1982 Hong Kong Advanced Level Examination
AL Physics
Multiple Choice Question

1. A solid of mass m starts from rest and travels for a given time under the action of a given force. The speed which it acquires is

   A. proportional to m.
   B. proportional to $1/m$.
   C. proportional to $\sqrt{m}$.
   D. proportional to $1/\sqrt{m}$.
   E. independent of m.

2. A communication satellite in a circular orbit of radius R has a period of 24 hours. The period of a satellite in a circular orbit of radius $R/4$ is

   A. 3 hours
   B. 6 hours
   C. 12 hours
   D. 24 hours
   E. 96 hours

3. Two objects of masses m and 4 m move towards each other along a straight line with kinetic energies E and 4 E respectively. The total linear momentum of both masses taken together is

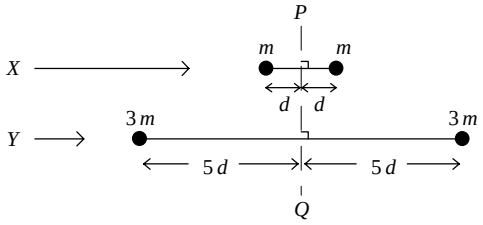
   A. $3\sqrt{2mE}$
   B. $4\sqrt{2mE}$
   C. $5\sqrt{2mE}$
   D. $15\sqrt{2mE}$
   E. $17\sqrt{2mE}$

4. A builder using a pulley system to lift a bucket of cement of weight 150 N exerts a steady force F and pulls 30 m of rope through the system in order to raise the bucket 10 m. The friction in the system is small but NOT negligible. The value of the force F is most probably

   A. less than 50 N.
   B. exactly equal to 50 N.
   C. between 50 N and 150 N.
   D. between 150 N and 450 N.
   E. more than 450 N.

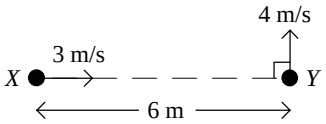
5. A stone of weight w tied to a piece of string is swung in a vertical circle. At the topmost point of its path, the tension in the string is T and the centripetal force is F. Which of the following statements is true?

   A. $F = w + T$.
   B. $F = w - T$.
   C. The net force acting downwards on the stone is $F + T + w$.
   D. The net force acting downwards on the stone is $F - T + w$.
   E. The net force acting downwards on the stone is $F - T - w$.

6. 

   X and Y are dumbell shaped objects comprising two equal small masses rigidly joined together by a light rod. I_1 and I_2 are the moments of inertia of X and Y respectively about the axis PQ. I_2/I_1 is equal to

   A. 9
   B. 15
   C. 25
   D. 45
   E. 75

7. 

   Two bodies X and Y are moving with constant velocities in the directions indicated by the arrows. At time $t = 0$, they are at the positions shown. At time $t = 2$ s, the magnitude of the velocity of Y relative to X is

   A. 4 m/s.

B. 5 m/s.
C. 6 m/s.
D. 8 m/s.
E. 10 m/s.

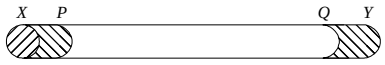
8. In an experiment to measure the specific latent heat of vaporisation of water, a potential difference V is applied across a heating coil immersed in boiling water, and the mass of water vaporised per second, m, is measured. Heat loss to the surroundings is negligible. If the potential difference is increased to 4 V, the mass vaporised per second is

A. 2 m.
B. 4 m.
C. 8 m.
D. 16 m.
E. 64 m.

9. When the temperature of a solid is increased, what will happen to the average kinetic energy and the average potential energy of the molecules?

	average kinetic energy	average potential energy
A.	increases	increases
B.	increases	no change
C.	increases	decreases
D.	no change	increases
E.	no change	decreases

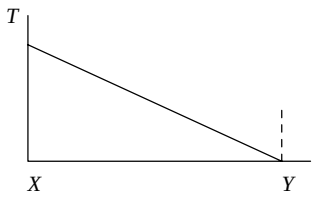
10.



