

- Which of the following is a dimensional constant ?
 (a) Refractive index
 (b) Dielectric constant
 (c) Relative density
 (d) Gravitational constant
- A bullet of mass 10 g is fired from a gun of mass 1 kg with recoil velocity of gun is 5 m/s. The muzzle velocity will be
 (a) 30 km/min (b) 60 km/min
 (c) 30 m/s (d) 500 m/s
- Work done by air when it expands from 50 L to 150 L at a constant pressure of 2 atmosphere is
 (a) 2×10^4 J (b) 2×10^2 J
 (c) 2×10^{11} J (d) 2×10^{15} J
- The moment of inertia of a cube will be minimum about an axis which
 (a) is an edge of the cube
 (b) is a face diagonal
 (c) joins mid points of opposite faces
 (d) is a body diagonal
- If earth suddenly shrinks to half of its present radius, the acceleration due to gravity will be
 (a) 4g (b) 2g
 (c) $g/2$ (d) $g/4$
- In a cyclic process, change in internal energy of a system over one complete cycle is
 (a) positive (b) zero
 (c) negative (d) cannot say
- The work done by the string of a simple pendulum during one complete oscillation is equal to
 (a) total energy of the pendulum
 (b) kinetic energy of the pendulum
 (c) potential energy of the pendulum
 (d) zero
- The velocity of sound in air at NTP is 330 m/s. What will be its value when temperature is doubled and pressure is halved?
 (a) 330 m/s (b) 165 m/s
 (c) $330\sqrt{3}$ m/s (d) $330\sqrt{2}$ m/s
- The heat produced by 1500 W heater in 14 min when used is
 (a) 3.0 kcal (b) 30.0 kcal
 (c) 300 kcal (d) 3000 kcal
- If two streams of protons move parallel to each other in the same direction, than these
 (a) do not exert any force on one another
 (b) repel each other
 (c) attract each other
 (d) get rotated to be perpendicular to each other
- Two isolated point poles of strength 30 A-m and 60 A-m are placed at a distance of 0.3 m. The force of repulsion is
 (a) 2×10^{-3} N
 (b) 2×10^{-4} N
 (c) 2×10^5 N
 (d) 2×10^{-5} N
- In an LCR circuit having $L = 8$ H, $C = 0.5 \mu\text{F}$ and $R = 100 \Omega$ in series, the resonance frequency in rad/s is
 (a) 600 (b) 200
 (c) $250/\pi$ (d) 500
- A slit of width 12×10^{-7} m is illuminated by light of wavelength 6000 \AA . The angular width of the central maximum is approximately
 (a) 30° (b) 60°
 (c) 90° (d) 0°
- Power of a lens is -4D and for second lens, power is $+2\text{D}$; the total power for the couple is
 (a) -2D (b) 6D
 (c) -6D (d) -8D

15. In an electron gun, the control grid is given a negative potential, relative to cathode in order to
- accelerate the electrons
 - decrease KE of electrons
 - repel the electrons
 - decelerate the electrons
16. In a triode valve, the cathode, grid and plate potentials are respectively 0, $-2V$ and $80V$. If an electron is emitted from the surface of cathode with kinetic energy $3eV$, then the kinetic energy of electron when it reaches the plate will be
- $80eV$
 - $82eV$
 - $78eV$
 - $83eV$
17. If the temperature scale is changed from Celsius to Fahrenheit, numerical value of specific heat will
- increase
 - decrease
 - remain same
 - cannot say
18. A suction pump at ground level can draw water from a well whose depth of water level is
- more than 40 feet
 - less than 35 feet
 - about 50.8 feet
 - none of the above
19. A raft of wood (density 600 kg/m^3) of mass 120 kg floats in water. How much weight can be put on the raft to make it just sink?
