

1991 Hong Kong Advanced Level Examination
AL Physics
Multiple Choice Question

1. In which of the following situations is the magnitude of the normal reaction of the supporting surface, R , equal to the weight of the body, mg ?

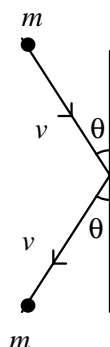
- (1) At rest on a rough inclined plane.
 (2) On the floor of a spacecraft in circular orbit around the earth.
 (3) On the floor of a lift moving upwards with uniform velocity.

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

2. An object of mass m slides with constant acceleration a down a plane making an angle θ with the horizontal. The frictional force acting on the object is

- A. $mg - ma$
 B. $mg - ma \sin \theta$
 C. $mg \sin \theta - ma$
 D. $(mg - ma) \sin \theta$
 E. $(mg + ma) \sin \theta$

- 3.



A gas atom of mass m moving with a uniform speed v makes an elastic collision with the wall of the container as shown in the diagram. What is the magnitude of the change in the momentum of the gas atom?

- A. $2mv$
 B. $mv \sin \theta$
 C. $mv \cos \theta$
 D. $2mv \sin \theta$
 E. $2mv \cos \theta$

4. A spacecraft of mass 4.0×10^4 kg was travelling on its way to the moon with the rocket motors shut down. At the instant when it was travelling at 1500 m/s, the rocket motors were turned on for 5 seconds to make a course correction. If the rocket gave a thrust of 1.0×10^5 N at right angles to the direction of travel, through what angle would the flight path of the spacecraft be turned?

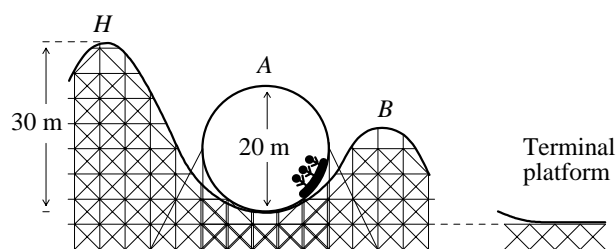
- A. 1.6×10^{-3} rad
 B. 5.7×10^{-3} rad
 C. 8.3×10^{-3} rad
 D. 1.6×10^{-2} rad
 E. 8.3×10^{-2} rad

5. A point mass is attached to the lower end of a light spring fixed at the upper end. The mass is made to oscillate vertically. If the potential energy of the system is taken to be zero when the mass is at its equilibrium position, the speed of the mass at the equilibrium position is directly proportional to the square root of

- (1) the amplitude of oscillation.
 (2) the total energy of the system.
 (3) the maximum potential energy of the system.

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

- 6.



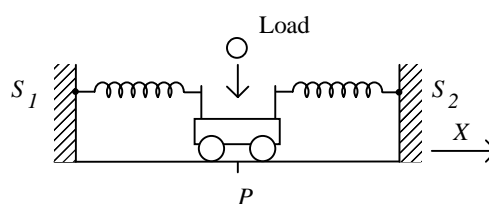
The diagram shows part of the route of a roller-coaster in an amusement park. The cart descends from H , completes a circular loop A and moves to B . If the cart of passengers is to complete the central circular track safely, what is the minimum velocity of the cart at the bottom of the circular track A ? (Assume that there is no friction between the cart and the track.)

- A. 10 m/s
- B. 20 m/s
- C. 22.4 m/s
- D. 24.5 m/s
- E. 30 m/s

7. A piece of iron is suspended from a vertical spring. The iron (but not the spring) is immersed in a jar of water, and oscillates with period T_0 . A vertical sinusoidal force of variable period T is now applied to the iron, using an electromagnet. Which one of the following statements is NOT correct?

- A. When the electromagnetic is switched off, the period of the oscillations changes from T to T_0 .
- B. The amplitude of the oscillations increases greatly when T is brought close to T_0 .
- C. For any value of T , the water temperature rises, due to energy transferred from the electromagnet.
- D. If the electromagnetic is switched off, the water gains energy as the amplitude of the oscillations decreases.
- E. For T not close to T_0 , the forced oscillations decrease slowly in amplitude due to damping.