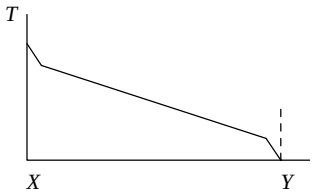
(diagram not to scale)

PQ is a metal bar with thin layers of plastic XP and QY attached to each end. The whole apparatus is well lagged. X is maintained at 100 ºC and Y at 0 ºC. Which of the graphs below best represents the variation of temperature T along XY?

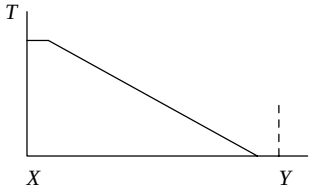
A.



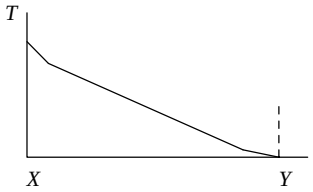
B.



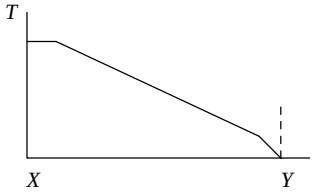
C.



D.



E.



11. A mass m of an ideal gas initially has volume V_0 and temperature T_0. When it is kept at constant volume V_0, heat Q is required to increase its temperature to $T_0 + \Delta T$. If the volume is not kept constant, but the gas expands from V_0 to $3V_0$ when the temperature increases from T_0 to $T_0 + 2\Delta T$, then the heat supplied must be

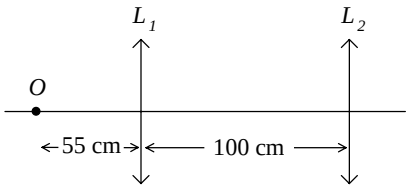
A. less than 2 Q.
B. equal to 2 Q.
C. more than 2 Q.
D. more than 3 Q.
E. more than 6 Q.

12. Mass M of an ideal gas at pressure p occupies volume V. The r.m.s. speed of its molecules is

A. $\sqrt{pV/3M}$.
B. $\sqrt{pV/M}$.
C. $\sqrt{3pV/M}$.
D. $\sqrt{pVM}$.

E. $\sqrt{3pVM}$.

13.



L_1 and L_2 are converging lenses, each of focal length 50 cm. The final image of object *O*, formed by refraction through both lenses, is at *I*. The distance *OI* is

A. 54.5 cm.
B. 110 cm.
C. 200 cm.
D. 550 cm.
E. 605 cm.

14. When a diver looks up towards the surface from underwater, the surface behaves like

A. a converging lens.
B. a diverging lens.
C. a plane mirror covering the entire surface.
D. a plane mirror with a circular hole in it, centred above the diver's head.
E. a circular plane mirror of limited extent, centred above the diver's head.

15. A near-sighted person's greatest distance of distinct vision is 0.9 m. His sight is improved by wearing spectacles which increase his greatest distance of distinct vision to 18 m. What is the magnitude of the focal length of the spectacle lenses?

A. 0.86 m.
B. 0.90 m.
C. 0.95 m.
D. 17.1 m.
E. 18.9 m.

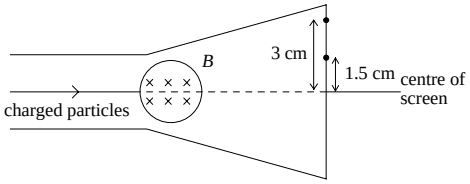
16. A plane mirror is rotating with angular speed ω. When pulses of light, of pulse frequency *f*, strike the mirror, they are reflected such that the angle between successive reflected pulses is θ. If the direction of the incident pulses remains constant, the value of θ is

A. $\frac{\omega}{\pi f}$
B. $\frac{\omega}{2\pi f}$
C. $\frac{\omega}{4\pi f}$
D. $\frac{\omega}{f}$
E. $\frac{2\omega}{f}$

17. A diffraction grating ruled with 5 000 lines per cm is illuminated normally by white light. If the wavelengths for yellow light and violet light are 600 nm and 400 nm respectively, which of the following statements is false?

