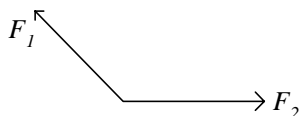


1993 Hong Kong Advanced Level Examination
AL Physics
Multiple Choice Question

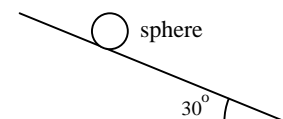
1.



The resultant of two forces F_1 and F_2 acting at a point can have a minimum value of 1 N and a maximum value of 7 N. When the two forces act at right angles to each other, the magnitude of their resultant is

- A. 3 N
 B. 5 N
 C. 6 N
 D. $\sqrt{50}$ N
 E. 8 N

2.



A sphere of mass 1 kg is released from rest on an inclined plane of inclination 30° to the horizontal (as shown). If the sphere rolls without slipping, find the gain in kinetic energy and the work done against friction by the sphere after travelling a distance of 5 m along the plane.

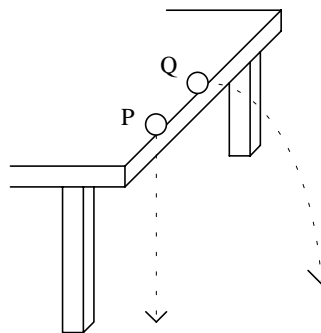
	<u>gain in kinetic energy/J</u>	<u>work done against friction/J</u>
A.	25	0
B.	25	25
C.	50	cannot be determined
D.	50	0
E.	50	25

3. A box moves at a uniform velocity of 2 m/s on a frictionless horizontal surface. Sand falls into the box with negligible speed at a rate of 90 kg per minute. What horizontal force is required to keep the box moving uniformly at 2 m/s?

- A. 0 N
 B. 3 N
 C. 6 N
 D. 90 N

E. 180 N

4.

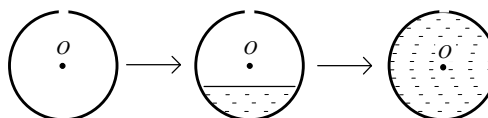


Two identical coins P and Q are placed at the edge of a table. At the same instant, P is pushed slightly and falls vertically to the ground while Q is projected horizontally and reaches the ground through a parabolic path (as shown). Which of the following statements is/are correct? (Neglect air resistance)

- (1) P and Q reach the ground at the same time.
 (2) P and Q have the same acceleration.
 (3) P and Q have the same vertical speed on reaching the ground.

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

5.

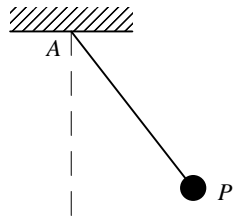


The above diagram shows a uniform hollow metal sphere with a small opening on top. O is the position of the centre of mass of the hollow sphere. What will happen to the position of the centre of mass of the system as the sphere is being slowly filled with oil from the opening?

- A. It will fall gradually, and its final position will be below O .
 B. It will fall gradually at first and then rise to its original position.

- C. It will rise gradually and its final position will be above O .
- D. It will rise gradually at first and then fall to its original position.
- E. It will remain unchanged throughout the process.
6. The period of a simple pendulum undergoing simple harmonic motion may be increased by
- A. using a heavier pendulum bob.
- B. increasing the amplitude of oscillation.
- C. placing the pendulum at the top of a mountain.
- D. placing the pendulum at the North Pole.
- E. shortening the string attached to the bob.
7. A particle oscillates with simple harmonic motion along a straight line with amplitude A . When the displacement of the particle from its equilibrium position is $\frac{1}{2}A$, its speed is u . The speed of the particle when passing the equilibrium position is
- A. $2u/\sqrt{3}$
- B. $\sqrt{2} u$
- C. $\sqrt{3} u$
- D. $2u$
- E. $4u$

8.



The figure shows a small heavy bob P attached to a fixed point A on the ceiling by a light inextensible string. The bob is pulled aside with the string taut and then released from rest. Which of the following descriptions is/are true?

