

1. Two dice are thrown. What is the probability that the sum of the numbers on the two dice is eight?

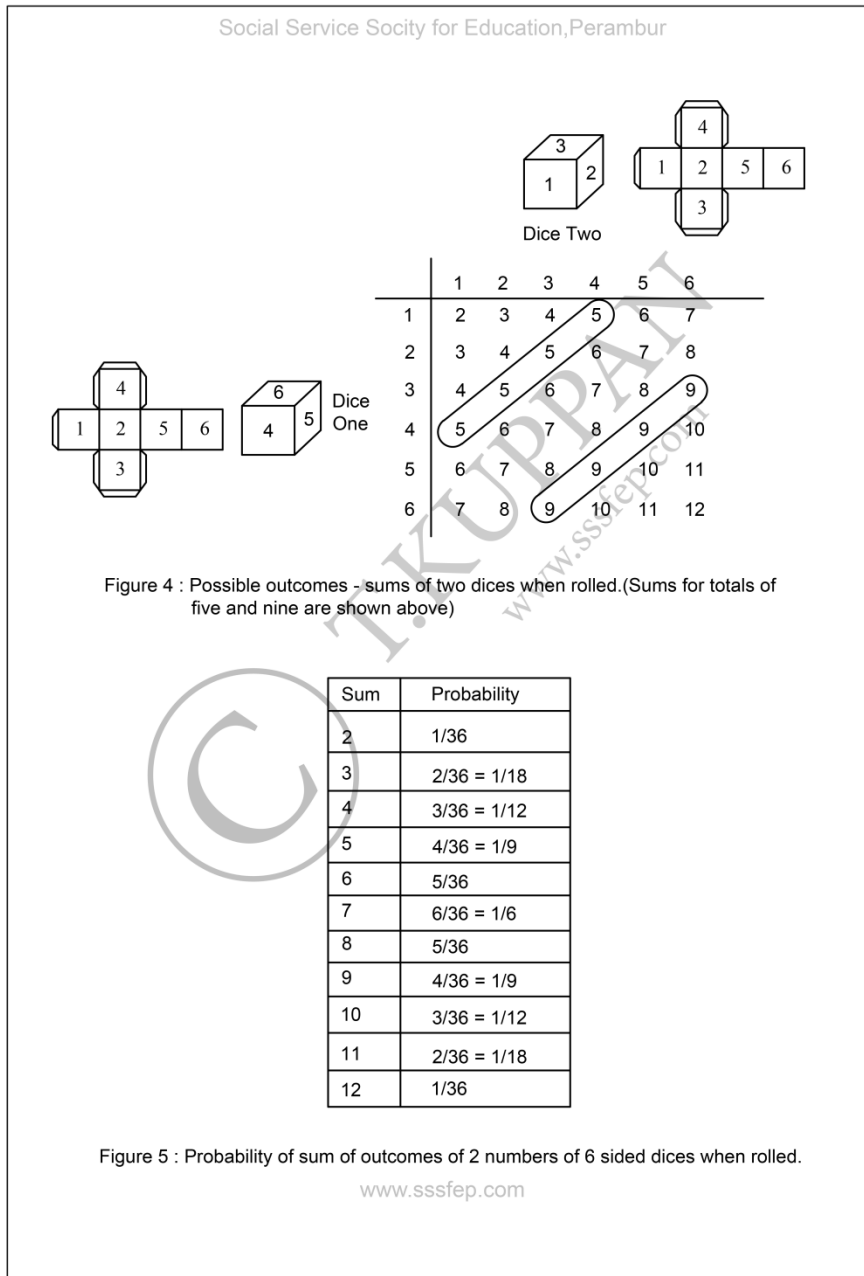
(1) $5/36$

(2) $5/18$

(3) $1/4$

(4) $1/3$

Ans: 1



2. The principles of motion economy are mostly used while conducting

- (1) a method study on an operation
- (2) a time study on an operation
- (3) a financial appraisal of an operation
- (4) a feasibility study of the proposed manufacturing plant

Ans: 1

The **principles of motion economy** form a set of rules and suggestions to improve the manual work in manufacturing and reduce fatigue and unnecessary movements by the worker, which can lead to the reduction in the work related trauma.

The principles of motion economy can be classified into four groups:^{[1][2]}

1. Principles related to the use of *human body*,
2. Principles related to the arrangement of the *work place*,
3. Principles related to the *design of tools and equipment*.
4. Principles related to *time conservation*.

https://en.wikipedia.org/wiki/Principles_of_motion_economy

TIME STUDY

Time study is a structured process of directly observing and measuring human work using a timing device to establish the time required for completion of the work by a qualified worker when working at a defined level of performance.

It follows the basic procedure of systematic work measurement of:

- **analysis** of the work into small, easily-measurable components or elements
- **measurement** of those components and
- **synthesis** from those measured components to arrive at a time for the complete job.