A. The central image is white.
B. The violet end of the first-order spectrum is closer to the central image than is the red end of the first-order spectrum.
C. The second-order image of yellow light coincides with the third-order image of violet light.
D. The angular displacement of the second-order image of yellow light from the central image is $\sin^{-1} 0.6$.
E. There is no fourth-order image for violet light.

18.



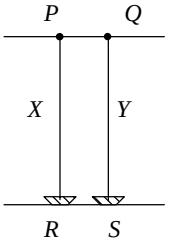
A beam of charged particles passes through a vacuum chamber and strikes the centre of the fluorescent screen at the end of the chamber. When a magnetic field *B* is applied in the direction shown, two spots appear on the screen, one 1.5 cm above the centre, and one 3 cm above the centre.

Which of the following can be possible constituents of the beam?

A. electrons and protons, travelling at the same speed
B. electrons and alpha particles, travelling at the same speed
C. electrons of speed *v* and protons of speed 2*v*
D. protons and alpha particles, travelling at the same speed

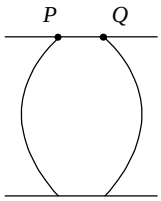
E. protons travelling with speed v and alpha particles travelling with speed $2v$

19.

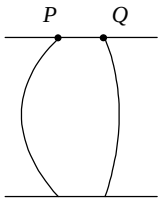


X and Y are identical flexible conducting ribbons, suspended from points P and Q. The bottom parts of the ribbons lie in dishes of a conducting liquid at R and S. When a current $2I$ is passed from R to P through X, and a current I is passed from Q to S through Y, which of the diagrams best represents the shapes assumed by the ribbons (if the ribbons remain in contact with the conducting liquid at R and S)?

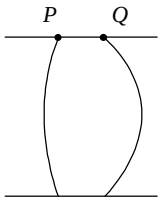
A.



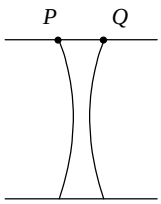
B.



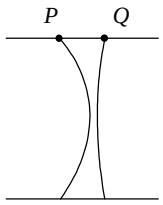
C.



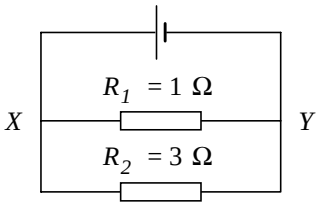
D.



E.



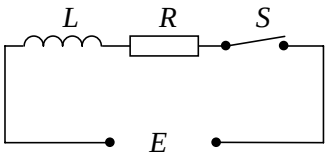
20.



In the circuit above, an electron travelling from Y to X through R_1 loses energy E_1, and an electron travelling from Y to X through R_2 loses energy E_2. E_1 is equal to

A. $E_2/4$.
B. $E_2/3$.
C. E_2.
D. $3E_2$.
E. $4E_2$.

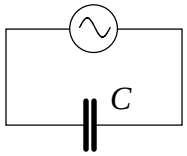
21. An inductor L, a resistor R and a switch S are connected in series across a source of alternating e.m.f. E. Initially the switch is closed, as shown in the figure below:



The switch S is now opened, and at the instant it is opened, a spark passes across it. This is because

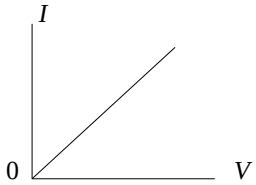
A. the breakdown potential of the air is less than E.
B. at the instant when the switch is opened the whole of the e.m.f. E is across L.
C. the rate of change of the current through the circuit is very large when the switch is opened.
D. the self-inductance of the circuit generates an e.m.f. equal to E.
E. the self-inductance of the circuit generates an e.m.f. which is proportional to the current flowing in the circuit.

22.

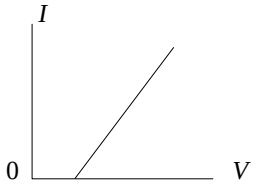


A sinusoidal potential difference of fixed frequency and variable amplitude V is applied across a capacitor of capacitance C. Which of the graphs below best represents the variation of the amplitude I of the current in the circuit with V?