- 120 kg
 - 200 kg
 - 40 kg
 - 80 kg
20. Two gases A and B having the same temperature T , same pressure P and same volume V are mixed. If the mixture is at the same temperature T and occupies a volume V , the pressure of the mixture is
- $2P$
 - P
 - $P/2$
 - $4P$
21. The unit of expression $\mu_0 \epsilon_0$ is
- m/s
 - m^2/s^2
 - s^2/m^2
 - s/m
22. If C and L denote the capacity and inductance, the units of LC is
- $[M^0L^0T^2]$
 - $[M^0L^2T^{-2}]$
 - $[MLT^{-2}]$
 - $[M^0L^0T^0]$
23. If $\vec{a} = 2\hat{i} - 3\hat{j} + \hat{k}$ and $\vec{b} = 3\hat{i} + \hat{j} - 2\hat{k}$, the cosine of angle θ between them is equal to
- $\frac{5}{14}$
 - $\frac{1}{7}$
 - $\frac{3}{14}$
 - $\frac{1}{14}$
24. A coil is wound on a frame of rectangular cross-section. If all the linear dimensions of the frame are increased by a factor of 2 and the number of turns per unit length of the coil remains the same, self-inductance of the coil increases by a factor of
- 4
 - 8
 - 12
 - 16
25. A small metallic ball is charged positively and negatively in a sinusoidal manner at a frequency of 10^6 cps . The maximum charge on the ball is 10^{-6}C . What is the displacement current due to this alternating current?
- 6.28 A
 - 3.4 A
 - $3.75 \times 10^{-4}\text{ A}$
 - 12.56 A
26. A bullet hits and gets embedded in a solid block resting on a horizontal frictionless table. What is conserved?
- Momentum and kinetic energy
 - Momentum alone
 - Kinetic energy alone
 - Neither momentum nor kinetic energy
27. A bullet of mass 50g travelling at 500 m/s penetrates 100 cm into a wooden block. The average force exerted on the block is
- $6.25 \times 10^5\text{ N}$
 - $26.5 \times 10^4\text{ N}$
 - $6.25 \times 10^3\text{ N}$
 - $2.65 \times 10^4\text{ N}$
28. A spherical ball rolls on a table without slipping. Then, the fraction of its total kinetic energy associated with rotation is
- $\frac{2}{5}$
 - $\frac{2}{7}$
 - $\frac{5}{7}$
 - $\frac{3}{5}$
29. If the velocity of projection is increased by 1% (other things remaining constant) the horizontal range will increase by
- 1%
 - 2%
 - 4%
 - 8%
30. If units of force and length are doubled, the unit of energy will become
- half
 - two times
 - four times
 - eight times
31. If x denotes displacement in time t and $x = a \cos t$, then acceleration is

- (a) $a \cos t$ (b) $-a \cos t$
(c) $a \sin t$ (d) $-a \sin t$
32. A stone of mass m is tied to a string of length l and rotated in a circle with a constant speed v . If the string is released the stone flies
(a) radially outward
(b) radially inward
(c) tangentially outward
(d) with an acceleration $\frac{mv^2}{l}$
33. A body is just floating in a liquid (their densities are equal). If the body is slightly pressed down and released, it will
(a) start oscillating
(b) sink to the bottom
(c) come back to the same position immediately
(d) come back to the same position slowly
34. Two gases are at absolute temperatures 300K and 350K respectively. The ratio of average kinetic energy of their molecules is
(a) 6 : 7 (b) 36 : 49
(c) 7 : 6 (d) 343 : 216
35. Two charges of 1C and 5C are placed at some distance in air. The ratio of the forces acting on them is
(a) 1 : 25 (b) 1 : 5
(c) 1 : 1 (d) 5 : 1
36. The speed of a projectile u reduces by 50% on reaching maximum height. The range on the horizontal plane is
(a) $\frac{2u^2}{3g}$ (b) $\frac{u^2}{g}$
(c) $\frac{\sqrt{3}u^2}{2g}$ (d) $\frac{3u^2}{g}$
37. It is possible to observe total internal reflection when a ray travels from
(a) air into water (b) air into glass
(c) water into glass (d) glass into water
38. What is the number of equal parts into which a conductor having a resistance $R_0 = 100\Omega$ should be cut to obtain the resistance $R = 1\Omega$, if the parts are connected in parallel?
(a) 5 (b) 10
(c) 20 (d) 2
39. In which one of the following regions of the electromagnetic spectrum will the vibrational motion of molecules give rise to absorption?