8.



A trolley attached to two fixed supports S_1 and S_2 by identical springs is displaced from the equilibrium position along the direction X and set into oscillation. A load is dropped onto and is retained by the trolley when it passes through its equilibrium position P . Which of the following statements is/are correct?

- (1) Linear momentum in the horizontal direction is conserved just before and after the load lands on the trolley.
- (2) The amplitude of oscillation decreases after the landing of the load.
- (3) The period increases after the landing of the load.

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

9. The turntable of a gramophone rotates at a steady angular speed ω . A record is dropped from rest on the turntable. Initially, the record slips but it undergoes uniform angular acceleration and eventually moves with the same angular speed as the turntable. The turntable turns through an angle θ while the record is slipping on its surface. Find the angular acceleration of the record and the angle which it turns through before it attains the steady speed of the turntable.

Angular acceleration Angle

- A. $\omega^2/(2\theta)$ $\theta/2$
- B. $\omega^2/(2\theta)$ θ
- C. $\omega^2/(2\theta)$ 2θ
- D. ω^2/θ $\theta/2$
- E. ω^2/θ θ

10. Which of the following properties of molecules of an ideal gas is/are the same on the moon as on the earth, if the temperature and volume of the gas are unchanged?

- (1) The average momentum change when a molecule of the gas rebounds from a wall of the container.
- (2) The average kinetic energy of a molecule of the gas.
- (3) The weight of a molecule of the gas.

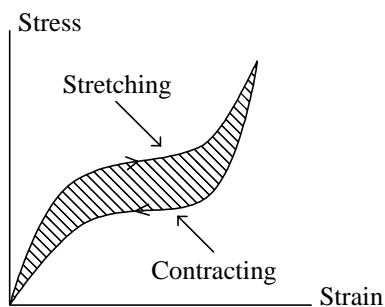
- A. (1), (2) and (3)
- B. (1) and (2) only
- C. (2) and (3) only
- D. (1) only
- E. (3) only

11. The breaking stress of a steel wire is 5.0×10^8 N/m². If the steel wire is replaced by a similar piece which is twice as long, which of the following statements is/are true?

- (1) The extension when the longer wire breaks is the same as for the shorter wire.
- (2) The work done in stretching the longer wire to the breaking point is the same as for the shorter wire.
- (3) The stress needed to break the longer wire is 5.0×10^8 N/m².

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

12.

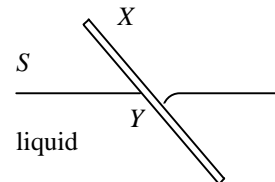


A suspended fibre was stretched by an increasing load attached to the bottom end. Then it was allowed to contract by slowly reducing the load. A stress-strain graph was obtained as shown. Which one of the following conclusions may be deduced from the graph?

- (1) All the work done in stretching the fibre is converted into potential energy.
- (2) More work is done in stretching than is recovered in contracting.
- (3) The temperature of the fibre rises after it has been stretched and allowed to contract for a few times.

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

13. A glass plate X is placed at an angle to a liquid so that the surface S appears to be a plane at Y as shown.

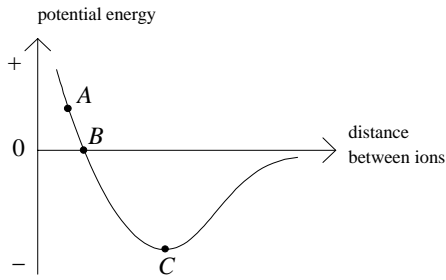


Which of the following statements is/are correct?

- (1) The angle of contact between the liquid and the glass is greater than 90° .
- (2) The cohesive force between two molecules of liquid is greater than the adhesive force between a molecule of the liquid and a molecule of the glass.
- (3) When spilt on glass, the liquid would spread over the glass.