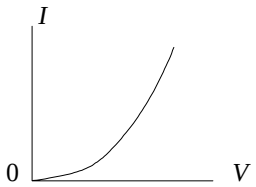
A.



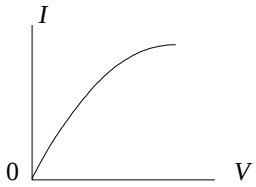
B.



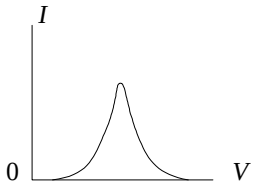
C.



D.



E.



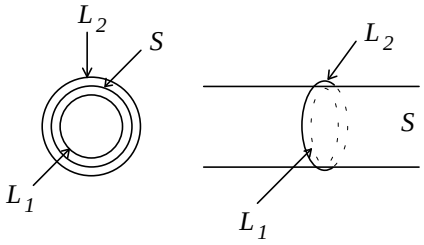
23. A ballistic galvanometer of resistance R_1 is connected in series with a search coil of resistance R_2 (the resistance of the connecting wires is negligible). When the search coil is removed from a magnetic field, the charge which passes through the ballistic galvanometer is proportional to

A. R_2.
B. $(R_1 + R_2)$.
C. $1/R_1$.
D. $1/R_2$.
E. $1/(R_1 + R_2)$.

24. In a circuit with a vibrating reed switch, a 2 μF capacitor is charged from a battery of e.m.f. 12 V and completely discharged through a resistor with a frequency of 25 Hz. The average power dissipated as heat in the resistor is

A. 24 μW.
B. 57.6 μW.
C. 144 μW.
D. 0.6 mW.
E. 3.6 mW.

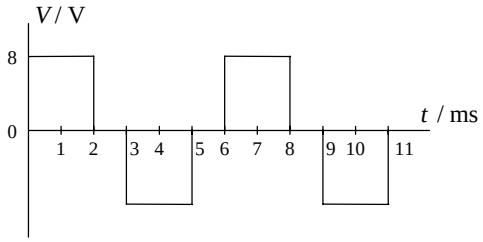
25.



S is a long, current-carrying solenoid. L_1 is a wire loop just inside the solenoid, and L_2 is a wire loop just outside the solenoid. The current in the solenoid is increased at a steady rate, such that the e.m.f. induced in L_1 is 1.2 V. The e.m.f. induced in L_2 is approximately

A. 0 V.
B. 0.6 V.
C. 1.2 V.
D. 2.4 V.
E. larger than 2.4 V.

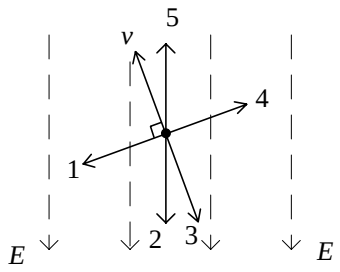
26.



The diagram shows the waveform of an alternating p.d. V applied across a resistor R. What is the value of the steady p.d. which should be applied across R to give the same heating effect?

A. 0 V
B. 16/3 V
C. $4\sqrt{2}$ V
D. $8\sqrt{2/3}$ V
E. 8 V

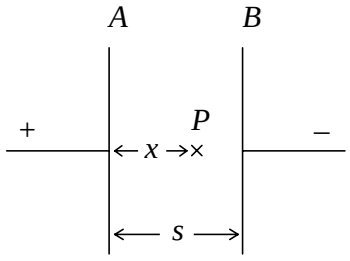
27.



The diagram shows an electron in a uniform, vertical electric field E. At the instant shown, the electron is travelling in the direction of the arrow v. Which of the arrows 1 to 5 gives the direction of the acceleration of the electron at this instant?

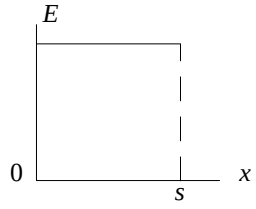
A. 1
B. 2
C. 3
D. 4
E. 5

28.