(a) Ultraviolet (b) Microwave
(c) Infrared (d) Radio wave
40. The current in a coil changes from 0 to 2 A in 0.05s. If the induced emf is 80V, the self-inductance of the coil is
(a) 1 H (b) 0.5 H
(c) 1.5 H (d) 2 H

Chemistry

1. Mixture of $MgCl_2$ and MgO is called
(a) portland cement (b) sorrel's cement
(c) double salt (d) none of the above
2. The effect of temperature increase on conduction is as follows
(a) metallic conduction increases, electrolytic conduction decreases
(b) electrolytic conduction increases, metallic conduction decreases
(c) both metallic and electrolytic conduction decrease
(d) both metallic and electrolytic conduction increase
3. An ideal gas cannot be liquified because
(a) its critical temperature is always above $0^\circ C$
(b) its molecules are relatively smaller in size
(c) it solidifies before becoming a liquid
(d) forces operative between its molecules are negligible
4. The lower electron gain enthalpy of fluorine than that of chlorine is due to
(a) smaller size
(b) smaller nuclear charge
(c) difference in their electronic configurations
(d) its highest reactivity
5. Volume at NTP of 0.22 g of CO_2 is same as that of
(a) 0.01g of hydrogen
(b) 0.085g of NH_3
(c) 320 mg of gaseous SO_2
(d) all of the above
6. Which one of the following is pyrophosphoric acid?
(a) H_3PO_4 (b) $H_4P_2O_7$
(c) $H_4P_2O_5$ (d) H_3PO_4
7. H_2O_2 is always stored in black bottles because
(a) it is highly unstable
(b) its enthalpy of decomposition is high

- (c) it undergoes autoxidation on prolonged standing
(d) none of the above
8. Which of the following has maximum dipole moment?
(a) NCl_3 (b) NBr_3 (c) NH_3 (d) NI_3
9. In the reaction $2\text{NO} + \text{Cl}_2 \longrightarrow 2\text{NOCl}$, it has been found that doubling the concentration of both the reactants increases the rate by a factor of eight but doubling the chlorine concentration alone only doubles the rate. Which of the following statements is incorrect?
(a) The reaction is first order in Cl_2
(b) The reaction is second order in NO
(c) The overall order of reaction is 2
(d) The overall order of reaction is 3
10. Internal energy does not include
(a) vibrational energy
(b) rotational energy
(c) energy arising by gravitational pull
(d) nuclear energy
11. A metal X on heating in nitrogen gas gives Y . Y on treatment with water gives a colourless gas which when passed through CuSO_4 solution gives a blue colour. Y is
(a) $\text{Mg}(\text{NO}_3)_2$ (b) Mg_3N_2
(c) NH_3 (d) MgO
12. Ferrocene is an example of
(a) sandwiched complex
(b) π -bonded complex
(c) a complex in which all the five carbon atoms of cyclopentadiene anion are bonded to the metal
