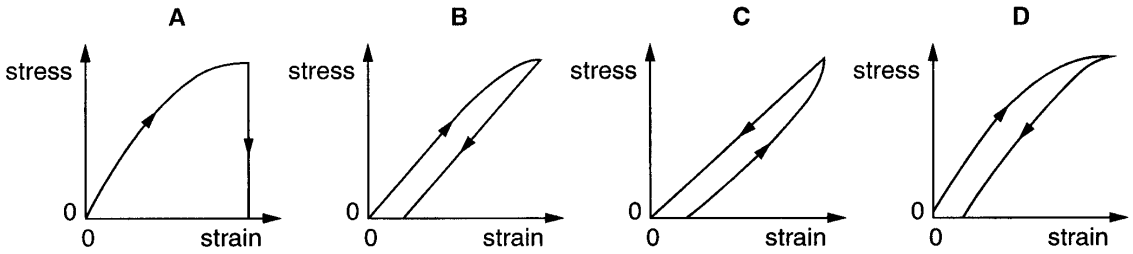
A 20cm B 40cm C 50cm D 76cm

17. A wire is stretched by 8 mm when a load of 60N is applied. What will be the extension of a wire of the same material having four times the cross- sectional area and twice the original length, when the same load is applied?

A 2 mm B 4 mm C 8 mm D 16 mm

18. A suspended copper wire is gradually loaded until it is stretched just beyond the elastic limit and it is then gradually unloaded.

Which graph (with arrow indicating the sequence) best illustrates the variation of the tensile stress with longitudinal strain?



19. What is the ultimate tensile stress of a material?

A the stress at which the material becomes ductile
B the stress at which the material breaks
C the stress at which the material deform plastically
D the stress at which the material reaches its elastic limit

20. Two springs P and Q both obey Hooke's law. They have spring constants 2k and k respectively. The springs are stretched separately by a number of slotted weights so that the extension produced is the same for each spring. The work done in stretching spring P is W_P and the work done in stretching spring Q is W_Q.

How is W_P related to W_Q?

A $W_P = 1/4W_Q$ B $W_P = 1/2W_Q$

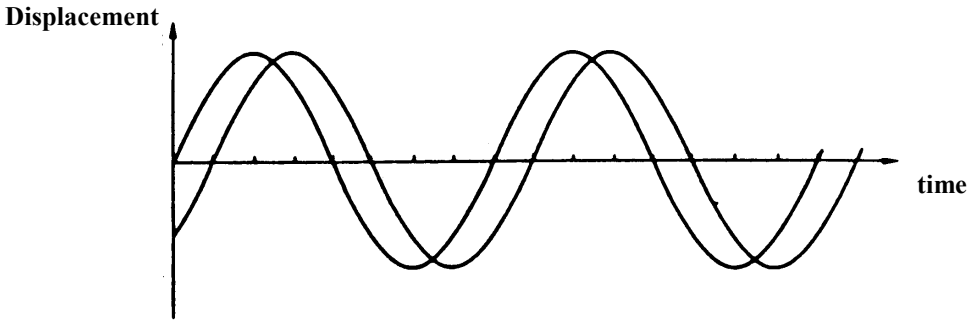
C $W_P = 2W_Q$ D $W_P = 4W_Q$

21. A sound source of frequency 2000 Hz is placed several metres from a reflecting plane wall in a large chamber containing a gas. A microphone, connected to a cathode-ray oscilloscope, is used to detect nodes and antinodes along the normal from the source to the wall. The microphone is moved from one node through 20 antinodes to another node, a distance of 1.900 m.

What is the speed of the gas in ms^{-1}?

A. 325 B. 350 C. 380 D. 400

22. The diagram shows two oscillations.



What is the phase difference between the oscillations?

A. $\pi/2$ rad B. $\pi/4$ rad C. $3\pi/4$ rad D. π rad

23. If a wave can be polarised, it must be

A. an electromagnetic wave
B. a longitudinal wave
C. a transverse wave
D. a stationary wave

24. Coherent light is incident on two fine parallel slits, S_1 and S_2, as shown in the diagram.

If a dark fringe occurs at **P**, which of the following gives possible phase differences for the light waves arriving at **P** from S_1 and S_2?