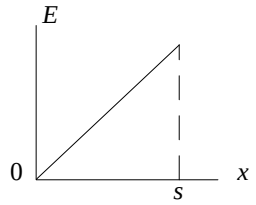


The figure above shows a charged parallel plate capacitor. P is a point between the plates and its distance from plate A is x. If E is the electric field at point P, which of the following graphs best represents the variation of E with x? (The separation of the plates is s.)

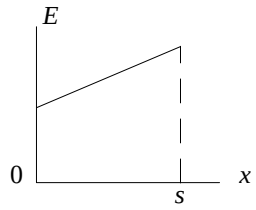
A.



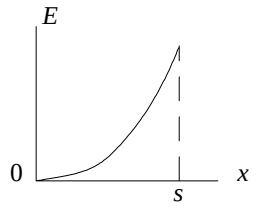
B.



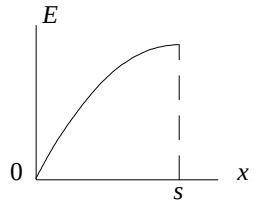
C.



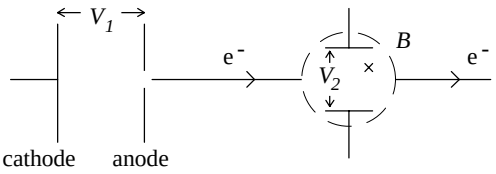
D.



E.



29.



In Thomson's method of measuring e/m, electrons are accelerated by a potential difference V_1, then passed undeviated through a region with a magnetic flux density B and an electric field E. E is provided by a potential difference V_2 between the two plates. If V_1 is increased to 16 V_1, in order for the electron

beam to remain undeviated, V_2 must be changed to

A. $4\ V_2$.
B. $8\ V_2$.
C. $16\ V_2$.
D. $32\ V_2$.
E. $256\ V_2$.

30. With the time base switched off, a cathode ray oscilloscope can be used to display graphically

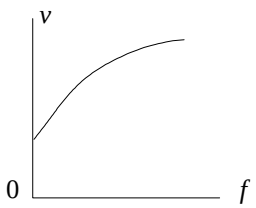
A. the sawtooth waveform of the timebase.
B. the sinusoidal waveform of the mains supply.
C. the variation of the potential difference between the *X* plates with time.
D. the variation of the potential difference between the *Y* plates with time.
E. the variation of the electric field between the *Y* plates with the electric field between the *X* plates.

31. In an X-ray tube, an accelerating potential *V* produces X-rays of minimum wavelength 1.2×10^{-10} m. In order to produce X-rays of minimum wavelength 0.6×10^{-10} m, the accelerating potential should be

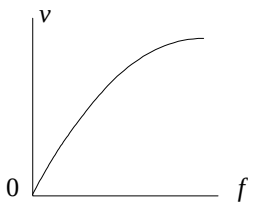
A. $V/4$.
B. $V/2$.
C. $V\sqrt{2}$.
D. $2\ V$.
E. $4\ V$.

32. Which of the following graphs best represents the variation of the maximum velocity *v* of photoelectrons emitted from a target with the frequency *f* of the incident light?

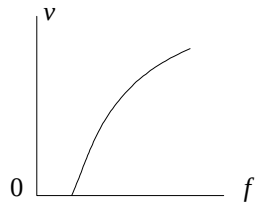
A.



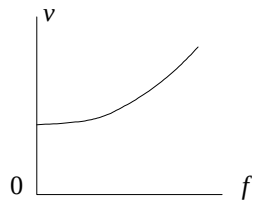
B.



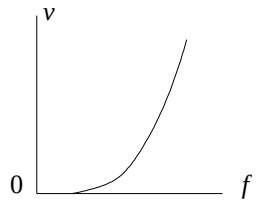
C.



D.



E.



33. If *h* is the Planck constant and *c* is the speed of light in a vacuum, photons of wavelength λ have momentum *p*. Which of the following expressions is dimensionally correct for *p*?