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

14. The graph shows how the potential energy of a pair of ions varies with the distance between them.

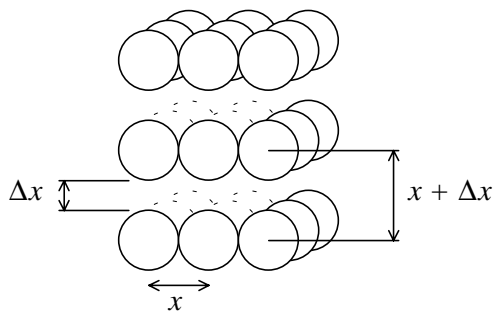


Which of the following arguments about the points *A*, *B* and *C* marked on the graph is/are correct?

- (1) From *A* to *B* the potential energy falls with distance, so here the net force between the ions must be pushing them apart.
- (2) At *C* the potential energy curve is a minimum, so a supply of energy is needed either to increase or decrease the distance between ions.
- (3) At *B*, the potential energy is zero, so here any repulsive force between the ions must be zero.

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

15.

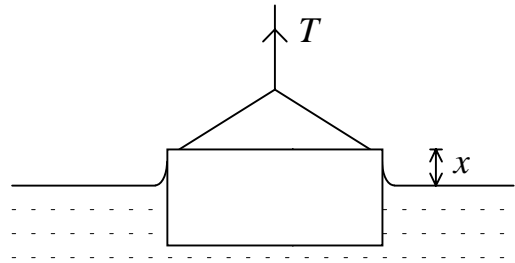


In an idealised atomic model of the material of a wire, each atom is in equilibrium at a distance x from its nearest neighbours, both in its own layer and in the layer above or below. There are n atoms per unit area within each layer. If the force required to increase the separation between two atoms from x to $(x + \Delta x)$ is $(k\Delta x)$, what is the longitudinal stress in the wire?

- A. $\Delta x/x$
 B. $k \Delta x$

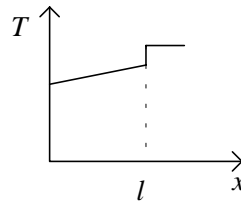
- C. $nk \Delta x/x^2$
 D. $nk \Delta x$
 E. k/x

16.

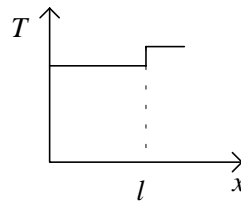


The diagram shows a microscope slide of length l partially immersed in water. As the level of water is gradually lowered, which of the following graphs represents the variation of the tension T in the thread with x ?

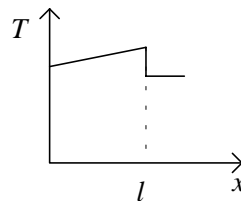
A.



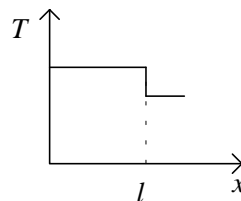
B.



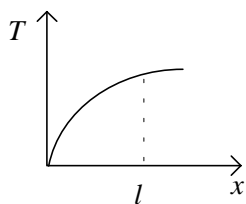
C.



D.



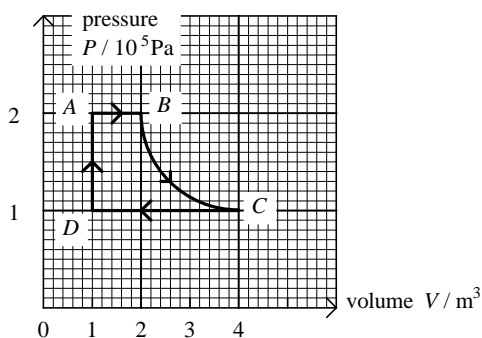
E.