(d) all of the above
13. Which of the following is /are not affected by temperature?
(a) Molarity (b) Molality
(c) Normality (d) None of these
14. The nucleus of an atom is made up of X protons and Y neutrons. For the most stable and abundant nuclei
(a) X and Y both are even
(b) X and Y both are odd
(c) X is even and Y is odd
(d) X is odd and Y is even
15. Which one of the following species has the largest internuclear distance for its ion pair?
(a) NaCl (b) NaBr (c) LiCl (d) KI
16. Which of the following has giant co-valent structure?
(a) NaCl (b) SiO_2 (c) AlCl_3 (d) PbO_2
17. The extraction of which of the following metals involves basemmerisation?
(a) Fe (b) Ag (c) Al (d) Cu
18. A reaction has both ΔH and ΔS negative. The rate of reaction
(a) increases with increase of temperature
(b) increases with decrease of temperature
(c) remains unaffected by change of temperature
(d) cannot be predicted for change in temperature
19. Chlorine acts as a bleaching agent only in presence of
(a) dry air (b) moisture
(c) sunlight (d) pure oxygen
20. Acetic acid reacts separately with the following alcohols. The rate of esterification is highest for
(a) CH_3OH (b) $\text{C}_2\text{H}_5\text{OH}$
(c) $(\text{CH}_3)_2\text{CHOH}$ (d) $(\text{CH}_3)_3\text{COH}$
21. CaCl_2 is preferred to NaCl for clearing ice on roads particularly in very cold countries. This is because
(a) CaCl_2 is less soluble in H_2O than NaCl
(b) CaCl_2 is hygroscopic but NaCl is not
(c) eutectic mixture of $\text{CaCl}_2 / \text{H}_2\text{O}$ freezes at -55°C while that of $\text{NaCl} / \text{H}_2\text{O}$ freezes at -18°C
(d) NaCl makes the road slippery but CaCl_2 does not
22. Helium-oxygen mixture is used by deep sea divers in preference to nitrogen-oxygen mixture because
(a) helium is much less soluble in blood than nitrogen
(b) nitrogen is much less soluble in blood than helium
(c) due to high pressure deep under the sea nitrogen and oxygen react to give poisonous nitric oxide
(d) nitrogen is highly soluble in water
23. An element M has an atomic mass 19 and atomic number 9. Its ion is represented by
(a) M^+ (b) M^{2+} (c) M^- (d) M^{2-}
24. 100 cc of 1.5% solution of urea is found to have an osmotic pressure of 6.0 atm and 100 cc of 3.42% solution of sugar cane is found to have an osmotic pressure of 2.4 atm. If the two solutions are mixed, the osmotic pressure of the resulting solution will be
(a) 8.4 atm (b) 4.2 atm
(c) 16.8 atm (d) 2.1 atm

25. Which of the following is a co-polymer ?
 (a) Buna-S (b) PAN
 (c) Polythene (d) PTFE
26. A sample of diesel has the same knocking characteristics as a 60 mL mixture of cetane and α -methyl naphthalene mixed in 2 : 1 ratio. The cetane number of the diesel sample is
 (a) 60 (b) 40 (c) 66.6 (d) 33.3
27. Phenol reacts with PCl_5 to give mainly
 (a) *p*-chlorophenol
 (b) chlorobenzene
 (c) *o*- and *p*-chlorophenols
 (d) triphenylphosphate
28. Which of the following on heating does not form an anhydride ?
 (a) Oxalic acid (b) Succinic acid
 (c) Glutaric acid (d) Maleic acid
29. The magnetic moment of a transition metal ion is found to be 3.87 BM. The number of unpaired electrons, present in it is
 (a) 2 (b) 3 (c) 4 (d) 5
30. Sterling silver is
 (a) AgNO_3
 (b) Ag_2S
 (c) alloy of 80% Ag + 20% of Cu
 (d) AgCl
31. When applied, the uncertainty principle has significance in case of
 (a) moving train
 (b) spinning cricket ball
 (c) moving α -particle
 (d) all of the above
32. One mole of an anhydrous salt AB dissolves in water with the evolution of 21.0 J mol^{-1} of heat. If the heat of hydration of AB is -29.4 J mol^{-1} , then the heat of dissociation of hydrated salt AB is
 (a) 50.4 J mol^{-1} (b) 8.4 J mol^{-1}
 (c) -50.4 J mol^{-1} (d) -8.4 J mol^{-1}
33. A certain compound gives negative test with ninhydrin and positive test with Benedict's solution. The compound is
 (a) a protein (b) a monosaccharide
 (c) a lipid (d) an amino acid
34. In a transition series, as the atomic number increases paramagnetism
 (a) increases gradually
 (b) decreases gradually
 (c) first increases to a maximum and then decreases
 (d) first decreases to a minimum and then increases
35. Which of the following reagents would you prefer to find out whether the hydrocarbon C_3H_4 contains one-triple bond or two-double bonds ?
 (a) Fehling's solution
 (b) Ammoniacal AgNO_3 or CuCl solution
 (c) Baeyer's reagent
 (d) $\text{Br}_2 / \text{CCl}_4$
36. Natural rubber and gutta-percha respectively are
 (a) *cis*-polyisoprene and *trans*-polyisoprene
 (b) both are *cis*-polyisoprene
 (c) both are *trans*-polyisoprene
 (d) *trans*-polychloroprene and *cis*-polychloroprene
37. A dextro-rotatory optically active alkyl halide undergoes hydrolysis by $\text{S}_{\text{N}}2$ mechanism. The resulting alcohol is