A. $h\lambda$
B. h/λ
C. hc/λ
D. $h\lambda/c$
E. $hc\lambda$

34. In a Bainbridge mass spectrometer, an ion of mass *m* and charge *Q* travels in a circular path of radius *r*. The path of an ion of mass $3m$ and charge $2Q$ has radius

A. $r/6$.
B. $r/3$.
C. $2\ r/3$.
D. $3\ r/2$.
E. $6\ r$.

35. A radioactive source with a half-life $t_{½}$ initially contains *N* atoms of the radioactive element. The energy released in each disintegration is *E*. What is the total energy released in time $2\ t_{½}$?

A. $¼\ NE$
B. $½\ NE$

C. ¾ *NE*
D. ½ $NEt_{½}$
E. $NEt_{½}$

36. Two copper wires, *X* and *Y*, are suspended vertically, and the same downward vertical force *F* is applied to the lower end of each wire. The extension of *X* is twice the extension of *Y*. Which of the following may account for this difference?

(1) The diameter of *X* is half the diameter of *Y*, but their lengths are equal.
(2) *X* is twice as long as *Y*, but their diameters are equal.
(3) *Y* is twice as long as *X*, and its diameter is twice that of *X*.

A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

37. A bob of mass *m* supported by an elastic string performs simple harmonic oscillations in a vertical plane. The tension in the string

(1) is independent of *m*.
(2) is proportional to the amplitude of the oscillations.
(3) has its maximum value when the bob is at its lowest point.

A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

38. 'The volume of a fixed mass of an ideal gas at constant pressure is proportional to its temperature.' The statement above is true only when

(1) an absolute temperature scale is used.
(2) the gas is at a very low pressure.
(3) the gas is at a very high pressure.

A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

39. Which of the following statements about vapours is/are correct?

(1) Saturated vapour pressure is independent of temperature.
(2) If the volume of a closed vessel containing saturated vapour is halved, the pressure will be doubled.
(3) The pressure inside a closed vessel containing air, water and water vapour increases with temperature.

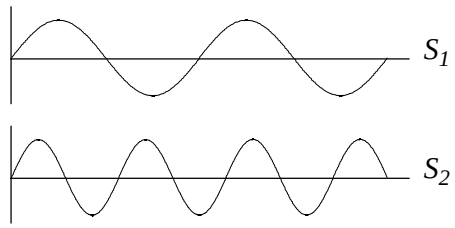
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

40. The critical temperature of a substance is the temperature

(1) below which the substance in its gaseous phase can be liquified by the application of sufficient pressure.
(2) at which the densities of its liquid and saturated vapour are equal.
(3) at which solid, liquid and gaseous phases of the substance can exist together in equilibrium.

A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

41.



The figure above shows each of the stationary traces S_1 and S_2 observed on the screen of a cathode ray oscilloscope connected to a microphone, when two tuning forks F_1 and F_2 respectively are sounded in turn. (The time base remains the same in each case.) Which of the following statements is/are correct?

(1) The period of F_1 is greater than the period of F_2.
(2) The pitch of F_1 is greater than the pitch of F_2.

(3) The speed of sound from F_1 is greater than the speed of sound from F_2.

A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

42. Which of the following statements about electromagnetic radiation is/are correct? (σ = Stefan constant)

(1) A black body at a given temperature T radiates equal amounts of power for all wavelength bands of width $\delta\lambda$.
(2) If T increases to $(T + \delta T)$, the emitted power of a black body increases from P to $(P + \delta P)$, where $\delta P = \sigma(\delta T)^4$.
(3) The wavelength λ_m for maximum emissive power from a black body is inversely proportional to temperature T.

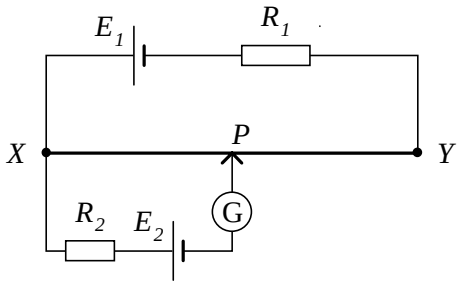
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

43. A very long solenoid with a metallic core has a radius r and n turns per unit length. It carries a current I. The magnetic flux density B on its axis is

(1) independent of r.
(2) proportional to n.
(3) independent of the material of the core.

