

JEE MAIN-2017

PHYSICS

General Instructions :

1. Immediately fill in the particulars on this page of the Test Booklet with *only Black Ball Point Pen* provided in the examination hall.
2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of **90** questions. The maximum marks are **360**.
5. Candidates will be awarded marks as started above in instruction No. 5 for correct response of each question. $\frac{1}{4}$ (one fourth) marks of the total marks allotted to the question (i.e. 1 mark) will be deducted for indicating incorrect response of each question. No deduction from that total score will be made if no response is indicated for an item in the answer sheet.
6. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.
7. For writing particulars / marking responses on *Side-1* and *Side-2* of the Answer Sheet use *only Black Ball Point Pen* provided in the examination hall.
8. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination room/hall.
9. Rough work is to be done on the space provided for this purpose in the Test Booklet only. This space is given at the bottom of each page and in **four** pages (Page **20-30**) at the end of the booklet.
10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room / Hall. *However, the candidates are allowed to take away this Test Booklet with them.*
11. **Do not fold or make any stray mark on the Answer Sheet.**

31. A radioactive nucleus A with a half life T , decays into a nucleus B . At $t=0$, there is no nucleus. At sometime t , the ratio of the number of B to that of A is 0.3. Then, T is given by :

(1) $t = \frac{T}{\log(1.3)}$

(2) $t = \frac{T \log 2}{2 \log 1.3}$

(3) $t = T \frac{\log 1.3}{\log 2}$

(4) $t = T \log(1.3)$

32. The following observations were taken for determining surface tension T of water by capillary method:

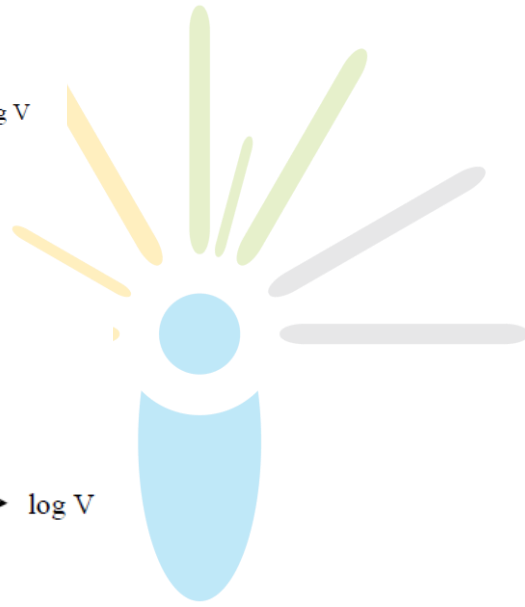
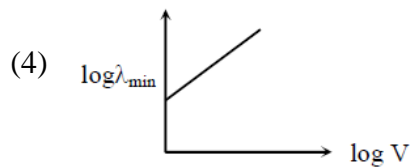
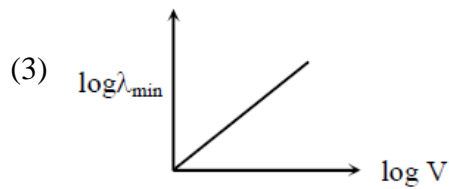
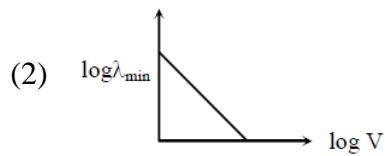
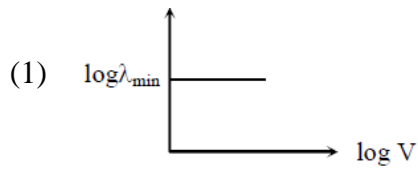
diameter of capillary, $D = 1.25 \times 10^{-2}$ m

rise of water, $h = 1.45 \times 10^{-2}$ m

Using $g = 9.80 \text{ m/s}^2$ and the simplified relation $T = \frac{r h g}{2} \times 10^3 \text{ N/m}$, the possible error in surface tension is closest to :

- (1) 10%
(2) 0.15%
(3) 1.5%
(4) 2.4%

33. An electron beam is accelerated by a potential difference V to hit a metallic target to produce X -rays. It produces continuous as well as characteristic X -rays. If λ_{\min} is the smallest possible wavelength of X -ray in the spectrum, the variation of $\log \lambda_{\min}$ with $\log V$ is correctly represented in:



34. The moment of inertia of a uniform cylinder of length ℓ and radius R about its perpendicular bisector is I . What is the ratio ℓ/R such that the moment of inertia is minimum ?