17. A fixed mass of ideal gas at S.T.P. occupies a volume of 2 m^3 . The gas is heated and allowed to expand to a final volume of 4 m^3 with its pressure doubled. The root mean square speed of the gas molecules is

A. reduced to one quarter of its value.
 B. halved.
 C. unchanged.
 D. doubled.
 E. increased four times.

18. An ideal gas is taken through the series of changes shown.



Which of the following statements is/are correct?

- (1) No net work is done by the gas in completing one cycle.
 (2) The work done by the gas during the change AB is equal to that done on the gas during the change CD .
 (3) The gas has the same temperature at B and at C .

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

19. Which of the following statements about an experiment showing the Brownian motion with smoke particles in air is/are correct?

- (1) The motion is caused by collisions between air molecules and smoke particles.
 (2) The experiment makes it possible to see the motion of the air molecules.
 (3) The motion is irregular because air is a mixture of gases, and the molecules have different masses.

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

20. Orange light of wavelength 600 nm (in air) is incident normally from air onto a liquid film whose refractive index is 1.25 . For what minimum value of film thickness will the greatest amount of light be transmitted through the film?

A. 120 nm
 B. 180 nm
 C. 240 nm
 D. 300 nm
 E. 480 nm

21. In experiment with optical diffraction gratings, the $\frac{\text{grating spacing}}{\text{wavelength of light}}$ is of the order of

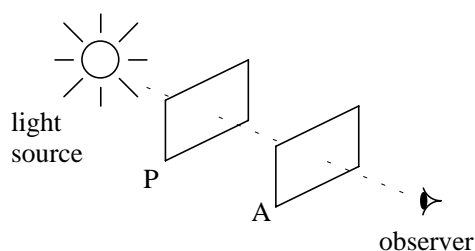
A. 10^{-6}
 B. 10^{-3}
 C. 1
 D. 10^3
 E. 10^6

22. In an arrangement for viewing Newton's rings, if the lens which rests on a glass plate were moved slowly upwards by one wavelength (of the viewing light), which of the following would be observed?

A. The central spot becomes bright.
 B. The rings disappear.
 C. The rings move towards the centre.
 D. The rings move out from the centre.

E. The rings are no longer concentric.

23.



Light from an unpolarised source is allowed to fall on a piece of polaroid P and then on a second polaroid A . In the position shown in the diagram, the intensity of the light emerging from polaroid A is a maximum. As A is slowly rotated, the intensity of light emerging is reduced to half the maximum value at angle θ_1 and to a minimum at angle θ_2 .

Which of the following gives the correct values of angles θ_1 and θ_2 ?

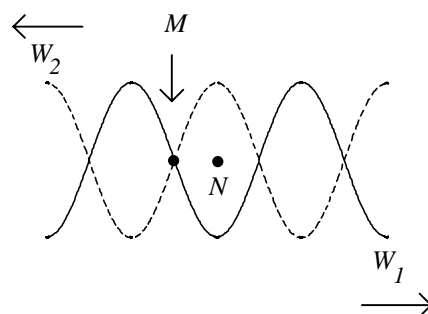
	θ_1	θ_2
A.	30°	90°
B.	45°	90°
C.	45°	180°
D.	60°	90°
E.	60°	180°

24. When a diffraction grating is replaced by another with more lines per mm, which of the following quantities is/are increased?

- (1) the angle of diffraction for every spectral line
- (2) the angle separation of red and blue lines in the first order spectrum
- (3) the number of orders which can be observed

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

25.



Two trains of travelling waves W_1 and W_2 , of the same amplitude, wavelength and speed move in opposite directions. The period of both of the waves is T and their amplitude is A . At time $t = t_1$, the waves W_1 and W_2 are as shown in the figure above. Which of the following statements is/are correct?

- (1) The wavelength of the waves is four times the distance MN .
- (2) At time $t = t_1 + T/4$, the displacement at point M is $2A$.
- (3) Point N is a displacement node.