A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

44.



The diagram shows a potentiometer circuit. Which of the following statements is/are correct?

(1) If the e.m.f. E_1 drops, the balance point P will be closer to Y.
(2) If the e.m.f. E_2 drops, the balance point P will be closer to X.
(3) If R_2 is increased, the balance point P will be closer to Y.

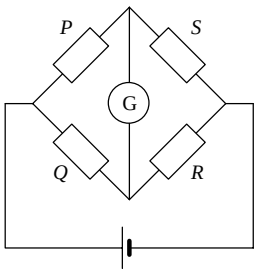
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

45. In the electrolysis of water acidulated with dilute sulphuric acid, using platinum as electrodes,

(1) hydrogen is evolved at the cathode.
(2) the concentration of sulphuric acid decreases with time.
(3) the voltameter obeys Ohm's Law.

A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

46.



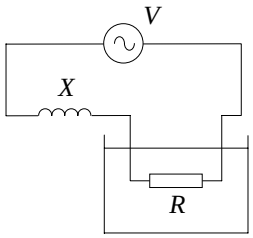
The figure above shows 4 resistors, of resistance P, Q, R and S in a Wheatstone Bridge circuit. Which of the following statements is/are correct when the bridge is balanced?

(1) The potential difference across P is equal to the potential difference across Q.
(2) $P/Q = S/R$
(3) $P/(Q + R) = Q/(P + S)$

A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only

D. (1) only
E. (3) only

47.



In the circuit above, *V* is an a.c. source, *X* is an air-cored solenoid and *R* is a heating coil used to boil some liquid in a vessel. Which of the following adjustments would decrease the time required to boil the liquid?

(1) The frequency of the a.c. supply is increased.
(2) A soft iron cylinder is inserted into the solenoid.
(3) A suitable capacitor is added in series with the circuit.

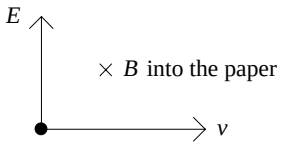
A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

48. Which of the following statements about a thermionic diode is/are correct?

(1) A thermionic diode can be used to convert a.c. into d.c.
(2) Increasing the filament current will increase the saturation current.
(3) The current flow to the anode increases linearly with the anode voltage within a certain range.

A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

49. An electron travelling with velocity *v* enters a region with a uniform electric field *E* and a uniform magnetic flux density *B*. *E*, *B* and *v* are mutually perpendicular, as shown in the diagram.

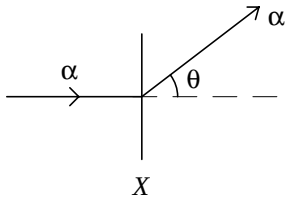


Which of the following statements is/are correct?

(1) When $B = 0$, the path of the electron is parabolic.
(2) When $E = 0$, the path of the electron is circular.
(3) The curvature of the electron's path is independent of *v*.

A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

50. In the Rutherford experiment on alpha particle scattering, an alpha particle strikes a thin metal foil *X* and is deflected through an angle θ.



Which of the following statements is/are true?

(1) θ cannot be greater than 90º.
(2) The closer the alpha particle approaches to a nucleus, the greater is the value of θ.
(3) For the same approach path, θ is larger for slower alpha particles than for faster ones.

A. (1), (2) and (3)
B. (1) and (2) only
C. (2) and (3) only
D. (1) only
E. (3) only

- End of Paper -

Question No.	Key	Question No.	Key
1.	B	26.	D
2.	A	27.	E
3.	A	28.	A
4.	C	29.	A
5.	A	30.	E
6.	E	31.	D
7.	B	32.	C
8.	D	33.	B
9.	A	34.	D
10.	B	35.	C
11.	C	36.	C
12.	C	37.	E
13.	C	38.	D
14.	D	39.	E
15.	C	40.	B
16.	E	41.	D
17.	E	42.	E
18.	D	43.	B
19.	A	44.	B
20.	C	45.	D
21.	C	46.	B
22.	A	47.	E
23.	E	48.	A
24.	E	49.	B
25.	C	50.	C