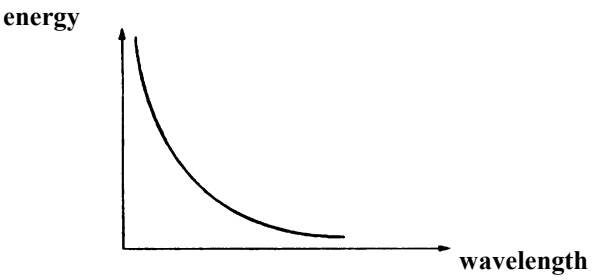
A. $\pi, 3\pi, 5\pi \ldots$
B. $2\pi, 4\pi, 6\pi \ldots$
C. $\pi, 2\pi, 3\pi \ldots$
D. $\pi/2, 3\pi/2, 5\pi/2 \ldots$

25. A narrow beam of monochromatic light falls at normal incidence on a diffraction grating. Third-order diffracted beams are formed at angles of 45° to the original direction.

What is the highest order of diffracted beam produced by this grating?

A. 3^{rd} B. 4^{th} C. 5^{th} D. 6^{th}

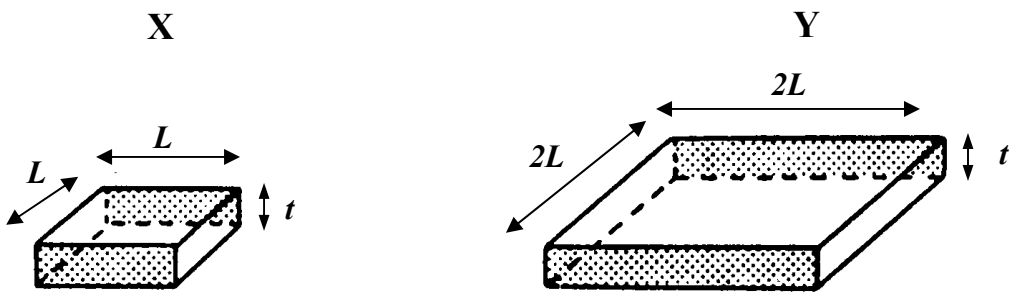
26. The diagram shows the relationship between the energy of electromagnetic radiation and the wave length of the waves.



Which of the following has the lowest energy?

A. infrared
B. microwaves
C. ultra-violet
D. X-rays

27. The diagram shows two squares, **X** and **Y**, cut from a sheet of metal of uniform thickness *t*. **X** and **Y** have sides of length *L* and *2L* respectively.



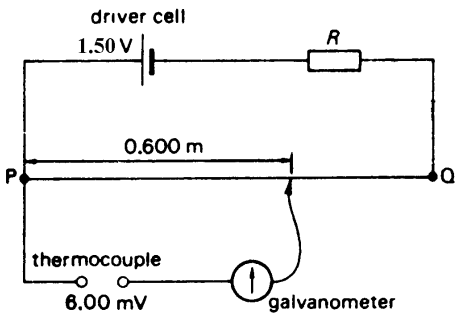
The resistances of the squares, R_X and R_Y, are measured between the opposite faces shaded in the diagram. What is the value of $\frac{R_X}{R_Y}$?

A. 1 B. 2 C. 3 D. 4

28. A cell of e.m.f. *E* delivers a charge *Q* to an external circuit. Which statement is correct?

A. The energy dissipation in the external circuit is *EQ*
B. The energy dissipation within the cell is *EQ*
C. The external resistance is *EQ*
D. The total energy dissipation in the cell and the external circuit is *EQ*

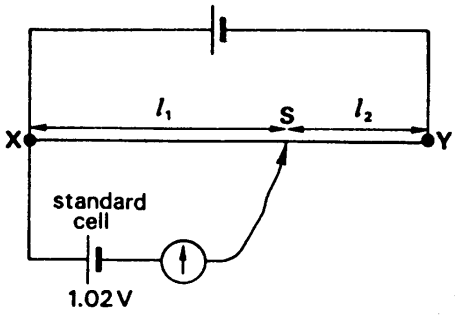
29. The diagram below shows a simple potentiometer circuit for measuring a small e.m.f. produced by a thermocouple.



