Ordinary Thinking

Objective Questions

Gas Laws

1. The temperature of a gas at pressure P and volume V is $27°C$. Keeping its volume constant if its temperature is raised to $927°C$, then its pressure will be [MP PMT 1985]

(a) $2P$ (b) $3P$

(c) $4P$ (d) $6P$

2. 4 moles of an ideal gas is at $0°C$. At constant pressure it is heated to double its volume, then its final temperature will be

(a) $0°C$ (b) $273°C$

(c) $546°C$ (d) $136.5°C$

3. Every gas (real gas) behaves as an ideal gas

[CPMT 1997; RPMT 2000; MP PET 2001]

(a) At high temperature and low pressure

(b) At low temperature and high pressure

(c) At normal temperature and pressure

(d) None of the above

4. Boyle's law holds for an ideal gas during

[AFMC 1994; KCET 1999]

(a) Isobaric changes (b) Isothermal changes

(c) Isochoric changes (d) Isotonic changes

5. S.I. unit of universal gas constant is

[MNR 1988; MP PMT 1994; UPSEAT 1999]

(a) $cal/°C$ (b) J/mol

(c) $J\,mol^{-1}\,K^{-1}$ (d) J/kg

6. Molecules of a gas behave like [J & K CET 2000]

(a) Inelastic rigid sphere

(b) Perfectly elastic non-rigid sphere

(c) Perfectly elastic rigid sphere

(d) Inelastic non-rigid sphere

Ordinary Thinking

Objective Questions

Communication

1. In short wave communication waves of which of the following frequencies will be reflected back by the ionospheric layer, having electron density 10^{11} per *m* [AIIMS 2003]

   (a) 2 *MHz* (b) 10 *MHz*
   (c) 12 *MHz* (d) 18 *MHz*

2. In an amplitude modulated wave for audio frequency of 500 *cycle/second*, the appropriate carrier frequency will be [AMU 1996]

   (a) 50 *cycles/sec* (b) 100 *cycles/sec*
   (c) 500 *cycles/sec* (d) 50,000 *cycles/sec*

3. AM is used for broadcasting because

   (a) It is more noise immune than other modulation systems
   (b) It requires less transmitting power compared with other systems
   (c) Its use avoids receiver complexity
   (d) No other modulation system can provide the necessary bandwidth faithful transmission

4. Range of frequencies allotted for commercial FM radio broadcast is

   (a) 88 to 108 *MHz* (b) 88 to 108 *kHz*
   (c) 8 to 88 *MHz* (d) 88 to 108 *GHz*

5. The velocity factor of a transmission line *x*. If dielectric constant of the medium is 2.6, the value of *x* is [AFMC 1995]

   (a) 0.26 (b) 0.62
   (c) 2.6 (d) 6.2

6. The process of superimposing signal frequency (*i.e.* audio wave) on the carrier wave is known as [AIIMS 1987]

   (a) Transmission (b) Reception
   (c) Modulation (d) Detection

7. Long distance short-wave radio broadcasting uses [AFMC 1996]

   (a) Ground wave (b) Ionospheric wave
   (c) Direct wave (d) Sky wave

8. A step index fibre has a relative refractive index of 0.88%. What is the critical angle at the corecladding interface [Manipal 2003]

   (a) 60° (b) 75°
   (c) 45° (d) None of these

9. The characteristic impedance of a coaxial cable is of the order of

   (a) 50 Ω (b) 200 Ω
   (c) 270 Ω (d) None of these

10. In which frequency range, space waves are normally propagated

    (a) HF (b) VHF
    (c) UHF (d) SHF

11. If μ_1 and μ_2 are the refractive indices of the materials of core and cladding of an optical fibre, then the loss of light due to its leakage can be minimised by having [BVP 2003]

    (a) $\mu_1 > \mu_2$ (b) $\mu_1 < \mu_2$
    (c) $\mu_1 = \mu_2$ (d) None of these

12. Through which mode of propagation, the radio waves can be sent from one place to another [JIPMER 2003]

    (a) Ground wave propagation
    (b) Sky wave propagation
    (c) Space wave propagation
    (d) All of them

13. A laser beam of pulse power 10^{12} *watt* is focussed on an object are 10^{-4} cm^2. The energy flux in $watt/cm^2$ at the point of focus is

    (a) 10^{20} (b) 10^{16}
    (c) 10^{8} (d) 10^{4}

14. The carrier frequency generated by a tank circuit containing 1 *nF* capacitor and 10 μH inductor is [AFMC 2003]

    (a) 1592 *Hz* (b) 1592 *MHz*
    (c) 1592 *kHz* (d) 159.2 *Hz*

15. Broadcasting antennas are generally [AFMC 2003]

    (a) Omnidirectional type (b) Vertical type
    (c) Horizontal type (d) None of these

16. For television broadcasting, the frequency employed is normally

    (a) 30-300 *MHz* (b) 30-300 *GHz*
    (c) 30-300 *KHz* (d) 30-300 *Hz*

17. The radio waves of frequency 300 *MHz* to 3000 *MHz* belong to [MNR 1997]

    (a) High frequency band
    (b) Very high frequency band
    (c) Ultra high frequency band
    (d) Super high frequency band

18. An antenna behaves as resonant circuit only when its length is

    (a) $\frac{\lambda}{2}$
    (b) $\frac{\lambda}{4}$
    (c) λ
    (d) $\frac{\lambda}{2}$ or integral multiple of $\frac{\lambda}{2}$

19. Maximum useable frequency (MUF) in *F*-region layer is *x*, when the critical frequency is 60 *MHz* and the angle of incidence is 70°. Then *x* is [Himachal PMT 2003]

    (a) 150 *MHz* (b) 170 *MHz*
    (c) 175 *MHz* (d) 190 *MHz*

20. The electromagnetic waves of frequency 2 *MHz* to 30 *MHz* are [CPMT 2003]

    (a) In ground wave propagation
    (b) In sky wave propagation
    (c) In microwave propagation
    (d) In satellite communication