- (1) When moving towards the lowest point of its path, the angular speed of the bob is increasing.
- (2) The centripetal acceleration of the bob is constant.

(3) When the bob is at the lowest point, the tension in the string equals the centripetal force.

- A. (1) only
- B. (3) only
- C. (1) and (2) only
- D. (2) and (3) only
- E. (1), (2) and (3)
9. A ring of radius a is made from thin wire. The moment of inertia of the ring about an axis through its centre and perpendicular to its plane is I . What would be the moment of inertia of a ring, made from the same type of wire but with radius $2a$, about a similar axis?
- A. I
- B. $2I$
- C. $4I$
- D. $8I$
- E. $16I$
10. The velocity of escape from the earth is V_0 . For a planet with radius twice that of the earth and with density three times that of the earth, the velocity of escape from the planet would be
- A. $\sqrt{3} V_0/2$
- B. $2V_0$
- C. $\sqrt{6} V_0$
- D. $2\sqrt{3} V_0$
- E. $2\sqrt{6} V_0$
11. For planets or satellites in circular orbits around a celestial body such as the sun or the earth, the period T is related to the radius of orbit r by Kepler's 3rd law $T^2 = kr^3$ where k is a constant.
- Which of the following statements concerning the constant k is correct?
- A. It is a dimensionless constant whose value is not affected by the choice of units.
- B. It is a universal constant whose value is not affected by the choice of units.
- C. It is a universal constant whose value depends on the choice of units.
- D. It would have a certain value for the earth moving around the sun, but a different

value for another planet moving around the sun.

- E. It would have a certain value for all planets moving around the sun, but a different value for all satellites moving around the earth.

12. A communication satellite appears stationary vertically above an observer at the equator. The height of the satellite above the observer is 3.6×10^7 m. Calculate the mass of the earth.

Given:

Radius of the earth = 6.4×10^6 m

Gravitational constant = 6.7×10^{-11} Nm²kg⁻²

- A. 4.5×10^{24} kg
 B. 5.0×10^{24} kg
 C. 5.5×10^{24} kg
 D. 6.0×10^{24} kg
 E. 6.5×10^{24} kg

13. Which of the following phenomena is/are due to capillary action?

- (1) The drying action of blotting paper.
 (2) Mercury in a narrow tube is depressed below the mercury level outside.
 (3) Molten solder penetrates cracks in soldering.

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

14. A metal sphere released in a liquid falls with terminal velocity V_1 . If a polystyrene sphere of the same radius is released in the same liquid, it then rises with terminal velocity V_2 . Find the ratio V_1/V_2 .

Given: d = density of the liquid

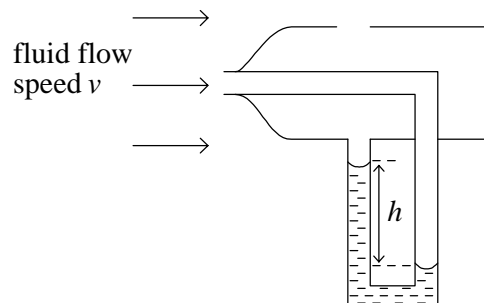
ρ_1 = density of the metal sphere

ρ_2 = density of the polystyrene sphere

- A. ρ_1/ρ_2
 B. $(\rho_2 - d)/(d - \rho_1)$

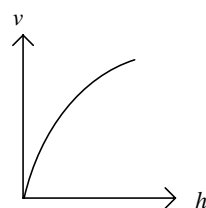
- C. ρ_2/ρ_1
 D. $(\rho_1 - d)/(d - \rho_2)$
 E. $(\rho_1 + d)/(\rho_2 + d)$

15.

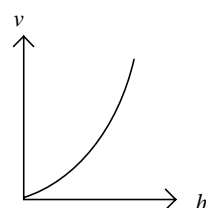


The above figure shows a Pitot-static tube situated in a moving fluid. Which of the following graphs best shows the relation between the speed v of the fluid and the difference in manometer levels h ?