The meter wire **PQ** has a resistance of 5 Ω and the driver cell has an e.m.f. of 1.50V. If a balance point is obtained 0.600 m along **PQ** when measuring an e.m.f. of 6.00 mV, what is the value of the resistance *R*?

A. 445 Ω B. 545 Ω C. 645 Ω D. 745 Ω

30. A standard cell of e.m.f. 1.02 V is used to find the potential difference across the wire **XY** as shown in the diagram. It is found that there is no current in the galvanometer when the sliding contact is at **S**, l_1 from **X** and l_2 from **Y**.



What is the potential difference across **XY**?

A. 1.02 $\left[\frac{l_1 + l_2}{l_1}\right]$ V

B. 1.02 $\left[\frac{l_1 + l_2}{l_2}\right]$ V

C. 1.02 $\left[\frac{l_2}{l_1}\right]$ V

D. 1.02 $\left[\frac{l_1}{l_2}\right]$ V

31. An electrical source with internal resistance r is used to operate a lamp of resistance R. What fraction of the total power is delivered to the lamp?

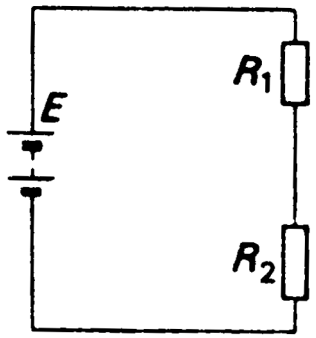
A. $\frac{R}{R + r}$

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

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

D. $\frac{r}{R}$

32. A battery of e.m.f. E and negligible internal resistance is connected to 2 resistors of resistances R_1 and R_2 as shown in the circuit diagram.



What is the potential difference across the resistor of resistance R_2?

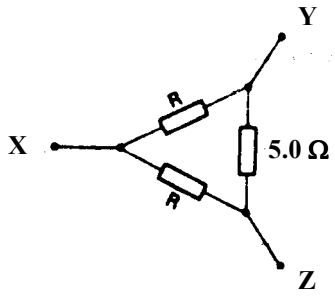
A. $\frac{E (R_1 + R_2)}{R_1}$

B. $\frac{E (R_1 + R_2)}{R_2}$

C. $\frac{E R_2}{R_1 + R_2}$

D. $\frac{E R_2}{R_1}$

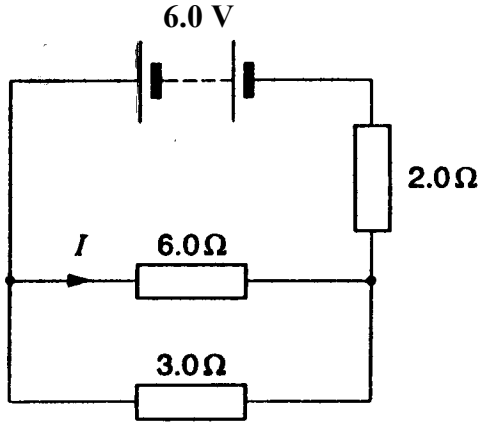
33. The diagram shows a network of three resistors. Two of these marked *R* are identical. The other one has a resistance of 5.0 Ω.



The resistance between **Y** and **Z** is found to be 2.5 Ω. What is the resistance between **X** and **Y**?