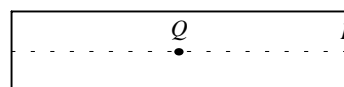
- A. (1), (2) and (3)
- B. (1) and (2) only
- C. (2) and (3) only
- D. (1) only
- E. (3) only

26. Ultrasonic waves are used instead of audible sound waves to measure the depth of the sea because

- (1) ultrasonic waves will not be interfered with by other sound waves in the water.
- (2) ultrasonic waves can penetrate a greater depth of water with less spreading-out of waves.
- (3) small-sized objects can also be located.

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

27.



A stationary sound wave vibrating in its fundamental mode is set up in a tube closed at one end. P and Q are two points at the end and the middle of the tube along its axis. Neglecting end-correction, what is the phase difference between the vibrations of the air molecules at points P and Q ?

- A. 0
- B. $\frac{1}{4} \pi$ radian
- C. $\frac{1}{2} \pi$ radian
- D. π radian
- E. $1 \frac{1}{4} \pi$ radians

28. A simple two-convex lens refracting telescope has a magnifying power of 12.5 when the telescope is in normal adjustment. The focal length of the objective is 0.75 m. The separation between the objective and the eye piece is

- A. 0.06 m
- B. 0.69 m
- C. 0.81 m
- D. 1.35 m
- E. 16.7 m

29. A transistor radio produces a sound of intensity level 40 dB at a point 5 m away from it. What is the intensity level in decibels 20 m from the radio, which may be regarded as a point source?

- A. 10 dB
- B. 28 dB
- C. 30 dB
- D. 34 dB
- E. 40 dB

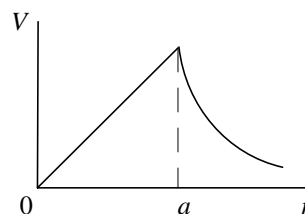
30. The f-number of a certain camera is decreased without changing any other camera controls. How would the image size, image brightness and depth of field be affected?

<u>Image size</u>	<u>Image brightness</u>	<u>Depth of field</u>
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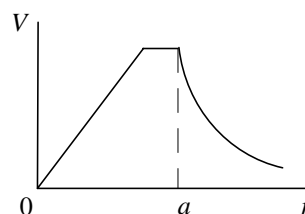
- | | | |
|---------------|-----------|-----------|
| A. decreased | decreased | increased |
| B. decreased | increased | decreased |
| C. increased | increased | decreased |
| D. unaffected | increased | decreased |
| E. unaffected | decreased | increased |

31. Which of the graphs below best represents the variation of electrical potential V with distance r from the centre of a charged hollow metal sphere of external radius a ?

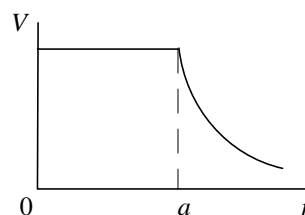
A.



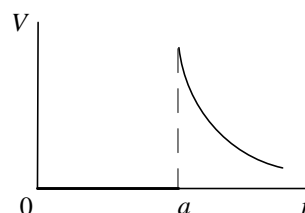
B.



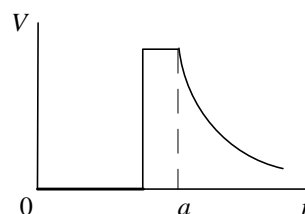
C.



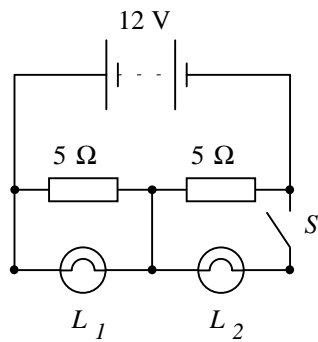
D.



E.



32.

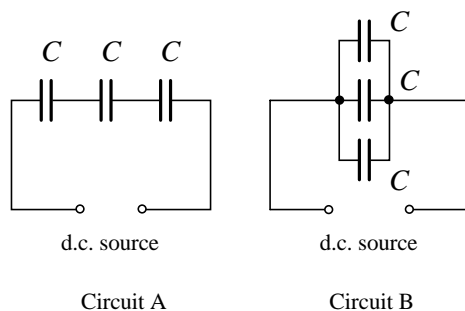


In the circuit shown, filament lamps L_1 and L_2 are identical and are seen to be marked '6V 18 W'. Which of the following statements is/are correct?