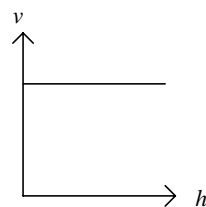
A.



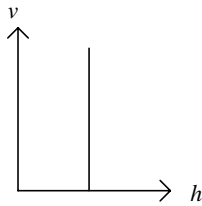
B.



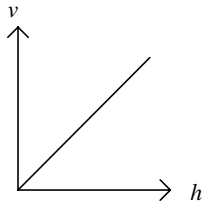
C.



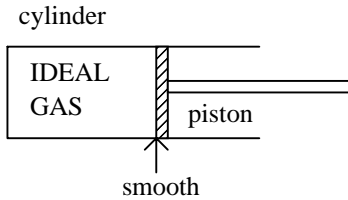
D.



E.

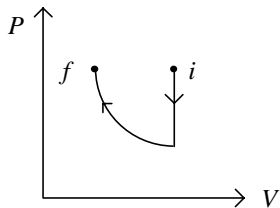


16. An ideal gas is contained in a cylinder fitted with a light piston as shown below:

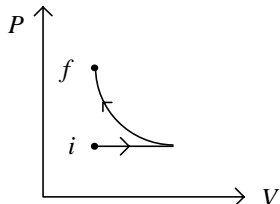


Initially, the piston is held fixed and the gas is cooled. Afterwards, the piston is pushed inwards slowly. Which of the following graphs represents the variation of gas pressure P with gas volume V ? (i represents initial state; f represents final state)

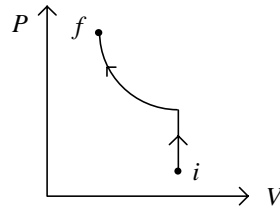
A.



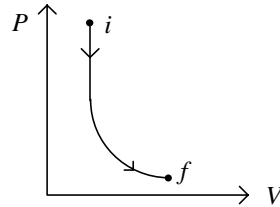
B.



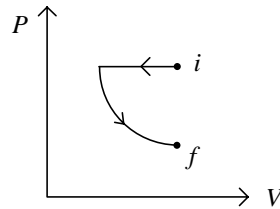
C.



D.



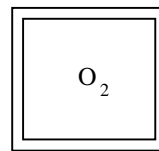
E.



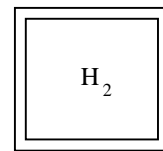
17. An inexpandible vessel contains air at 50°C . What percentage of air remains in the vessel if it is heated to 100°C under constant pressure? (You may take the ice point to be 273 K)

- A. 87%
- B. 85%
- C. 73%
- D. 63%
- E. 50%

18. Identical containers A and B contain oxygen (O_2) and hydrogen (H_2) respectively.



Container A



Container B

Both gases are at room temperature and atmospheric pressure. Which of the following statements is/are true?

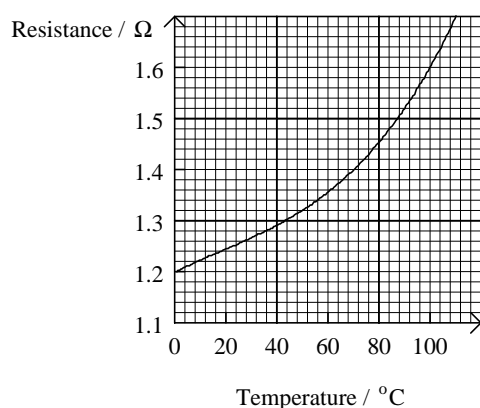
In both containers,

- (1) the number of gas molecules is the same;

- (2) the r.m.s. speed of gas molecules is the same;
 (3) the frequency of collision of gas molecules with the walls of container is the same.

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

19. The calibration curve of a resistance thermometer against a constant volume gas thermometer is given below:



When the resistance thermometer is left in a room, its resistance is found to be 1.28Ω . Find the values of room temperature on both the resistance thermometer scale and the gas thermometer scale.