 (a) dextrorotatory
 (b) laevorotatory
 (c) optically inactive due to racemization
 (d) may be dextro or laevorotatory
38. Which of the following reagents can be used to prepare benzaldehyde from toluene ?
 (a) CrO_3 in $(\text{CH}_3\text{CO})_2\text{O}$
 (b) $\text{K}_2\text{Cr}_2\text{O}_7 + \text{conc. H}_2\text{SO}_4$
 (c) Hot alkaline KMnO_4
 (d) Conc. HNO_3
39. Distinguishing reagent between silver and lead salts is
 (a) H_2S gas
 (b) dil. HCl solution
 (c) NH_4Cl (solid) + NH_4OH solution
 (d) NH_4Cl (solid) + $(\text{NH}_4)_2\text{CO}_3$ solution
40. In the set of the given reactions, acetic acid yielded a product 'C'
- $$\text{CH}_3\text{COOH} + \text{PCl}_5 \longrightarrow \text{A} \xrightarrow[\text{anhy. AlCl}_3]{\text{C}_6\text{H}_6} \text{B} \xrightarrow[\text{ether}]{\text{C}_2\text{H}_5\text{MgBr}} \text{C}$$
- The product 'C' would be
 (a) $\text{CH}_3\text{CH}(\text{OH})\text{C}_2\text{H}_5$
 (b) $\text{CH}_3\text{COC}_6\text{H}_5$
 (c) $\text{CH}_3\text{CH}(\text{OH})\text{C}_6\text{H}_5$
 (d) $\text{CH}_3 - \overset{\text{C}_2\text{H}_5}{\underset{|}{\text{C}}(\text{OH})} - \text{C}_6\text{H}_5$

- Red algae are able to grow deep in sea as
 - they can trap blue light of short wavelength in deep layer of water
 - they have phycoerythrin to trap blue green light in deep layer of water
 - both (a) and (b)
 - none of the above
- Source of carrageenin, a gel like phycocolloid used in bakery, jams, jellies, soups and clarification of beer, is obtained from a red alga which is
 - Chondrus*
 - Porphyra*
 - Gracilaria*
 - Ulva*
- At the base of seta of capsule of moss, there is a haploid brownish growth known as
 - calyptra
 - vaginula
 - perigonium
 - perichaetial
- Seed habit was first originated in
 - ferns
 - Cycadofilicales*
 - gymnosperm
 - mosses
- In sea anemone, the symmetry is
 - radial
 - spherical
 - bilateral
 - absent
- Infective stage of *Ascaris* is
 - adult worm
 - second juvenile
 - fourth juvenile
 - egg
- Which of the following eats its prey?
 - Leech
 - Sepia*
 - Starfish
 - Both (b) and (c)
- Membranous bag with hydrolytic enzymes which is used for controlling intracellular digestion of macromolecules is
 - endoplasmic reticulum
 - nucleosome
 - lysosome
 - phagosome
- Inner mitochondrial membrane possesses enzyme
 - ATP-synthetase, succinate dehydrogenase and respiratory chain enzymes
 - NADH-cytochrome reductase and monomeric oxidase
 - Malate and isocitrate dehydrogenases, fumarate, aconitase and citrate synthetase.
 - Adenyrate kinase and nucleoside diphosphokinase.
- The stage at which cleavage or cytokinesis begins in animal cell is
 - anaphase
 - telophase
 - interphase
 - G₀ phase
- Shape of chromosomes can be best studied during
 - prophase
 - metaphase
 - anaphase
 - telophase
- The number of pollen grains produced by head inflorescence of Asteraceae (Compositae) having 10 flowers, if each anthers produces 20 pollen grains are
 - 300
 - 500
 - 800
 - 1,000
- Term torus applies to
 - spongy thalamus in lotus
 - swelling in bordered pits
 - both (a) and (b)
 - a condensed petiole
- Bitterness of cucurbits fruit is due to phenols amines and
 - acids in them
 - alkalinity in their pulp
 - occurrence of tetracyclic triterpenes
 - presence of better seeds in them
- Which pair of spiracles are borne dorsolaterally over the tergum instead of pleura?
 - First thoracic
 - Second thoracic
 - First abdominal
 - Second abdominal
- Nephridiopores present over the body of earthworm belongs to
 - integumentary nephridia
 - septal nephridia
 - pharyngeal nephridia
 - peptonephridia
- Which statement is not correct for septal nephridia of *Pheretima posthuma*?