21. A laser is a coherent source because it contains [JIPMER 2003] [EAMCET 2002]

    (a) Many wavelengths
    (b) Uncoordinated wave of a particular wavelength

(c) Coordinated wave of many wavelengths

(d) Coordinated waves of a particular wavelength

22. The attenuation in optical fibre is mainly due to [AFMC 2003]

(a) Absorption

(b) Scattering

(c) Neither absorption nor scattering

(d) Both (a) and (b)

23. The maximum distance upto which TV transmission from a TV tower of height h can be received is proportional to [AIIMS 2003]

(a) $h^{1/2}$ (b) h

(c) $h^{3/2}$ (d) h^2

24. A laser beam is used for carrying out surgery because it [AIIMS 2003]

(a) Is highly monochromatic (b) Is highly coherent

(c) Is highly directional (d) Can be sharply focussed

25. Laser beams are used to measure long distances because [DCE 2002, 03]

(a) They are monochromatic

(b) They are highly polarised

(c) They are coherent

(d) They have high degree of parallelism

26. An oscillator is producing FM waves of frequency 2 kHz with a variation of 10 kHz. What is the modulating index [DCE 2004]

(a) 0.20 (b) 5.0

(c) 0.67 (d) 1.5

27. The maximum peak to peak voltage of an AM wire is 24 mV and the minimum peak to peak voltage is 8 mV. The modulation factor is

(a) 10% (b) 20%

(c) 25% (d) 50%

28. Sinusoidal carrier voltage of frequency 1.5 MHz and amplitude 50 V is amplitude modulated by sinusoidal voltage of frequency 10 kHz producing 50% modulation. The lower and upper side-band frequencies in kHz are

(a) 1490, 1510 (b) 1510, 1490

(c) $\frac{1}{1490}, \frac{1}{1510}$ (d) $\frac{1}{1510}, \frac{1}{1490}$

29. What is the modulation index of an over modulated wave

(a) 1 (b) Zero

(c) < 1 (d) > 1

30. Basically, the product modulator is

(a) An amplifier (b) A mixer

(c) A frequency separator (d) A phase separator

31. If f_a and f_f represent the carrier wave frequencies for amplitude and frequency modulations respectively, then

(a) $f_a > f_f$ (b) $f_a < f_f$

(c) $f_a \approx f_f$ (d) $f_a \geq f_f$

32. Which of the following is the disadvantage of FM over AM

(a) Larger band width requirement

(b) Larger noise

(c) Higher modulation power

(d) Low efficiency

33. If a number of sine waves with modulation indices n_1, n_2, n_3 .... modulate a carrier wave, then total modulation index (n) of the wave is

(a) $n_1 + n_2 .... + 2(n_1 + n_2.....)$

(b) $\sqrt{n_1 - n_2 + n_3..........}$

(c) $\sqrt{n_1^2 + n_2^2 + n_3^2.........}$

(d) None of these

34. An AM wave has 1800 $watt$ of total power content, For 100% modulation the carrier should have power content equal to

(a) 1000 $watt$ (b) 1200 $watt$

(c) 1500 $watt$ (d) 1600 $watt$

35. The frequency of a FM transmitter without signal input is called

(a) Lower side band frequency

(b) Upper side band frequency

(c) Resting frequency

(d) None of these

36. What type of modulation is employed in India for radio transmission

(a) Amplitude modulation (b) Frequency modulation

(c) Pulse modulation (d) None of these

37. When the modulating frequency is doubled, the modulation index is halved and the modulating voltage remains constant, the modulation system is

(a) Amplitude modulation (b) Phase modulation

(c) Frequency modulation (d) All of the above

38. An antenna is a device

(a) That converts electromagnetic energy into radio frequency signal

(b) That converts radio frequency signal into electromagnetic energy

(c) That converts guided electromagnetic waves into free space electromagnetic waves and vice-versa

(d) None of these

39. While tuning in a certain broadcast station with a receiver, we are actually

(a) Varying the local oscillator frequency

(b) Varying the frequency of the radio signal to be picked up

(c) Tuning the antenna

(d) None of these

40. Indicate which one of the following system is digital

(a) Pulse position modulation

(b) Pulse code modulation

(c) Pulse width modulation

(d) Pulse amplitude modulation

41. In a communication system, noise is most likely to affect the signal

(a) At the transmitter

(b) In the channel or in the transmission line

(c) In the information source

(d) At the receiver

42. The waves used in telecommunication are

(a) IR (b) UV

(c) Microwave (d) Cosmic rays

43. In an FM system a 7 *kHz* signal modulates 108 *MHz* carrier so that frequency deviation is 50 *kHz*. The carrier swing is

(a) 7.143 (b) 8

(c) 0.71 (d) 350

44. Consider telecommunication through optical fibres. Which of the following statements is not true [AIEEE 2003]

(a) Optical fibres may have homogeneous core with a suitable cladding

(b) Optical fibres can be of graded refractive index

(c) Optical fibres are subject to electromagnetic interference from outside

(d) Optical fibres have extremely low transmission loss

45. The phenomenon by which light travels in an optical fibres is

(a) Reflection (b) Refraction

(c) Total internal reflection (d) Transmission

46. Television signals on earth cannot be received at distances greater than 100 *km* from the transmission station. The reason behind this is that [DCE 1995]

(a) The receiver antenna is unable to detect the signal at a distance greater than 100 *km*

(b) The TV programme consists of both audio and video signals

(c) The TV signals are less powerful than radio signals

(d) The surface of earth is curved like a sphere

47. Advantage of optical fibre [DCE 2005]

(a) High bandwidth and EM interference

(b) Low bandwidth and EM interference

(c) High band width, low transmission capacity and no EM interference

(d) High bandwidth, high data transmission capacity and no EM interference

48. In frequency modulation [Kerala PMT 2005]

(a) The amplitude of modulated wave varies as frequency of carrier wave

(b) The frequency of modulated wave varies as amplitude of modulating wave

(c) The amplitude of modulated wave varies as amplitude of carrier wave

(d) The frequency of modulated wave varies as frequency of modulating wave

(e) The frequency of modulated wave varies as frequency of carrier wave

49. Audio signal cannot be transmitted because

[Kerala PMT 2005]