<u>Room temperature on the resistance thermometer scale/°C</u>	<u>Room temperature on the gas thermometer scale/°C</u>
--	---

- A. 36 36
 B. cannot be determined 36
 C. 20 36
 D. 20 cannot be determined
 E. 36 20

20. If the diameter of an air molecule is d , which of the following gives correct estimates of the average separation of air molecules and their mean free path under atmospheric pressure?

<u>Average separation of air molecules</u>	<u>Mean free path</u>
--	-----------------------

- A. d $10d$
 B. $10d$ $10d$
 C. $10d$ $100d$
 D. $100d$ $10d$
 E. $100d$ $100d$

21. The f-numbers on the aperture ring of a camera are as follows:

2 2.8 4 5.6 8 11 16 22

Which of the following statements is/are true?

- (1) The camera's largest aperture has an area of $\pi f^2/16$ where f is the focal length of the camera lens.
 (2) The depth of field increases with increasing f-number.
 (3) A photograph taken at f-number 5.6 and exposure time $1/60$ s receives the same exposure as another taken at f-number 8 and exposure time $1/120$ s.

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

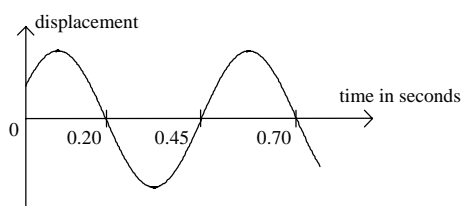
22. Which of the following equations correctly gives the relation between the polarising angle i and the refractive index n of a material?

- A. $\sin i = n$
 B. $n \sin i = 1$
 C. $\cos i = n$
 D. $n \tan i = 1$
 E. $\tan i = n$

23. An object placed in front of a magnifying glass forms an image at infinity with magnifying power 3. What is the focal length of the magnifying glass? (You may assume the least distance of distinct vision to be 25 cm)

- A. 6.3 cm
 B. 8.3 cm
 C. 12.5 cm
 D. 25 cm
 E. 75 cm

- 24.



A displacement-time graph of a particle in a plane progressive wave is shown above. What is the frequency of this wave?

- A. 1.43 Hz
- B. 2 Hz
- C. 2.22 Hz
- D. 4 Hz
- E. 5 Hz

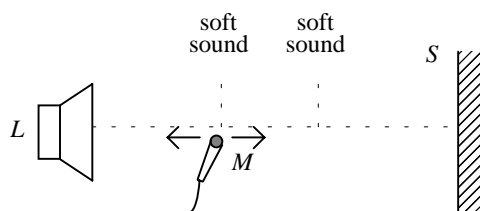
25. A radio produces a sound intensity level of 50 dB at a point 2 m away from it. If the power output of the radio is doubled, what is the sound intensity level at a point 6 m from the radio? (You may regard the radio as a point source)

- A. 30.9 dB
- B. 43.5 dB
- C. 46.5 dB
- D. 48.2 dB
- E. 49.7 dB

26. A hydrogen source in a laboratory emits a line spectrum with one of the lines having wavelength 656.3 nm. For a star receding from the earth at a speed of 200 km/s, what would be the wavelength of the corresponding line from the star observed on the earth? (Velocity of light = 3×10^8 m/s)

- A. 655.5 nm
- B. 655.9 nm
- C. 656.7 nm
- D. 657.1 nm
- E. 657.5 nm

27.



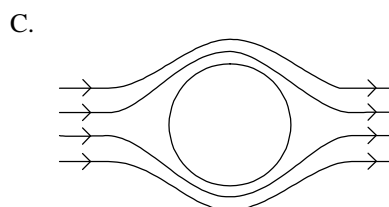
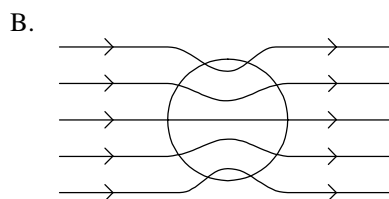
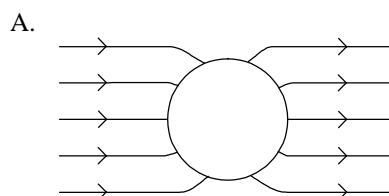
A loudspeaker L produces sound waves with frequency 1 000 Hz. The sound waves are reflected from a wall S . When a microphone M is moved between L and S , the loudness of the sound detected varies. (Speed of sound in air = 340 m/s)

Which of the following statements is/are true?