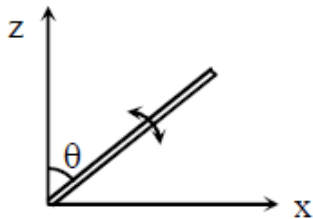
(1) $\frac{3}{\sqrt{2}}$

(2) $\sqrt{\frac{3}{2}}$

(3) $\frac{\sqrt{3}}{2}$

(4) 1

35. A slender uniform rod of mass M and length ℓ is pivoted at one end so that it can rotate in a vertical plane (see figure). There is negligible friction at the pivot. The free end is held vertically above the pivot and then released. The angular acceleration of the rod when it makes an angle θ with the vertical is:



(1) $\frac{2g}{3\ell} \cos \theta$

(2) $\frac{3g}{2\ell} \sin \theta$

(3) $\frac{2g}{3\ell} \sin \theta$

(4) $\frac{3g}{2\ell} \cos \theta$

36. C_p and C_v are specific heats at constant pressure and constant volume respectively. It is observed that

$$C_p - C_v = a \text{ for hydrogen gas}$$

$$C_p - C_v = b \text{ for nitrogen gas}$$

The correct relation between a and b is

(1) $a = 28b$

(2) $a = \frac{1}{14}b$

(3) $a = b$

(4) $a = 14b$

37. A copper ball of mass 100 gm is at a temperature T . It is dropped in a copper calorimeter of mass 100 gm, filled with 170 gm of water at room temperature.

Subsequently, the temperature of the system is found to be 75°C . T is given by: (Given : room temperature = 30°C , specific heat of copper = $0.1\text{cal/gm}^\circ\text{C}$)

(1) 825°C

(2) 800°C

(3) 885°C

(4) 1250°C

38. In amplitude modulation, sinusoidal carrier frequency used is denoted by ω_c and the signal frequency is denoted by ω_m . The bandwidth ($\Delta\omega_m$) of the signal is such that $\Delta\omega_m \ll \omega_c$. Which of the following frequencies is **not** contained in the modulated wave?

(1) $\omega_c - \omega_m$

(2) ω_m

(3) ω_c

(4) $\omega_m + \omega_c$

39. The temperature of an open room of volume 30 m^3 increases from 17°C to 27°C due to the sunshine. The atmospheric pressure in the room remains $1 \times 10^5\text{ Pa}$. If n_i and n_f are the number of molecules in the room before and after heating, then $n_f - n_i$ will be :

(1) -25×10^{25}

(2) -1.61×10^{23}

(3) 1.38×10^{23}

(4) 2.5×10^{25}

40. In a Young's double slit experiment, slits are separated by 0.5 mm , and the screen is placed 150 cm away. A beam of light consisting of two wavelengths, 650 nm and 520 nm , is used to obtain interference fringes on the screen. The least distance from the common central maximum to the point where the bright fringes due to both the wavelengths coincide is

(1) 15.6 mm

(2) 1.56 mm

(3) 7.8 mm

(4) 9.75 mm

41. A particle A of mass m and initial velocity v collides with a particle B of mass $\frac{m}{2}$ which is at rest. The collision is head on, and elastic. The ratio of the de-Broglie wavelengths λ_A to λ_B after the collision is:

(1) $\frac{\lambda_A}{\lambda_B} = \frac{1}{2}$

(2) $\frac{\lambda_A}{\lambda_B} = \frac{1}{3}$

(3) $\frac{\lambda_A}{\lambda_B} = 2$

(4) $\frac{\lambda_A}{\lambda_B} = \frac{2}{3}$

42. A magnetic needle of magnetic moment $6.7 \times 10^{-2} \text{ Am}^2$ and moment of inertia $7.5 \times 10^{-6} \text{ kg m}^2$ is performing simple harmonic oscillations in a magnetic field of 0.01 T . Time taken for 10 complete oscillations is:

(1) 8.76 s

(2) 6.65 s

(3) 8.89 s

(4) 6.98 s

43. An electric dipole has a fixed dipole moment \vec{p} , which makes angle θ with respect to x -axis. When subjected to an electric field $\vec{E}_1 = E\hat{i}$, it experiences a torque $\vec{T}_1 = \tau\hat{k}$. When subjected to another electric field $\vec{E}_2 = \sqrt{3}E_1\hat{j}$ it experiences a torque $\vec{T}_2 = -\vec{T}_1$. The angle θ is:

(1) 90°

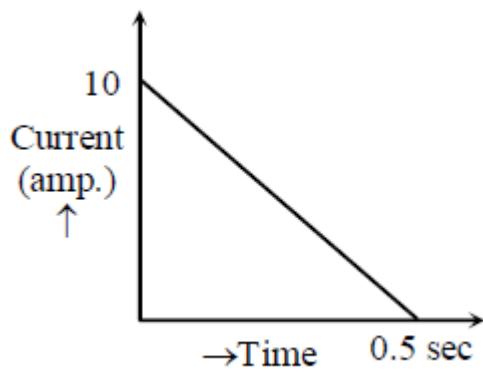
(2) 30°

(3) 45°

(4) 60°

44. In a coil of resistance 100Ω , a current is induced by changing the magnetic flux through it as shown in the figure. The magnitude of change in flux through the coil is:

- (1) 275 Wb
- (2) 200 Wb
- (3) 225 Wb
- (4) 250 Wb



45. A time dependent force $F = 6t$ acts on a particle of mass 1 kg . If the particle starts from rest, the work done by the force during the first 1 sec . will be:

- (1) 18 J
- (2) 4.5 J
- (3) 22 J
- (4) 9 J

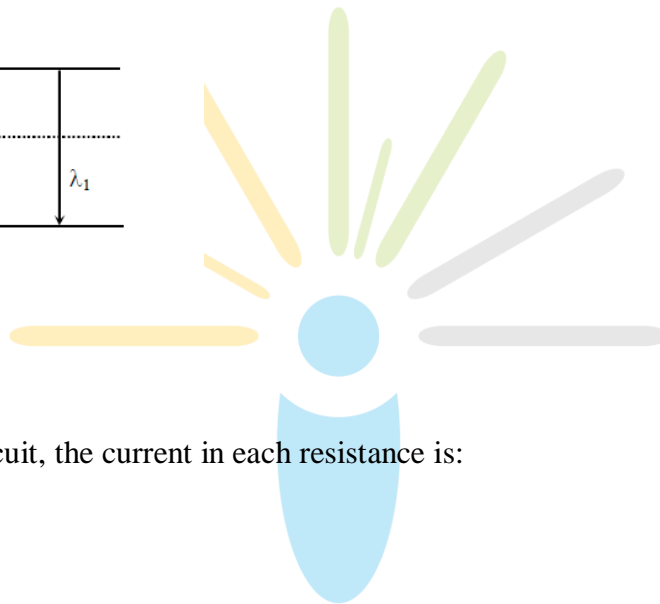
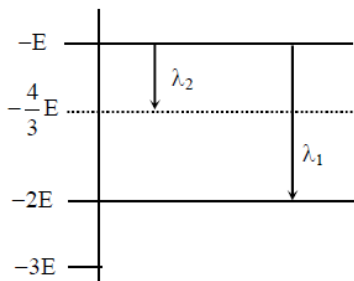
46. Some energy levels of a molecule are shown in the figure. The ratio of the wavelengths $r = \lambda_1/\lambda_2$, is given by:

(1) $r = \frac{1}{3}$

(2) $r = \frac{4}{3}$

(3) $r = \frac{2}{3}$

(4) $r = \frac{3}{4}$



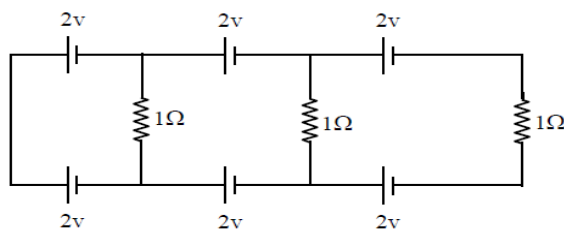
47. In the given circuit, the current in each resistance is:

(1) 0 A

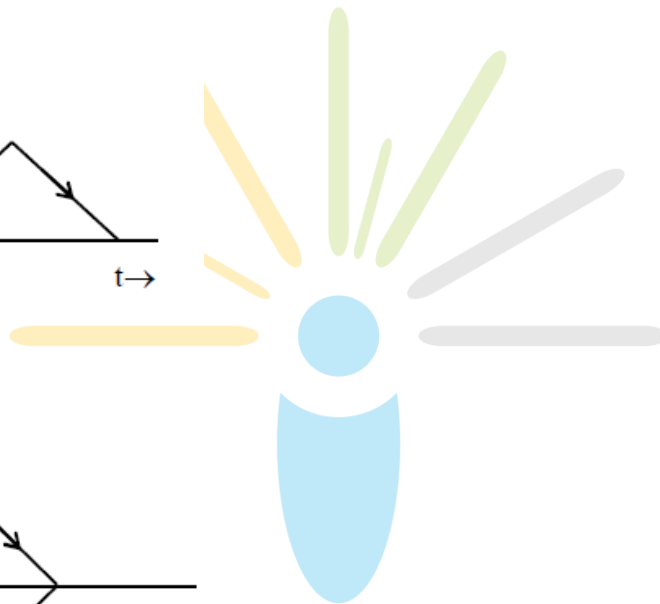
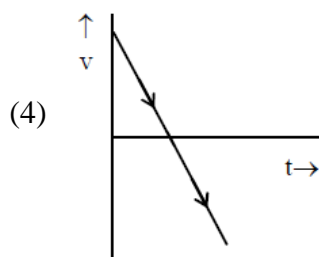
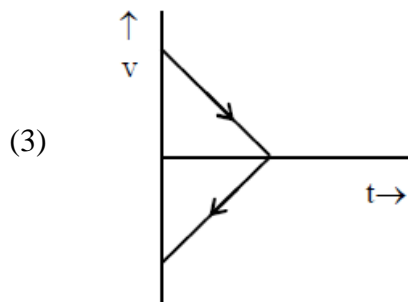
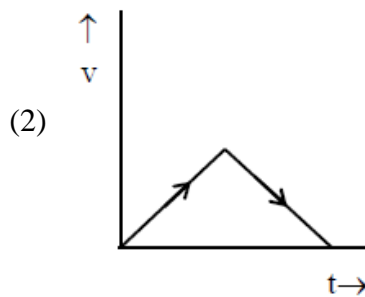
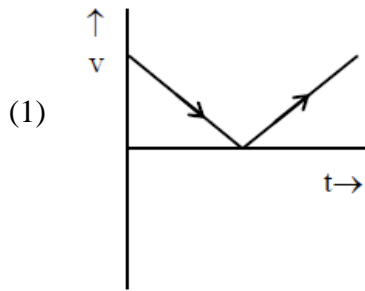
(2) 1 A

(3) 0.25 A

(4) 0.5 A



48. A body is thrown vertically upwards. Which one of the following graphs correctly represent the velocity vs time?

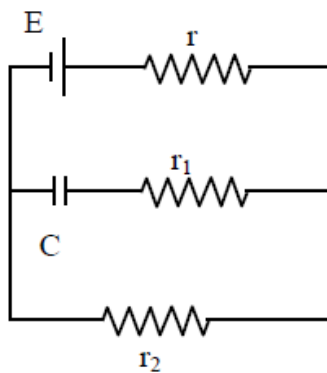
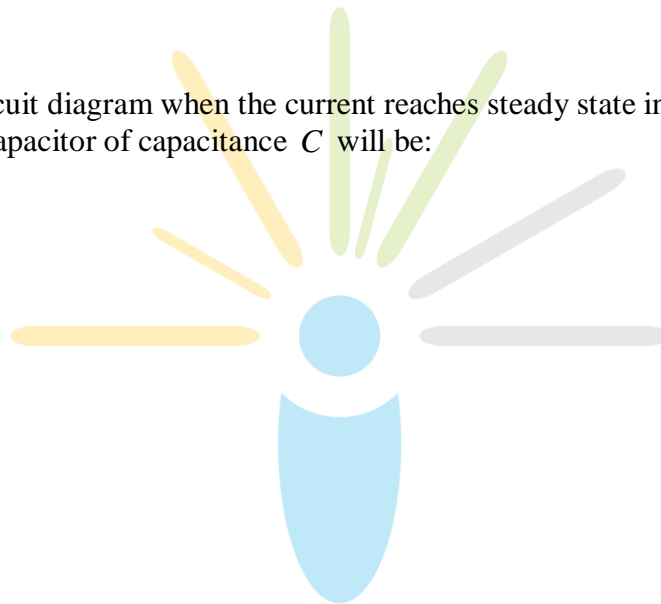


49. A capacitance of $2\mu F$ is required in an electrical circuit across a potential difference of 1.0 kV . A large number of $1\mu F$ capacitors are available which can withstand a potential difference of not more than 300 V . The minimum number of capacitors required to achieve this is:

- (1) 32
- (2) 2
- (3) 16
- (4) 24

50. In the given circuit diagram when the current reaches steady state in the circuit, the charge on the capacitor of capacitance C will be:

- (1) $CE \frac{r_1}{(r_1 + r)}$
- (2) CE
- (3) $CE \frac{r_1}{(r_2 + r)}$
- (4) $CE \frac{r_2}{(r + r_2)}$



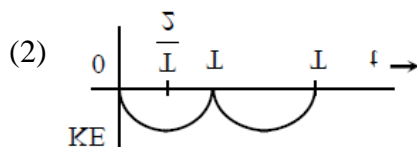
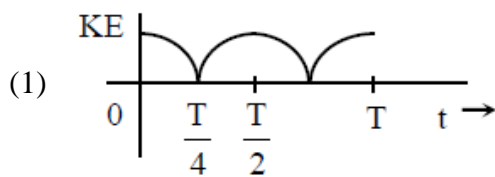
51. In a common emitter amplifier circuit using an n-p-n transistor, the phase difference between the input and the output voltages will be:

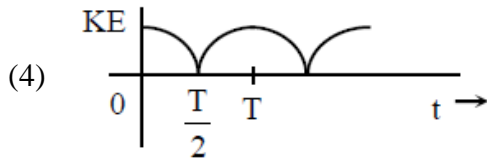
- (1) 180°
- (2) 45°
- (3) 90°
- (4) 135°

52. Which of the following statements is **false**?

- (1) Kirchhoff's second law represents energy conservation.
- (2) Wheatstone bridge is the most sensitive when all the four resistances are of the same order of magnitude.
- (3) In a balanced wheatstone bridge if the cell and the galvanometer are exchanged, the null point is disturbed.
- (4) A rheostat can be used as a potential divider.

53. A particle is executing simple harmonic motion with a time period T . At time $t = 0$, it is at its position of equilibrium. The kinetic energy – time graph of the particle will look like:





54. An observer is moving with half the speed of light towards a stationary microwave source emitting waves at frequency 10 GHz . What is the frequency of the microwave measured by the observer? (speed of light = $3 \times 10^8 \text{ ms}^{-1}$)

(1) 15.3GHz

(2) 10.1GHz

(3) 12.1GHz

(4) 17.3GHz

55. A man grows into a giant such that his linear dimensions increase by a factor of 9 . Assuming that his density remains same, the stress in the leg will change by a factor of:

(1) $\frac{1}{81}$

(2) 9

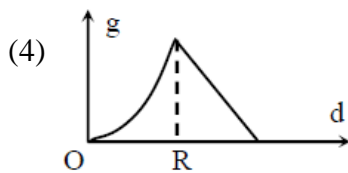
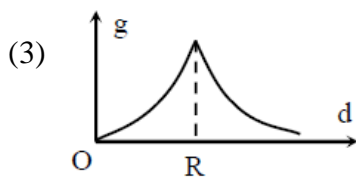
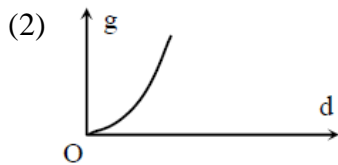
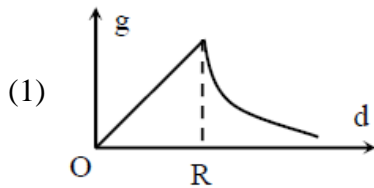
(3) $\frac{1}{9}$

(4) 81

56. When a current of 5 mA is passed through a galvanometer having a coil of resistance 15Ω , it shows full scale deflection. The value of the resistance to be put in series with the galvanometer to convert it into a voltmeter of range $0-10\text{ V}$ is:

- (1) $4.005 \times 10^3 \Omega$
- (2) $1.985 \times 10^3 \Omega$
- (3) $2.045 \times 10^3 \Omega$
- (4) $2.535 \times 10^3 \Omega$

57. The variation of acceleration due to gravity g with distance d from centre of the earth is best represented by ($R = \text{Earth's radius}$):



58. An external pressure P is applied on a cube at 0°C so that it is equally compressed from all sides. K is the bulk modulus of the material of the cube and α is its coefficient of linear expansion. Suppose we want to bring the cube to its original size by heating. The temperature should be raised by:

(1) $3PK\alpha$

(2) $\frac{P}{3\alpha K}$

(3) $\frac{P}{\alpha K}$

(4) $\frac{3\alpha}{PK}$

59. A diverging lens with magnitude of focal length 25 cm is placed at a distance of 15 cm from a converging lens of magnitude of focal length 20 cm. A beam of parallel light falls on the diverging lens. The final image formed is:

(1) real and at a distance of 6 cm from the convergent lens.

(2) real and at a distance of 40 cm from convergent lens.

(3) virtual and at a distance of 40 cm from convergent lens.

(4) real and at a distance of 40 cm from the divergent lens.

60. A body of mass $m = 10^{-2}\text{kg}$ is moving in a medium and experiences a frictional force $F = -kv^2$. Its initial speed is $v_0 = 10\text{ms}^{-1}$. If, after 10 s, its energy is $\frac{1}{8}mv_0^2$, the value of k will be:

(1) $10^{-1}\text{kg m}^{-1}\text{s}^{-1}$

(2) 10^{-3}kg m^{-1}

(3) 10^{-3}kg s^{-1}

(4) 10^{-4}kg m^{-1}