(a) The signal has more noise

(b) The signal cannot be amplified for distance communication

(c) The transmitting antenna length is very small to design

(d) The transmitting antenna length is very large and impracticable

(e) The signal is not a radio signal

50. In which of the following remote sensing technique is not used

(a) Forest density (b) Pollution

(c) Wetland mapping (d) Medical treatment

51. For sky wave propagation of a 10 *MHz* signal, what should be the minimum electron density in ionosphere

[AIIMS 2005]

(a) $\sim 1.2 \times 10^{12}\ m^{-3}$ (b) $\sim 10^{6}\ m^{-3}$

(c) $\sim 10^{14}\ m^{-3}$ (d) $\sim 10^{22}\ m^{-3}$

52. What should be the maximum acceptance angle at the aircore interface of an optical fibre if n_1 and n_2 are the refractive indices of the core and the cladding, respectively

[AIIMS 2005]

(a) $\sin^{-1}(n_2/n_1)$ (b) $\sin^{-1}\sqrt{n_1^2 - n_2^2}$

(c) $\left[\tan^{-1}\dfrac{n_2}{n_1}\right]$ (d) $\left[\tan^{-1}\dfrac{n_1}{n_2}\right]$

[DCE 2001]

Critical Thinking

Objective Questions

1. A sky wave with a frequency 55 *MHz* is incident on *D*-region of earth's atmosphere at 45°. The angle of refraction is (electron density for *D*-region is 400 $electron/cm^3$)

[Haryana PMT 2003]

(a) 60° (b) 45°

(c) 30° (d) 15°

2. In a diode AM-detector, the output circuit consist of $R = 1k\Omega$ and $C = 10\ pF$. A carrier signal of 100 *kHz* is to be detected. Is it good

(a) Yes

(b) No

(c) Information is not sufficient

(d) None of these

3. Consider an optical communication system operating at $\lambda \sim 800\ nm$. Suppose, only 1% of the optical source frequency is the available channel bandwidth for optical communication. How many channels can be accommodated for transmitting audio signals requiring a bandwidth of 8 *kHz*

(a) 4.8×10^{8} (b) 48

(c) 6.2×10^{8} (d) 4.8×10^{5}

4. A photodetector is made from a semiconductor $In_{0.53}Ga_{0.47}As$ with E_g = 0.73 *eV*. What is the maximum wavelength, which it can detect

(a) 1000 *nm* (b) 1703 *nm*

(c) 500 *nm* (d) 173 *nm*

5. A transmitter supplies 9 kW to the aerial when unmodulated. The power radiated when modulated to 40% is

(a) 5 kW (b) 9.72 kW

(c) 10 kW (d) 12 kW

6. The antenna current of an AM transmitter is 8 A when only carrier is sent but increases to 8.96 A when the carrier is sinusoidally modulated. The percentage modulation is

(a) 50% (b) 60%

(c) 65% (d) 71%

7. The total power content of an AM wave is 1500 W. For 100% modulation, the power transmitted by the carrier is

(a) 500 W (b) 700 W

(c) 750 W (d) 1000 W

8. The total power content of an AM wave is 900 W. For 100% modulation, the power transmitted by each side band is

(a) 50 W (b) 100 W

(c) 150 W (d) 200 W

9. The modulation index of an FM carrier having a carrier swing of 200 kHz and a modulating signal 10 kHz is

(a) 5 (b) 10

(c) 20 (d) 25

10. A 500 Hz modulating voltage fed into an FM generator produces a frequency deviation of 2.25 kHz. If amplitude of the voltage is kept constant but frequency is raised to 6 kHz then the new deviation will be

(a) 4.5 kHz (b) 54 kHz

(c) 27 kHz (d) 15 kHz

11. The audio signal used to modulate 60 sin $(2\pi \times 10^6\ t)$ is $15 \sin 300\pi t$. The depth of modulation is

(a) 50% (b) 40%

(c) 25% (d) 15%

12. The bit rate for a signal, which has a sampling rate of 8 kHz and where 16 quantisation levels have been used is

(a) 32000 *bits/sec* (b) 16000 *bits/sec*

(c) 64000 *bits/sec* (d) 72000 *bits/sec*

13. An amplitude modulated wave is modulated to 50%. What is the saving in power if carrier as well as one of the side bands are suppressed

(a) 70% (b) 65.4%

(c) 94.4% (d) 25.5%

14. In AM, the centpercent modulation is achieved when

(a) Carrier amplitude = signal amplitude

(b) Carrier amplitude ≠ signal amplitude

(c) Carrier frequency = signal frequency

(d) Carrier frequency ≠ signal frequency

AR Assertion & Reason

For AIIMS Aspirants

Read the assertion and reason carefully to mark the correct option out of the options given below:

(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of the assertion.
(c) If assertion is true but reason is false.
(d) If the assertion and reason both are false.
(e) If assertion is false but reason is true.

1. Assertion : Diode lasers are used as optical sources in optical communication.

Reason : Diode lasers consume less energy.

[AIIMS 2005]

2. Assertion : Television signals are received through sky-wave propagation.

Reason : The ionosphere reflects electromagnetic waves of frequencies greater than a certain critical frequency. **[AIIMS 2005]**

3. Assertion : In high latitude one sees colourful curtains of light hanging down from high altitudes.

Reason : The high energy charged particles from the sun are deflected to polar regions by the magnetic field of the earth. **[AIIMS 2003]**

4. Assertion : Short wave bands are used for transmission of radio waves to a large distance.

Reason : Short waves are reflected by ionosphere

[AIIMS 1994]

5. Assertion : The electrical conductivity of earth's atmosphere decreases with altitude.

Reason : The high energy particles (*i.e.* γ-rays and cosmic rays) coming from outer space and entering our earth's atmosphere cause ionisation of the atoms of the gases present there and the pressure of gases decreases with increase in altitude.