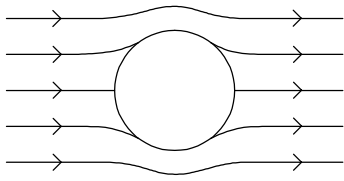
- (1) The variation in the loudness of the sound is due to diffraction.
- (2) The separation between consecutive positions of soft sound is 0.34 m.
- (3) Increasing the sound frequency will make the positions of soft sound closer.

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

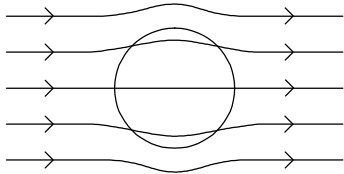
28. An unchanged metal sphere is placed in a uniform electric field. Which of the following best represents the electric field pattern around the metal sphere?



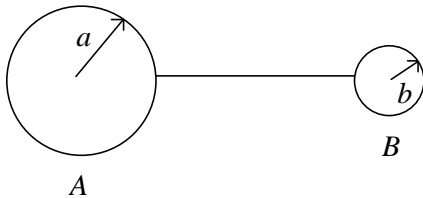
D.



E.



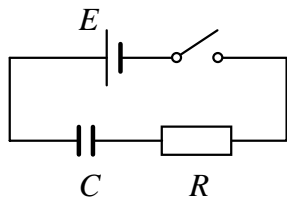
29.



A positively-charged metal sphere *A* of radius *a* is joined by a conducting wire to an uncharged metal sphere *B* of radius *b* placed far away from the first sphere. The ratio of the surface charge density on sphere *A* to that on sphere *B* is

- A. b/a
- B. b^2/a^2
- C. a/b
- D. a^2/b^2
- E. $\sqrt{(b/a)}$

30.

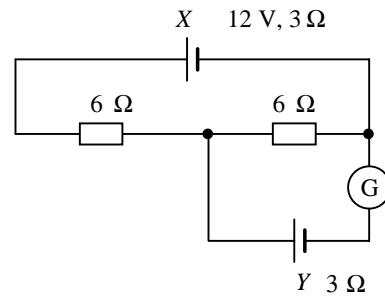


An initially uncharged capacitor of capacitance *C* is connected in series with a resistor *R* and a battery of e.m.f. *E*. What will be (1) the total work done by the battery in fully charging up *C* and (2) the energy finally stored in *C*?

Work done by battery Energy stored in C

- A. $\frac{1}{2}CE^2$ 0
- B. CE^2 0
- C. $\frac{1}{2}CE^2$ $\frac{1}{2}CE^2$
- D. CE^2 $\frac{1}{2}CE^2$
- E. CE^2 CE^2

31.



Two cells *X* and *Y*, each of internal resistance 3Ω , are connected with two 6Ω resistors as shown in the above circuit.

If cell *X* has e.m.f. 12 V and the galvanometer *G* shows null deflection, what is the e.m.f. of cell *Y*?

- A. 3.0 V
- B. 4.0 V
- C. 4.8 V
- D. 6.0 V
- E. 7.2 V

32. Which of the following devices is/are used to stored energy?

- (1) an inductor
- (2) a capacitor
- (3) a photocell

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

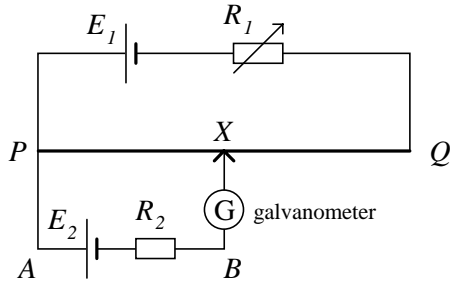
33. Which of the following physical quantities take(s) the unit ohm (Ω)?