- (1) When switch S is closed, lamp L_1 and Lamp L_2 glow with the same brightness.
- (2) When switch S is closed, lamp L_2 glows with its normal brightness.
- (3) When switch S is opened, lamp L_1 glows with its normal brightness.

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

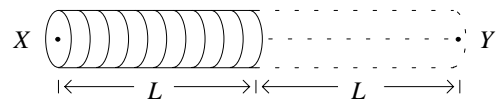
33.



Three identical capacitors are connected to the same d.c. source in series (circuit A) and then in parallel (circuit B). The magnitude of the ratio of the total energies stored by the capacitors in circuit A to circuit B is

- A. $1/9$
- B. $1/3$
- C. 1
- D. 3
- E. 9

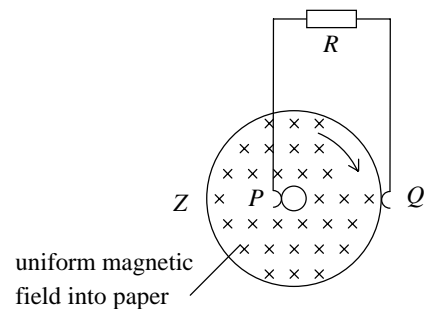
34. The magnetic field due to a steady current in the long air-core solenoid (uniformly wound) shown below is 8×10^{-3} T at X and 1×10^{-3} T at Y .



If an identical solenoid is connected to the end of the first so as to extend it to as far as Y , and the same current as before is passed through the complete solenoid, the magnetic field at Y will then be

- A. 7×10^{-3} T
- B. 8×10^{-3} T
- C. 9×10^{-3} T
- D. 16×10^{-3} T
- E. 17×10^{-3} T

35.



In the above figure, a copper disc rotates uniformly between the pole-pieces of a powerful magnet (not shown in figure) in a clockwise direction. P and Q are metallic brushes making contact with the axle and the edge of the disc respectively. Which of the following statements is correct?

- A. No current flows through R , because there is no flux change through the disc.
- B. No current flows through R because P and Q are at the same horizontal level.
- C. An alternating current flows through R .
- D. A steady current flows from P to Q through R .
- E. A steady current flows from Q to P through R .

36. An additional mechanical load is applied to a rotating motor. Which of the following is/are true?

- (1) The motor will decrease in speed.
- (2) The e.m.f. induced in the rotating coil will decrease.
- (3) More power will be drawn from the power supply.

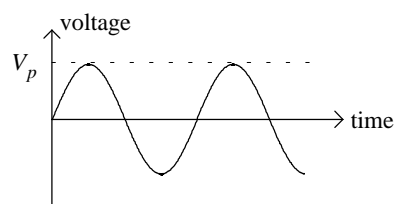
- A. (1), (2) and (3)
- B. (1) and (2) only
- C. (2) and (3) only
- D. (1) only
- E. (3) only

37. It is desired to re-design a moving coil galvanometer so as to make it four times as sensitive. Which of the following would alone achieve the desired result?

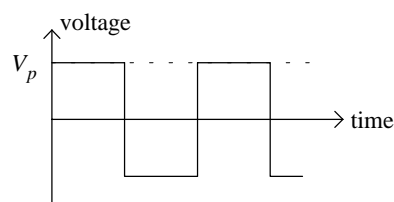
- (1) Increasing the magnetic flux density of the permanent magnet to twice its value and doubling the cross-sectional area of the coil.
- (2) Providing the coil with a shunt so that only a quarter of the input current flows through the coil itself.
- (3) Changing the suspension characteristics so that four times as great a couple is needed to cause one radian twist.

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

38.