6. Assertion : The electromagnetic waves of shorter wavelength can travel longer distances on earth's surface than those of longer wavelengths.

Reason : Shorter the wavelength, the larger is the velocity of wave propagation.

7. Assertion : The surface wave propagation is used for medium wave band and for television broadcasting.

Reason : The surface waves travel directly from transmitting antenna to receiver antenna through atmosphere.

8. Assertion : The television broadcasting becomes weaker with increasing distance.

Reason : The power transmitted from TV transmitter varies inversely as the distance of the receiver

9. Assertion : Microwave propagation is better than the sky wave propagation.

Reason : Microwaves have frequencies 100 to 300 GHz, which have very good directional properties.

10. Assertion : Satellite is an ideal platform for remote sensing.

Reason : Satellite in polar orbit can provide global coverage or continuous coverage of the fixed area in geostationary configuration.

11. Assertion : Fax is a modulating and demodulating device.

Reason : It is necessary for exact reproduction of a document.

12. Assertion : A dish antenna is highly directional.

Reason : This is because a dipole antenna is omni directional.

Answers

Communication

1	a	2	d	3	c	4	a	5	b
6	c	7	c	8	d	9	c	10	c
11	a	12	d	13	b	14	c	15	b
16	a	17	c	18	d	19	c	20	b
21	d	22	d	23	a	24	d	25	d
26	b	27	d	28	a	29	d	30	b
31	b	32	a	33	c	34	b	35	c
36	a	37	c	38	c	39	a	40	b
41	b	42	c	43	a	44	c	45	c
46	d	47	d	48	b	49	d	50	d
51	a	52	b						

Critical Thinking Questions

1	b	2	b	3	a	4	b	5	b
6	d	7	d	8	c	9	b	10	b
11	c	12	a	13	c	14	a		

Assertion & Reason

For AIIMS Aspirants

Read the assertion and reason carefully to mark the correct option out of the options given below:

(a) *If both assertion and reason are true and the reason is the correct explanation of the assertion.*
(b) *If both assertion and reason are true but reason is not the correct explanation of the assertion.*
(c) *If assertion is true but reason is false.*
(d) *If the assertion and reason both are false.*
(e) *If assertion is false but reason is true.*

1. Assertion : In pressure-temperature (P-T) phase diagram of water, the slope of the melting curve is found to be negative.
Reason : Ice contracts on melting to water. [AIIMS 2005]

2. Assertion : For gas atom the number of degrees of freedom is 3.
Reason : $\frac{C_P}{C_V}=\gamma$ [AIIMS 2000]

3. Assertion : A gas have a unique value of specific heat.
Reason : Specific heat is defined as the amount of heat required to raise the temperature of unit mass of the substance through unit degree.

4. Assertion : A gas can be liquified at any temperature by increase of pressure alone.
Reason : On increasing pressure the temperature of gas decreases.

5. Assertion : Equal masses of helium and oxygen gases are given equal quantities of heat. There will be a greater rise in the temperature of helium compared to that of oxygen.
Reason : The molecular weight of oxygen is more than the molecular weight of helium.

6. Assertion : Absolute zero is the temperature corresponding to zero energy.
Reason : The temperature at which no molecular motion cease is called absolute zero temperature.

7. Assertion : The ratio of specific heat gas at constant pressure and specific heat at constant volume for a diatomic gas is more than that for a monatomic gas.
Reason : The molecules of a monatomic gas have more degree of freedom than those of a diatomic gas.

8. Assertion : At room temperature, water does not sublimate from water to steam.
Reason : The critical point of water is much above the room temperature.

9. Assertion : Specific heat of a gas at constant pressure (C) is greater than its specific heat at constant volume (C).
Reason : At constant pressure, some heat is spent in expansion of the gas.

10. Assertion : The internal energy of a real gas is function of both, temperature and volume.
Reason : Internal kinetic energy depends on temperature and internal potential energy depends on volume.

11. Assertion : For an ideal gas, at constant temperature, the product of the pressure and volume is constant.
Reason : The mean square velocity of the molecules is inversely proportional to mass. [AIIMS 1998]

12. Assertion : If a gas container in motion is suddenly stopped, the temperature of the gas rises.
Reason : The kinetic energy of ordered mechanical motion is converted in to the kinetic energy of random motion of gas molecules.

13. Assertion : Internal energy of an ideal gas does not depend upon volume of the gas
Reason : Internal energy of ideal gas depends on temperature of gas.

14. Assertion : At low density, variables of gases P, V and T follows the equation $PV=\mu RT$
Reason : At low density real gases are more closely to ideal gases

15. Assertion : Maxwell speed distribution graph is symmetric about most probable speed
Reason : *rms* speed of ideal gas, depends upon it's type (monoatomic, diatomic and polyatomic)

Answers

Gas Laws

1	c	2	b	3	a	4	b	5	c
6	c	7	c	8	c	9	a	10	d
11	a	12	d	13	b	14	d	15	c
16	b	17	c	18	a	19	a	20	d
21	c	22	b	23	a	24	a	25	a
26	a	27	c	28	a	29	c	30	c
31	d	32	c	33	a	34	d	35	a
36	a	37	c	38	a	39	a	40	c
41	d	42	b	43	a	44	c	45	a
46	a	47	d	48	d	49	c	50	d
51	c	52	c	53	c	54	b	55	d
56	c	57	c	58	a	59	d	60	a
61	d	62	c	63	d	64	d	65	c
66	b	67	a	68	d	69	d	70	c
71	c	72	c	73	d	74	b	75	c
76	c	77	c	78	a	79	c	80	c
81	b	82	a	83	c	84	b	85	c
86	d	87	c	88	c	89	b	90	a
91	b	92	a	93	a	94	d	95	a
96	c	97	a	98	a	99	c	100	c