- (1) resistance
- (2) reactance
- (3) impedance

- A. (1) only

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

34.

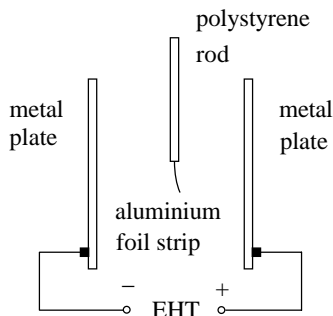


The figure above shows a potentiometer circuit used for measuring the e.m.f.s of cells. The potential gradient along the potentiometer wire PQ is assumed to be constant. Which of the following statements is/are true?

- (1) If the balance point X is close to P , the resistance of R_1 should be decreased.
- (2) At balance, it is better to have point X near the center of PQ .
- (3) At balance, there is no current flowing through the path $PABX$.

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

35. Two insulated parallel metal plates are connected to the terminals of an EHT. When a charged aluminium foil strip is placed between the plates, deflection of the foil is observed as shown.

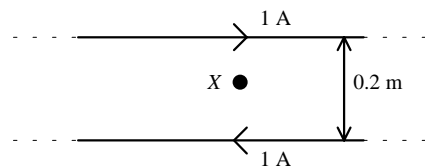


Which of the following statements is/are true?

- (1) The charge on the foil is negative.
- (2) Deflection of the foil increases if the separation between the plates decreases.
- (3) When moving the foil towards the positive plate, the deflection of the foil increases.

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

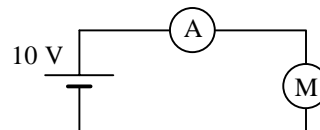
36.



The above figure shows two long parallel straight wires separated by a distance of 0.2 m, carrying currents of 1 A in opposite directions. The magnetic field at a point X mid-way between the wires is (Given: permeability constant $\mu_0 = 4\pi \times 10^{-7} \text{ TmA}^{-1}$)

- A. 0 T
- B. 2×10^{-6} T into paper
- C. 2×10^{-6} T out of paper
- D. 4×10^{-6} T into paper
- E. 4×10^{-6} T out of paper

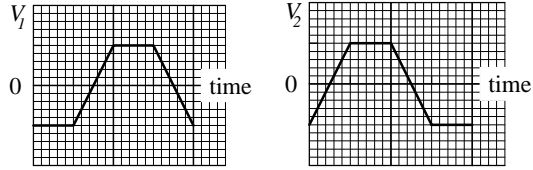
37.



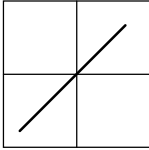
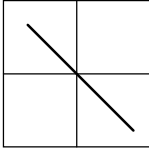
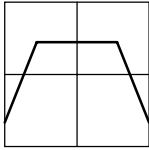
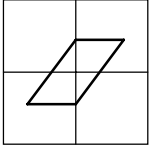
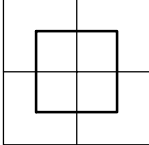
A 10 V battery of negligible internal resistance is applied to a d.c. motor M with armature resistance 5Ω . If the ammeter A of negligible internal resistance shows a reading of 0.4 A, the maximum useful output power delivered by the motor is

- A. 0.8 W.
- B. 1.6 W.
- C. 2.4 W.
- D. 3.2 W.
- E. 4.0 W.

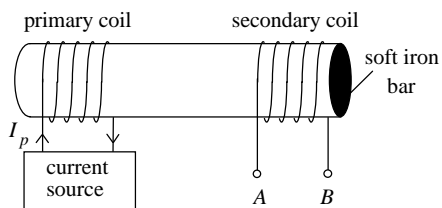
38.



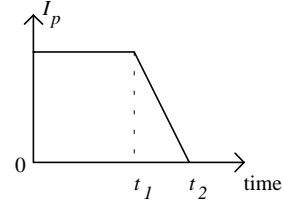
Potential differences V_1 and V_2 are applied to the X-plates and Y-plates of a C.R.O. respectively. The trace on the screen is

- A. 
- B. 
- C. 
- D. 
- E. 