(a)

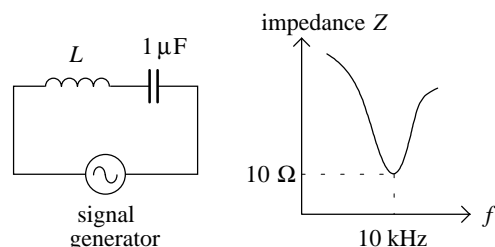


(b)

A signal generator produces either (a) a sinusoidal wave or (b) a square wave with the same peak value of voltage as shown in the diagram. For a pure resistive load, the ratio of the mean power for (a) compared with (b) is

- A. $1/\sqrt{2}$
- B. $\sqrt{2}$
- C. $1/2$
- D. 2
- E. $2\sqrt{2}$

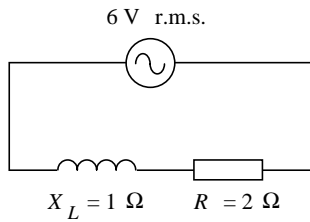
39.



A coil and a capacitor are joined in series to a signal generator as shown in the diagram. As the frequency f of the signal generator is increased, a graph of the total impedance Z of the circuit is plotted against f . If the capacitance of C is $1 \mu\text{F}$, what is the inductance of the coil?

- A. 0.25 mH
- B. 1.6 mH
- C. 2.5 H
- D. 10 H
- E. 16 H

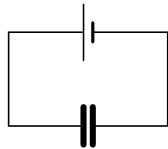
40.



An inductor of reactance 1Ω and a resistor of resistance 2Ω are joined in series to the terminals of a 6 V (r.m.s.) a.c. source as shown. What is the power dissipated in the circuit?

- A. 8 W
- B. 12 W
- C. 14.4 W
- D. 16.1 W
- E. 18 W

41.

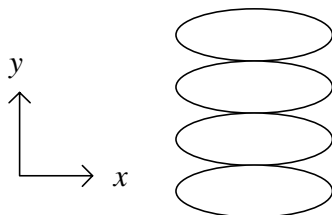


A parallel-plate capacitor is connected to a battery as shown. What will happen if the separation of the plates is increased?

capacitance voltage charge

- A. decreases decreases decreases
- B. decreases unchanged decreases
- C. decreases decreases increases
- D. increases unchanged decreases
- E. increases unchanged increases

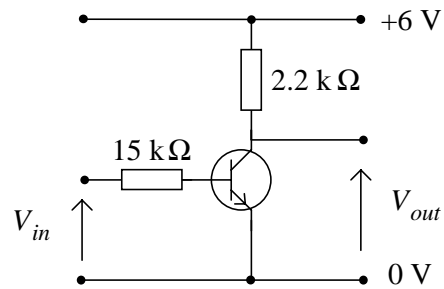
42. A.C. voltages of frequencies f_1 and f_2 were applied to the x-plates and y-plates of a cathode ray oscilloscope, respectively. The resulting observed trace is:



If the frequency of f_1 is 100 Hz , what is the frequency of f_2 ?

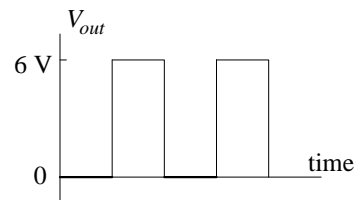
- A. 25 Hz
- B. 50 Hz
- C. 100 Hz
- D. 200 Hz
- E. 400 Hz

43.

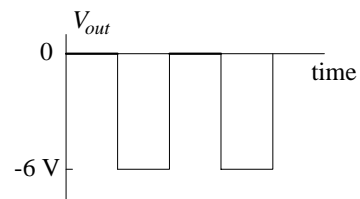


An n-p-n transistor is used in the above circuit as a pulse shaper or a squarer. When a sinusoidal voltage whose magnitude varies between $+2 \text{ V}$ and -2 V is applied to the input, what will be the output voltage?