Speed of Gas

1	b	2	a	3	c	4	c	5	a
6	a	7	d	8	d	9	a	10	a
11	c	12	d	13	b	14	c	15	a

16	a	17	a	18	d	19	c	20	a
21	d	22	c	23	c	24	a	25	d
26	a	27	b	28	d	29	a	30	b
31	c	32	b	33	d	34	c	35	a
36	b	37	a	38	c	39	d	40	a
41	d	42	a	43	c	44	b	45	b
46	c	47	c	48	b	49	b	50	a
51	b	52	b	53	b	54	d	55	a
56	a	57	c	58	b	59	d	60	a
61	c	62	b	63	b	64	d	65	a
66	b	67	b	68	a				

Degree of Freedom and Specific Heat

1	a	2	c	3	a	4	a	5	c
6	d	7	c	8	b	9	d	10	d
11	c	12	a	13	b	14	d	15	a
16	a	17	a	18	a	19	b	20	a
21	c	22	b	23	c	24	d	25	b
26	d	27	d	28	a	29	b	30	d
31	a	32	c	33	a	34	c	35	a
36	d	37	a	38	a	39	b	40	c
41	b	42	b	43	b	44	d	45	b
46	c	47	c	48	d				

Pressure and Energy

1	c	2	b	3	c	4	d	5	d
6	d	7	d	8	a	9	a	10	b
11	d	12	c	13	c	14	a	15	d
16	d	17	b	18	b	19	c	20	a
21	c	22	b	23	b	24	c	25	a
26	b	27	d	28	d	29	c	30	d
31	a	32	a	33	c	34	c	35	d
36	c	37	a	38	b	39	ac	40	d
41	d	42	b	43	a	44	a	45	a
46	b	47	a	48	a	49	d	50	a
51	c	52	c	53	d	54	c	55	b
56	c	57	d	58	d	59	c	60	c
61	a	62	c	63	c	64	a		

Critical Thinking Questions

1	d	2	d	3	a	4	b	5	a
6	acd	7	b	8	b	9	cd	10	b
11	b	12	bc	13	d	14	d	15	a
16	c	17	d	18	b	19	d	20	d
21	a	22	c	23	b	24	a	25	c
26	c	27	c	28	c	29	d	30	d
31	d	32	b	33	a	34	a	35	d
36	c	37	c	38	d				

Graphical Questions

1	d	2	b	3	c	4	c	5	c
6	c	7	a	8	b	9	a	10	c
11	b	12	c	13	c	14	a	15	b
16	b	17	a	18	a	19	b	20	c
21	a	22	c	23	b	24	b	25	a

Assertion and Reason

1	a	2	b	3	e	4	d	5	b
6	e	7	d	8	a	9	a	10	a
11	b	12	a	13	b	14	a	15	d

Answers and Solutions

Gas Laws

1. (c) Using Charle's law $\frac{P_1}{P_2} = \frac{T_1}{T_2}$

or $P_2 = \frac{P_1 T_2}{T_1} = \frac{P(273+927)}{(273+27)} = 4P.$

2. (b) $\frac{V_1}{V_2} = \frac{T_1}{T_2} \Rightarrow T_2 = 2 \times T_1 = 2 \times (273+0) = 546K$

$\Rightarrow T_2 = 273 \times 2 = 546K \Rightarrow 273°C \Rightarrow 273°C$

Kinetic Theory of Gases

SET Self Evaluation Test - 13

1. An ideal gas has an initial pressure of 3 pressure units and an initial volume of 4 volume units. The table gives the final pressure and volume of the gas (in those same units) in four, processes. Which processes start and end on the same isotherm

(a) A
(b) B
(c) C
(d) D

	A	B	C	D
P	5	4	12	6
V	7	6	1	3

2. Suppose ideal gas equation follows VP^3 = constant. Initial temperature and volume of the gas are T and V respectively. If gas expand to $27V$ then its temperature will be come

(a) T (b) $9T$
(c) $27T$ (d) $T/9$

3. One mole of a monoatomic ideal gas is mixed with one mole of a diatomic ideal gas. The molar specific heat of the mixture at constant volume is

(a) 8 (b) $\frac{3}{2}R$
(c) $2R$ (d) $2.5\ R$

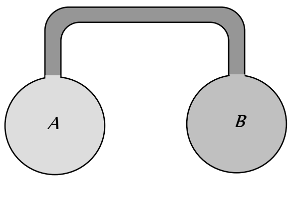
4. When the temperature of a gas is raised from 27°C to 90°C, the percentage increase in the *r.m.s.* velocity of the molecules will be

(a) 10% (b) 15%
(c) 20% (d) 17.5%

5. A gas is enclosed in a closed pot. On keeping this pot in a train moving with high speed, the temperature of the gas

(a) Will increase
(b) Will decrease
(c) Will remain the same
(d) Will change according to the nature of the gas

6. Two spherical vessel of equal volume, are connected by a n arrow tube. The apparatus contains an ideal gas at one atmosphere and 300K. Now if one vessel is immersed in a bath of constant temperature 600K and the other in a bath of constant temperature 300K. Then the common pressure will be



(a) 1 *atm*
(b) $\frac{4}{5}$ *atm*
(c) $\frac{4}{3}$ *atm*
(d) $\frac{3}{4}$ *atm*

7. The *r.m.s.* velocity of a gas at a certain temperature is $\sqrt{2}$ times than that of the oxygen molecules at that temperature. The gas can be