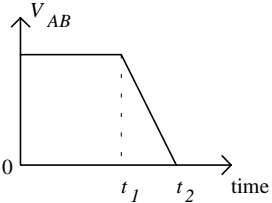
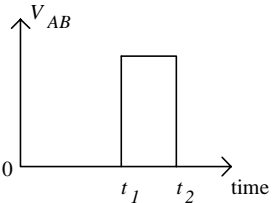
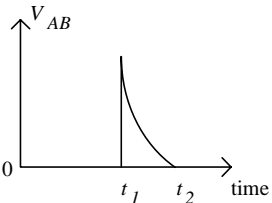
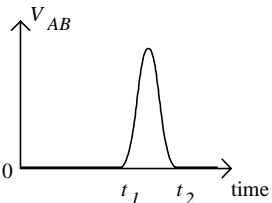
39.

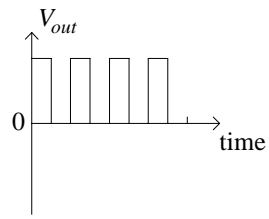
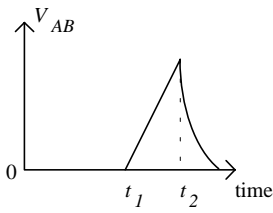


Two coils are linked by a soft iron bar as shown. A current source is connected to the primary coil. The primary current I_p varies with time as shown by the graph below:

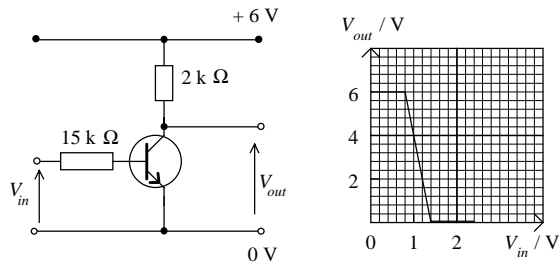


Which of the following sketches represents the variation of the voltage across the secondary coil V_{AB} with time?

- A. 
- B. 
- C. 
- D. 
- E.



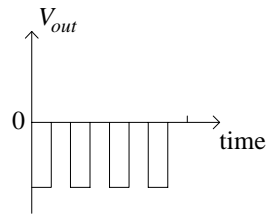
40.



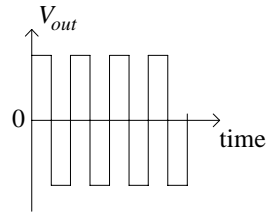
The above diagrams show an NPN transistor circuit and its input/output voltage characteristic. What is the current amplification factor of the transistor?

- A. 10
- B. 30
- C. 60
- D. 75
- E. 150

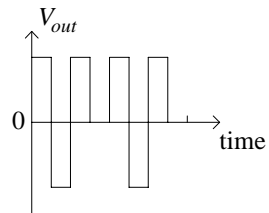
B.



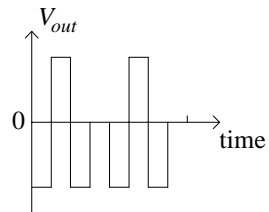
C.



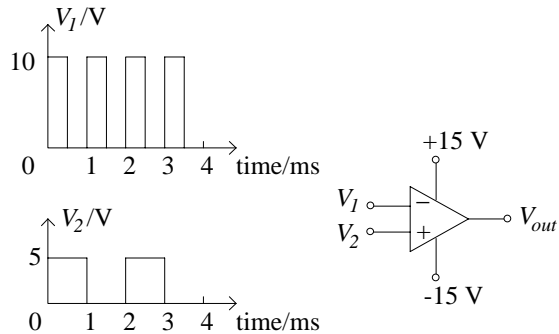
D.



E.



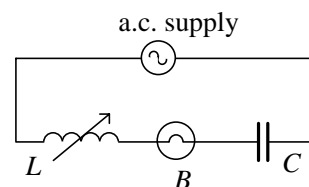
41.