A. 1.9 Ω B. 2.9 Ω C. 0.9 Ω D. 3.8 Ω

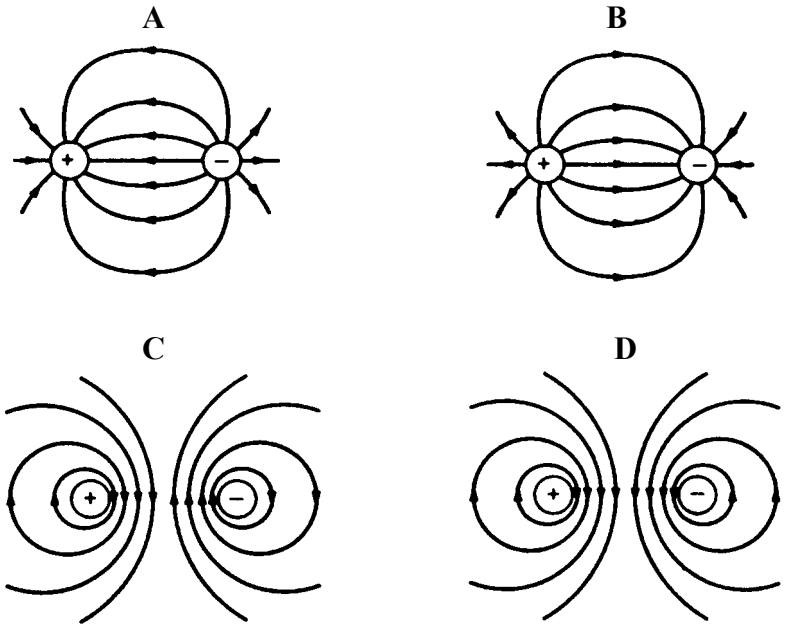
34. The diagram shows a circuit in which the battery has negligible internal resistance.



What is the value of the current *I*?

A. 0.5 A B. 1.0 A C. 1.5 A D. 2.0 A

35. A positive charge and a negative charge of equal magnitude are placed a short distance apart. Which diagram best represents the associated electric field?



36. Two large horizontal metal plates are separated by 4 mm. The lower plate is at a potential of -6 V.

What potential should be applied to the upper plate to create an electric field of strength 5000 V m^{-1} upwards in the space between the plates?

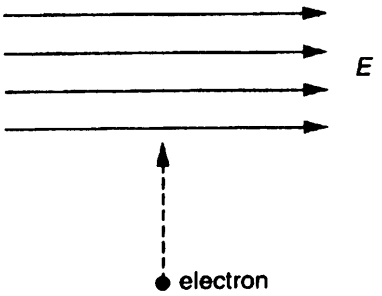
A. + 20 V B. – 20 V C. + 26 V D. – 26 V

37. In an experiment to investigate the nature of the atom, a very thin gold film was bombarded with α - particles.

What pattern of deflection of the α - particles was observed?

A. No α - particle was deflected through an angle greater than a right angle.
B. All α - particles were deflected from their original path.
C. Most α - particles were deflected through angles greater than a right angle.
D. A few α - particles were deflected through angles greater than a right angle.

38. An electron is projected at right angles to a uniform electric field E.



In the absence of other fields, in which direction is the electron deflected?

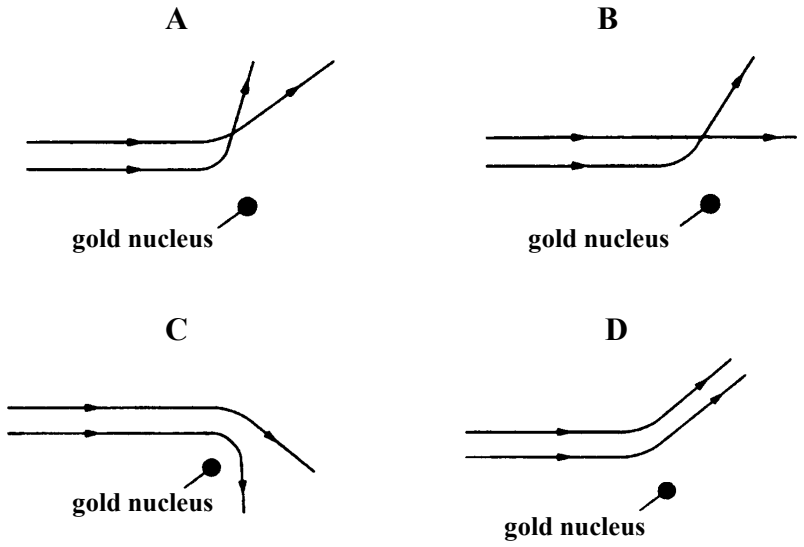
A. to the right
B. to the left
C. into the plane of the paper
D. out of the plane of the paper

39. A high energy α - particle collides with a $^{14}_{7}\mathrm{N}$ nucleus to produce a $^{17}_{8}\mathrm{O}$ nucleus. What could be the other products of this collision?

A. a γ - photon alone
B. a γ - photon and a β - particle
C. a γ - photon and a neutron
D. a γ - photon and a proton

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)?



** End of questions **