(a) H_2 (b) *He*
(c) CH_4 (d) SO_2

8. At what temperature, the mean kinetic energy of O_2 will be the same for H_2 molecules at – 73°C

(a) 127°C (b) 527°C
(c) – 73°C (d) – 173°C

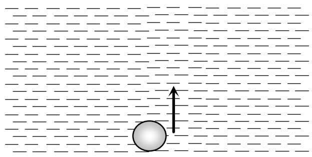
9. The volume of a gas at pressure $21\times10^4\ N/m^2$ and temperature 27°C is 83 *litres*. If R = 8.3 *J/mol/K*, then the quantity of gas in *gm-mole* will be

(a) 15 (b) 42
(c) 7 (d) 14

10. The pressure and temperature of an ideal gas in a closed vessel are 720 *kPa* and 40°C respectively. If $\frac{1}{4}$ th of the gas is released from the vessel and the temperature of the remaining gas is raised to 353°C, the final pressure of the gas is **[EAMCET (Med.) 2000]**

(a) 1440 *kPa* (b) 1080 *kPa*
(c) 720 *kPa* (d) 540 *kPa*

11. An air bubble doubles its radius on raising from the bottom of water reservoir to be the surface of water in it. If the atmospheric pressure is equal to 10 m of water, the height of water in the reservoir is **[EAMCET Med.1999]**



(a) 10 m
(b) 20 m
(c) 70 m
(d) 80 m

12. If the *r.m.s.* velocity of a gas at a given temperature (Kelvin scale) is 300 *m/sec*. What will be the *r.m.s.* velocity of a gas having twice the molecular weight and half the temperature on Kelvin scale =

(a) 300 *m/sec* (b) 600 *m/sec*
(c) 75 *m/sec* (d) 150 *m/sec*

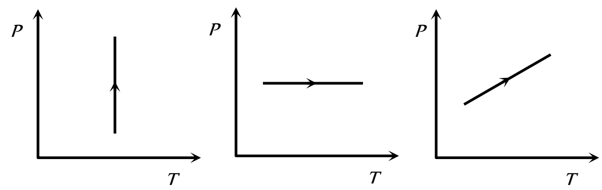
13. The ratio of two specific heats $\frac{C_P}{C_V}$ of CO is

(a) 1.33 (b) 1.40
(c) 1.29 (d) 1.66

14. The energy of a *gas/litre* is 300 joules, then its pressure will be

(a) $3\times10^5\ N/m^2$ (b) $6\times10^5\ N/m^2$
(c) $10^5\ N/m^2$ (d) $2\times10^5\ N/m^2$

15. Pressure versus temperature graphs of an ideal gas are as shown in figure. Choose the wrong statement



(i) (ii) (iii)

(a) Density of gas is increasing in graph (i)
(b) Density of gas is decreasing in graph (ii)
(c) Density of gas is constant in graph (iii)
(d) None of these

16. If pressure of CO_2 (real gas) in a container is given by $P = \dfrac{RT}{2V-b} - \dfrac{a}{4b^2}$ then mass of the gas in container is

(a) 11 *gm* (b) 22 *gm*

(c) 33 *gm* (d) 44 *gm*

17. A cylinder of fixed capacity 44.8 *litre.* contains a monatomic gas at standard temperature and pressure. The amount of heat required to cylinder by 10°*C* will be.

(*R*= universal gas constant)

(a) *R* (b) 10*R*

(c) 20*R* (d) 30*R*

18. A pressure cooker contains air at 1 *atm* and 30°*C*. If the safety value of the cooler blows when the inside pressure ≥ 3 *atm*, then the maximum temperature of the air, inside the cooker can be

(a) 90°*C* (b) 636°*C*

(c) 909°*C* (d) 363°*C*

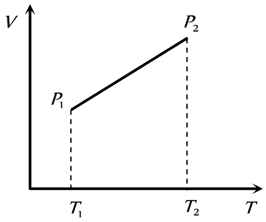
19. One mole of an ideal monatomic gas requires 210 *J* heat to raise the temperature by 10 *K*, when heated at constant temperature. If the same gas is heated at constant volume to raise the temperature by 10 *K* then heat required is

[Pb. PET 2000]

(a) 238 *J* (b) 126 *J*

(c) 210 *J* (d) 350 *J*

20. From the following *V-T* diagram we can conclude



(a) $P_1 = P_2$

(b) $P_1 > P_2$

(c) $P_1 < P_2$

(d) None of these

21. A cylinder contains 10 *kg* of gas at pressure of $10^7\ N/m^2$. The quantity of gas taken out of the cylinder, if final pressure is $2.5 \times 10^6\ N/m^2$, will be (Temperature of gas is constant)

[EAMCET 1998; Pb. PMT 1999; 2003; DPMT 199, 2003]

(a) 15.2 *kg* (b) 3.7 *kg*

(c) Zero (d) 7.5 *kg*

22. Certain amount of an ideal gas are contained in a closed vessel. The vessel is moving with a constant velocity *v*. The molecular mass of gas is *M*. The rise in temperature of the gas when the vessel is suddenly stopped is $(\gamma = C_P / C_V)$

(a) $\dfrac{Mv^2}{2R(\gamma+1)}$ (b) $\dfrac{Mv^2(\gamma-1)}{2R}$

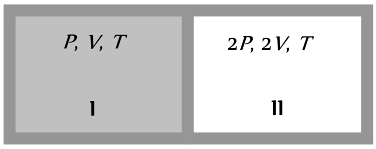
(c) $\dfrac{Mv^2}{2R(\gamma+1)}$ (d) $\dfrac{Mv^2}{2R(\gamma+1)}$

23. Air is filled at 60°*C* in a vessel of open mouth. The vessel is heated to a temperature *T* so that 1/4th part of air escapes. Assuming the volume of the vessel remaining constant, the value of *T* is

(a) 80°*C* (b) 444°*C*

(c) 333°*C* (d) 171°*C*

24. A partition divides a container having insulated walls into two compartments I and II. the same gas fills the two compartments. The ratio of the number of molecules in compartments I and II is