Two electrical signals V_1 and V_2 are fed into an operational amplifier. The variations of V_1 and V_2 with time are shown above. Which of the following graphs represents the variation of the output V_{out} with time?

A.

42.



The above figure shows an a.c. circuit with a filament lamp B connected in series with a variable inductor L and a capacitor C . The frequency of the a.c. supply can be varied.

Initially the applied voltage leads the current in the circuit. Which of the following methods will make the filament lamp *B* brighter?

- (1) Connect a capacitor in parallel with *C*
- (2) Increase the inductance of *L*
- (3) Decreases the frequency of the a.c. supply

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

43. Which of the following materials satisfies the description: ductile, strong and stiff?

- A. steel
- B. diamond
- C. glass
- D. concrete
- E. wood

44. The ionisation potential of a hydrogen atom is 13.6 V. What is the minimum excitation potential of a ground state hydrogen atom?

- A. 1.9 V
- B. 3.4 V
- C. 6.8 V
- D. 10.2 V
- E. 12.8 V

45. The spectrum of sunlight has dark lines in it. Which of the following statements concerning these dark lines is/are correct?

- (1) They are due to the absorption of certain wavelengths of light in the sun's atmosphere.
- (2) Light absorbed in the sun's atmosphere is re-emitted but in all directions.
- (3) They are due to the absorption of certain wavelengths of light in the earth's atmosphere.

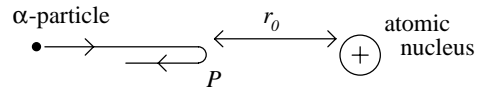
- A. (1) only
- B. (3) only
- C. (1) and (2) only
- D. (2) and (3) only
- E. (1), (2) and (3)

46. An X-ray tube emits X-rays with a minimum wavelength of 3.55×10^{-11} m. Estimate the potential difference between the cathode and the anode (target) in the X-ray tube.

Given: Planck constant = 6.63×10^{-34} Js
 Electronic charge = 1.6×10^{-19} C
 Velocity of light in air = 3×10^8 m/s

- A. 20 000 V
- B. 25 000 V
- C. 30 000 V
- D. 35 000 V
- E. 40 000 V

47.



The diagram shows an alpha-particle 'colliding' head-on with an atomic nucleus. At *P*, the alpha-particle is at the closest distance r_0 from the nucleus. Which of the following statements is/are correct?

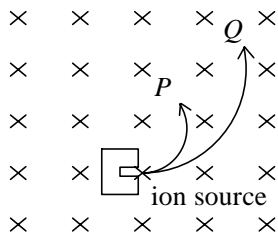
- (1) At *P*, the electric potential energy of the system is maximum.
- (2) r_0 is of the order 10^{-14} m.
- (3) r_0 gives an upper limit for the sum of the radii of the alpha-particle and the nucleus.

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

48. The number of radioactive nuclides in two different samples *P* and *Q* are initially $4N$ and N respectively. If the half-life of *P* is t and that of *Q* is $2t$, the number of radioactive nuclides in *P* will be the same as the number of radioactive nuclides in *Q* after a time of

- A. $t/2$
- B. t
- C. $2t$
- D. $4t$
- E. $8t$

49.



Two particles P and Q of same quantity of charge and mass but moving with different speeds v_P and v_Q respectively enter a region of uniform magnetic field directed into the plane of the paper. The subsequent circular paths are as shown. Which of the following statements is/are correct?

- (1) Both P and Q are positively charged.
- (2) v_P is small than v_Q .
- (3) The period of circular motion of P is shorter than that of Q .

- A. (1) only
- B. (3) only

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

50. A parallel-plate capacitor is formed by two square metal plates. To determine the capacitance C , a student measures the length of side l and separation d of the plates.

If the maximum percentage error of $l = 5\%$
 the maximum percentage error of $d = 3\%$
 then the maximum percentage error for C will be

- A. 7%
- B. 8%
- C. 13%
- D. 22%
- E. 28%

- End of Paper -

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