 - These occur in all segments except first fourteen
 - There are enteronephric
 - These are exonephric
 - These have complicated nephrostome

18. The normal type of embryo development in a dicot was studied in
 (a) *Cyperus* (b) *Capsella*
 (c) *Sagittaria* (d) *Opuntia*
19. When one molecule of pyruvic acid is subjected to anaerobic respiration it changed into lactic acid there is a
 (a) loss of 6 ATP (b) loss of 3 ATP
 (c) gain of 2 ATP (d) gain of 3 ATP
20. Ribulose biphosphate carboxylase enzyme catalyses the reaction between
 (a) oxaloacetic acid and acetyly Co A
 (b) CO₂ and ribulose 1, 5, biphosphate
 (c) ribulose biphosphate and phosphoglyceraldehyde
 (d) PGA and dihydroxy acetone phosphate
21. Which one does not contribute to nitrogen availability in the soil ?
 (a) Decay of organic matter
 (b) Electric storms
 (c) *Azotobacter*
 (d) Liming
22. Plants growing on hills show
 (a) higher rates of transpiration
 (b) lower rates of transpiration
 (c) same rate of transpiration as in plants
 (d) lower rate of transpiration provided the stomata are sunken
23. Process of imbibition involves
 (a) adsorption of water
 (b) diffusion of water
 (c) movement of water into imbibant through capillary
 (d) movement of water into imbibant through diffusion as well as capillary action
24. If an angiosperm is kept at compensation point
 (a) it will die after sometime
 (b) its growth will be normal
 (c) its growth will be faster
 (d) its growth will stop, but it will not die
25. What is correct about test tube baby ?
 (a) Fertilisation inside female genital tract and growth in test tube
 (b) Rearing of prematurely born body inside incubator
 (c) Fertilisation outside and gestation inside womb of mother
 (d) Both fertilisation and development are effected outside the female genital tract
26. Biotechnology utilises micro-organism and developed present organism utilizing
 (a) mutation
 (b) recombinant DNA technology
 (c) both (a) and (b)
 (d) none of the above
27. Hay fever is due to
 (a) hepatites (b) allergy
 (c) dengue (d) helper T-cells
28. NMR imaging technique is based on the gyromagnetic property of
 (a) electron (b) proton
 (c) positron (d) neutron
29. If one's own tissue is grafted to another part of the body, it is termed as
 (a) isograft (b) autograft
 (c) allograft (d) xenograft
30. Nobel prize of 1978 for restriction endonuclease technology was given to
 (a) Temin and Baltemore
 (b) Millstein and Kohler
 (c) Arber, Nathans and Smith
 (d) Melley, Khurana and Nirenberg
31. Keratomalacia is deficiency symptom of
 (a) vitamin A
 (b) protein energy malnutrition
 (c) phyloquinone
 (d) nicotinamide
32. Uraemia is an excretory disorder in which
 (a) the tubule of kidney reabsorb urea in large amount
 (b) concentration of urea goes high in the blood because the tubules are not able to remove it from the blood
 (c) urea is produced in excess in the body
 (d) none of the above
33. Which of the following enzyme differentiate osteoclast from osteoblast ?
 (a) Alkaline phosphate
 (b) Acid phosphate
 (c) Deoxyribonuclease
 (d) None of the above
34. Lateral funiculi possess ganglia
 (a) sensory (b) motor
 (c) both (a) and (b) (d) none of these
35. Retina is most sensitive at
 (a) optic disc (b) pephery
 (c) macula lutea (d) fovea centralis

- 36.** Which set is of purely motor nerve ?
- (a) Oculomotor, trochlear, abducens
 - (b) Optic, oculomotor, facial
 - (c) Auditory, optic, trigeminal
 - (d) Facial, trigeminal, glossopharyngeal
- 37.** Over secretion of androgens from adrenal cortex in females is responsible for
- (a) Addison's disease
 - (b) Appearance of masculine characters
 - (c) Parry's disease
 - (d) Increase in their sexual desire
- 38.** F-cells of islets of Langerhans secretes Pancreatic Polypeptide (PP). It
- (a) accelerates the release of pancreatic juice
 - (b) inhibits the release of digestive secretion of the pancreas
 - (c) accelerates the release of insulin
 - (d) inhibits the release of glucagon
- 39.** The perception of sound in a mammal is by stimulation of mechanoreceptors located in
- (a) Reissner's membrane
 - (b) sacculus
 - (c) semicircular canal
 - (d) organ of Corti
- 40.** Fabellae (bones) are associated with
- (a) elbow joint
 - (b) knee joint
 - (c) neck joint
 - (d) angular joint