(a) 1 : 6

(b) 6 : 1

(c) 4 : 1

(d) 1 : 4

25. Considering the gases to be ideal, the value of $\gamma = \dfrac{C_P}{C_V}$ for a gaseous mixture consisting of = 3 moles of carbon dioxide and 2 moles of oxygen will be $(\gamma_{O_2} = 1.4,\ \gamma_{CO_2} = 1.3)$

[UPSEAT 2000; Pb. PET 2004]

(a) 1.37 (b) 1.34

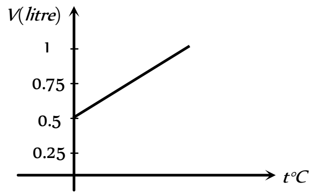
(c) 1.55 (d) 1.63

26. A jar has a mixture of hydrogen and oxygen gas in the ratio of 1 : 5. The ratio of mean kinetic energies of hydrogen and oxygen molecules is [CPMT 1977]

(a) 1 : 16 (b) 1 : 4

(c) 1 : 5 (d) 1 : 1

27. Graph between volume and temperature for a gas is shown in figure. If α = volume coefficient of gas = $\dfrac{1}{273}$ *per* °*C*, then what is the volume of gas at a temperature of 819°*C*



(a) $1 \times 10^{-3}\ m^3$

(b) $2 \times 10^{-3}\ m^3$

(c) $3 \times 10^{-3}\ m^3$

(d) $4 \times 10^{-3}\ m^3$

Answers and Solutions

(SET -13)

1. (c) For same isotherm ; $T \to$ constant

$\therefore\ P \propto \dfrac{1}{V} \Rightarrow P_1V_1 = P_2V_2$

2. (b) VP^3 = constant = $k \Rightarrow P = \dfrac{k}{V^{1/3}}$

Also $PV = \mu RT \Rightarrow \dfrac{k}{V^{1/3}}.V = \mu RT \Rightarrow V^{2/3} = \dfrac{\mu RT}{k}$

Hence $\left(\dfrac{V_1}{V_2}\right)^{2/3} = \dfrac{T_1}{T_2} \Rightarrow \left(\dfrac{V}{27V}\right)^{2/3} = \dfrac{T}{T_2} \Rightarrow T_2 = 9T$

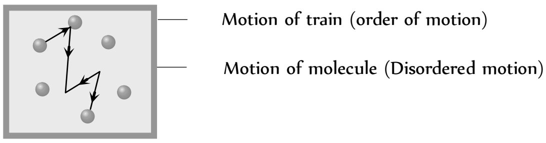
3. (c) $(C_V)_{mix} = \dfrac{\mu_1 C_{V_1} + \mu_2 C_{V_2}}{\mu_1 + \mu_2} = \dfrac{1 \times \frac{3}{2}R + 1 \times \frac{5}{2}R}{1+1} = 2R$

$\left((C_V)_{mono} = \dfrac{3}{2}R,\ (C_V)_{di} = \dfrac{5}{2}R\right)$

4. (a) $v_{rms} = \sqrt{\frac{3RT}{M}} \Rightarrow \frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}} = \sqrt{\frac{(273+90)}{(273+30)}} = 1.1$

% increase $= \left(\frac{v_2}{v_1} - 1\right) \times 100 = 0.1 \times 100 = 10\%$

5. (c) Temperature of the gas is concerned only with it's disordered motion. It is no way concerned with it's ordered motion.



6. (c) $\mu = \mu_1 + \mu_2$

$$\frac{P(2V)}{RT_1} = \frac{P'v}{RT_1} + \frac{P'V}{RT_2} \Rightarrow \frac{2P}{RT_1} = \frac{P'}{R}\left[\frac{T_2 + T_1}{T_1 T_2}\right]$$

$$P' = \frac{2PT_2}{(T_1 + T_2)} = \frac{2 \times 1 \times 600}{(300 + 600)} = \frac{4}{3} atm$$

7. (c) $v_{rms} \propto \frac{1}{\sqrt{M}} \Rightarrow \frac{v_1}{v_2} = \sqrt{\frac{M_2}{M_1}}$

$\therefore \frac{1}{\sqrt{2}} = \sqrt{\frac{M_2}{32}} \Rightarrow M_2 = 16$. Hence the gas is CH_4.

8. (c) Mean kinetic energy of molecule depends upon temperature only. For O_2 it is same as that of H_2 at the same temperature of $-73°C$.

9. (c) $PV = \mu RT \Rightarrow \mu = \frac{PV}{RT} = \frac{21 \times 10^4 \times 83 \times 10^{-3}}{8.3 \times 300} = 7$

10. (b) $P_1 = 720 kpa,\ T_1 = 40°C = 273 + 40 = 313K$

$P \propto mT \Rightarrow \frac{P_2}{P_1} = \frac{m_2}{m_1}\frac{T_2}{T_1} = \frac{3}{4} \times \frac{626}{313} = 1.5$

$\Rightarrow P_2 = 1.5P_1 = 1.5 \times 720 = 1080kPa$

11. (c) According to Boyle's law $(P_1V_1)_{\text{bottom}} = (P_2V_2)_{\text{top}}$

$(10 + h) \times \frac{4}{3}\pi r_1^3 = 10 \times \frac{4}{3}\pi r_2^3$ but $r_2 = 2r_1$

$\therefore (10 + h)r_1^3 = 10 \times 8r_1^3 \Rightarrow 10 + h = 80 \ \therefore h = 70m$

12. (d) $v_{rms} = \sqrt{\frac{3RT}{M}} \Rightarrow v_{rms} \propto \sqrt{\frac{T}{M}}$

$\frac{v_2}{v_1} = \sqrt{\frac{M_1}{M_2} \times \frac{T_2}{T_1}} = \sqrt{\frac{1}{2} \times \frac{1}{2}} \Rightarrow v_2 = \frac{v_1}{2} = \frac{300}{2} = 150$m/sec

13. (bc) *Co* is diatomic gas, for diatomic gas

$C_P = \frac{7}{2}R$ and $C_V = \frac{5}{2}R \Rightarrow \gamma_{di} = \frac{C_P}{C_V} = \frac{7R/2}{5R/2} = 1.4$

14. (d) Energy $= 300\ J/litre = 300 \times 10^3\ J/m^3$

$$P = \frac{2}{3}E = \frac{2 \times 300 \times 10^3}{3} = 2 \times 10^5\ N/m^2$$

15. (c) $\rho = \frac{PM}{RT}$

Density ρ remains constant when P/T or volume remains constant.