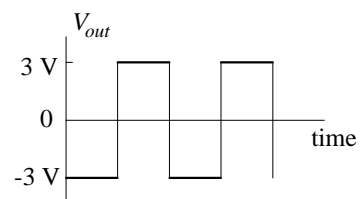
A.



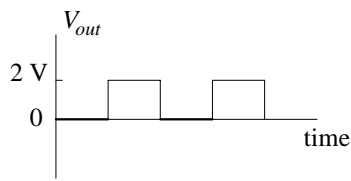
B.



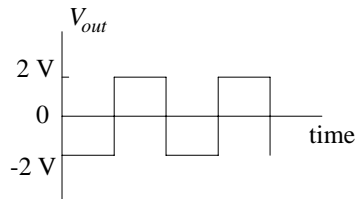
C.



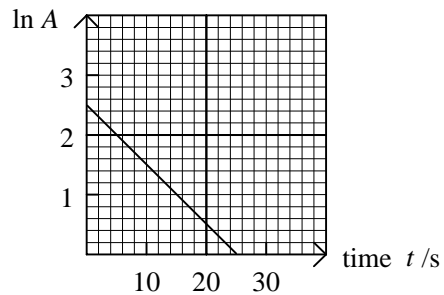
D.



E.



44. A beam of monochromatic light falls on a surface. If the frequency of the light is doubled but the intensity remains unchanged, which of the following statements is/are correct?
- (1) The photon energy is doubled.
 - (2) The momentum of a photon is doubled.
 - (3) The number of photons falling on the surface per second is halved.
- A. (1), (2) and (3)
 - B. (1) and (2) only
 - C. (2) and (3) only
 - D. (1) only
 - E. (3) only
45. In an experiment on the photoelectric effect, a beam of monochromatic light is directed onto a metal plate to liberate electrons. Which of the following statements is true?
- A. The velocity of the fastest electrons is directly proportional to the frequency of the incident light.
 - B. The velocity of the fastest electrons is directly proportional to the intensity of the incident light.
 - C. The kinetic energy of the fastest electrons is directly proportional to the frequency of the incident light.
 - D. The velocity of the fastest electrons is independent of the intensity of the incident light.
 - E. The velocity of the fastest electrons is independent of the type of metal.
46. The minimum wavelength of the X-rays emitted from a hot cathode X-ray tube is controlled by
- (1) the cathode temperature.
 - (2) the nature of the target.
 - (3) the anode-cathode voltage.
- A. (1), (2) and (3)
 - B. (1) and (2) only
 - C. (2) and (3) only
 - D. (1) only
 - E. (3) only
47. Electron transitions occur in an atom resulting in the emission of the following light wavelengths:
- from level *C* to level *A*: 600 nm
 from level *B* to level *A*: 500 nm
- Which of the following statements is/are correct?
- (1) Level *A* has a lower energy than both levels *B* and *C*.
 - (2) Level *C* has a higher energy than level *B*.
 - (3) The wavelength of light emitted for the transition between *C* and *B* is 100 nm.
- A. (1), (2) and (3)
 - B. (1) and (2) only
 - C. (2) and (3) only
 - D. (1) only
 - E. (3) only
48. The graph below shows how the count rate *A* of a radioactive source as measured by a Geiger-counter varies with time *t*:



The relationship between *A* and *t* is

- A. $A = 2.5e^{-10t}$
- B. $A = 12e^{10t}$

C. $A = 2.5e^{-0.1t}$

D. $A = 12e^{-0.1t}$

E. $A = 12e^{0.1t}$

(Assume $\ln 12 = 2.5$)

49. Which of the following statements concerning a moderator in a nuclear fission reactor is/are correct?

- (1) It is used to slow down the neutrons released during fissions.
- (2) It is used to absorb excess neutrons.
- (3) Boron steel is a suitable material.

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

D. (1) only

E. (3) only

50. Which of the following illustrates atomic resonance?

- (1) Electron diffraction
- (2) Photoelectric emission
- (3) Fraunhofer dark lines in the sun's spectrum

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

- End of Paper -

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