In graph (i) Pressure is increasing at constant temperature hence volume is decreasing so density is increasing. Graphs (ii) and (iii) volume is increasing hence, density is decreasing. Note that volume would had been constant in case the straight line in graph (iii) had passed through origin.

16. (b) Vander wall's gas equation for μ mole of real gas

$$\left(P + \frac{\mu^2 a}{V^2}\right)(V - \mu b) = \mu RT \Rightarrow P = \frac{\mu RT}{V - \mu b} - \frac{\mu^2 a}{V^2}$$

on comparing the given equation with this standard equation

we get $\mu = \frac{1}{2}$. Hence $\mu = \frac{m}{M} \Rightarrow$ mass of gas

$$m = \mu m = \frac{1}{2} \times 44 = 22gm.$$

17. (d) As we know 1 *mol* of any ideal gas at *STP* occupies a volume of 22.4 *litres*.

Hence number of moles of gas $\mu = \frac{44.8}{22.4} = 2$

Since the volume of cylinder is fixed,

Hence $(\Delta Q)_V = \mu \omega \Delta T$

$= 2 \times \frac{3}{2}R \times 10 = 30R \qquad \left(\because (C_V)_{mono} = \frac{3}{2}R\right)$

18. (b) Since volume is constant,

Hence $\frac{P_1}{P_2} = \frac{T_1}{T_2} \Rightarrow \frac{1}{3} = \frac{(273 + 30)}{T_2}$

$\Rightarrow T_2 = 909K = 636°C$

19. (b) $(\Delta Q)_P = \mu C_P \Delta T$ and $(\Delta Q)_V = \mu C_V \Delta T$

$$\Rightarrow \frac{(\Delta Q)_V}{(\Delta Q)_P} = \frac{C_V}{C_P} = \frac{\frac{3}{2}R}{\frac{5}{2}R} = \frac{3}{5}$$

$$\left[\because (C_V)_{mono} = \frac{3}{2}R, (C_P)_{mono} = \frac{5}{2}R\right]$$

$$\Rightarrow (\Delta Q)_V = \frac{3}{5} \times (\Delta Q)_P = \frac{3}{5} \times 210 = 126\ J$$

20. (b) In case of given graph, *V* and *T* are related as $V = aT - b$, where *a* and *b* are constants.

From ideal gas equation, $PV = \mu RT$

We find $P = \frac{\mu RT}{aT - b} = \frac{\mu R}{a - b/T}$

Since $T_2 > T_1$, therefore $P_2 < P_1$.

21. (d) $PV = mrT \Rightarrow P \propto m \qquad [\because V, r, T \rightarrow \text{constant}]$

$\Rightarrow \frac{m_1}{m_2} = \frac{P_1}{P_2} \Rightarrow \frac{10}{m_2} = \frac{10^7}{2.5 \times 10^6} \Rightarrow m_2 = 2.5\ kg.$

Hence mass of the gas taken out of the cylinder

$$= 10 - 2.5 = 7.5kg.$$

22. (b) If m is the total mass of the gas then its kinetic energy $= \frac{1}{2}mv^2$

When the vessel is suddenly stopped then total kinetic energy will increase the temperature of the gas. Hence

$$\frac{1}{2}mv^2 = \mu C_v \Delta T = \frac{m}{M} C_v \Delta T \qquad [\text{As } C_v = \frac{R}{\gamma - 1}]$$

$$\Rightarrow \frac{m}{M}\frac{R}{\gamma - 1}\Delta T = \frac{1}{2}mv^2 \;\Rightarrow\; \Delta T = \frac{Mv^2(\gamma - 1)}{2R}.$$

23. (d) For open mouth vessel, pressure is constant.
Volume is also given constant

Hence from $PV = \mu RT = \left(\frac{m}{M}\right)RT \Rightarrow T \propto \frac{1}{m} \Rightarrow \frac{T_1}{T_2} = \frac{m_2}{m_1}$

$\because$ $\frac{1}{4}th$ part escapes, so remaining mass in the vessel

$$m_2 = \frac{3}{4}m_1 \Rightarrow \frac{(273+60)}{T} = \frac{3/4\, m_1}{m_1}$$

$\Rightarrow T = 444K = 171°C$

24. (d) $n = \frac{PV}{kT}$ Now, $n' = \frac{(2P)(2V)}{kT} = 4\frac{PV}{kT} = 4n$ or $\frac{n}{n'} = \frac{1}{4}$.

25. (b) $$\gamma_{\text{mix}} = \frac{\frac{\mu_1\gamma_1}{\gamma_1 - 1} + \frac{\mu_2\gamma_2}{\gamma_2 - 1}}{\frac{\mu_1}{\gamma_1 - 1} + \frac{\mu_2}{\gamma_2 - 1}} = \frac{\frac{3\times 1.3}{(1.3-1)} + \frac{2\times 1.4}{(1.4-1)}}{\frac{3}{(1.3-1)} + \frac{2}{(1.4-1)}} = 1.33$$

26. (d) In mixture gases will acquire thermal equilibrium (*i.e.*, same temperature) so their kinetic energies will also be same.

27. (b) $V_t = V_0(1 + \alpha t) = 0.5\left(1 + \frac{1}{273}\times 819\right) = 2$ *litre* $= 2\times 10^{-3}\ m^3$