The observer first undertakes preliminary observation of the work (a pilot study) to identify suitable elements which can be clearly recognised on subsequent occasions and are of convenient length for measurement.

<https://www.ims-productivity.com/page.cfm/content/Time-Study/>

3. The standard time of an operation while conducting a time study is

- (1) mean observed time + allowances
- (2) **normal time + allowances**
- (3) mean observed time x rating factor + allowances
- (4) normal time x rating factor + allowances

Ans: 2

4. An item can be purchased for Rs.100. The ordering cost is Rs.200 and the inventory carrying cost is 10 % of the item cost per annum. If the annual demand is 4000 units, the economic order quantity (in units) is

- (1) 50 (2) 100 (3) 200 (4) 400

Ans:4

Basic EOQ Model

The **Objective** of this model is **to minimize total annual cost of purchase** by means of controlling the inventory levels. It is a best ordered quantity where total annual cost is minimum. In basic EOQ model,

Annual carrying or holding cost = Annual ordering cost.

The EOQ is given by:

$$EOQ = \sqrt{\frac{2DC_0}{C_c}}$$

where,

D = Annual demand,

C₀ = Ordering cost per order,

C_c = Carrying cost per unit per year and

C_u = unit cost.

For the given sum,

D = 4000 units/year, C_u = Rs. 100 per unit, C_c = 10% of C_u = 0.1 x 100 = Rs. 10 per unit per year, C₀ = Rs. 200 per order, EOQ = ?

$$\therefore EOQ = \sqrt{\frac{2DC_0}{C_c}} = \sqrt{\frac{2 \times 4000 \times 200}{10}} = 400 \text{ units}$$

5. The minimum number of teeth on the pinion to operate without interference in standard full height involute teeth gear mechanism with 20° pressure angle is

- (1) 14 (2) 12 (3) 18 (4) 32

Ans:3. (Interference occurs when the number of teeth on the smaller of the two meshing gears is less than a required minimum)

In gears, interference takes place when

- 1) the tip of a tooth of a mating gear digs into the portion between base and root circles
- 2) gears do not move smoothly in the absence of lubrication
- 3) pitch of the gears is not same
- 4) gear teeth are undercut.

6. The minimum number of links in a single degree-of-freedom planar mechanism with both higher and lower kinematic pairs is

- (1) 2 (2) 3 (3) 4 (4) 5

Ans:3

From the Kutzbach criterion the degree of freedom,
 $n = 3(l - 1) - 2j - h$

where

l = no. of links

j = no. of binary joints

For single degree of freedom ($n = 1$),

$$1 = 3(l - 1) - 2j - h$$

$$3l - 2j - 4 - h = 0 \dots(i)$$

The simplest possible mechanisms of single degree of freedom is four-bar mechanism. For this mechanism $j = 4$, $h = 0$. From equation (i), we have

$$3l - 2 \times 4 - 4 - 0 = 0$$

or, $l = 4$.

<https://edurev.in/question/458706/The-minimum-number-of-links-in-a-single-degree-of->

The **Chebyshev–Grübler–Kutzbach criterion** determines the number of degrees of freedom of a kinematic chain, that is, a coupling of rigid bodies by means of mechanical constraints. These devices are also called linkages. The Kutzbach criterion is also called the *mobility formula*, because it computes the number of parameters that define the configuration of a linkage from the number of links and joints and the degree of freedom at each joint.

https://en.wikipedia.org/wiki/Chebyshev%E2%80%93Gr%C3%BCbler%E2%80%93Kutzbach_criterion

7. The Coriolis component of acceleration is present in

- (1) 4-bar mechanisms with 4 turning pairs
- (2) **Shaper quick return mechanism**
- (3) slider-crank mechanism
- (4) Scotch Yoke mechanism

Ans:2

Coriolis component of acceleration exists when **there is a sliding motion of a slider which is sliding on a link which itself is rotating**. In the case of the shaper, the quick return mechanism is used which has slider sliding on the rotating link. So the Coriolis component of acceleration exists.

8. The total area under the stress-strain curve of a mild steel specimen tested up to failure under tension is a measure of

- (1) ductility
- (2) ultimate strength
- (3) stiffness
- (4) **toughness**

Ans:4. (Toughness is the ability of a material to absorb energy and plastically deform before fracturing and absorb energy per unit volume calculated by area under the stress-strain curve.)

9. A lead-screw with half nuts in a lathe, free to rotate in both directions has

- (1) V-threads
- (2) Whitworth threads
- (3) Buttress threads
- (4) **ACME threads**

Ans:4

10. The primary purpose of sprue in a casting mould is to

- (1) feed the casting at a rate consistent with the rate of solidification
- (2) act as a reservoir for molten metal
- (3) **feed molten metal from the pouring basin to the gate**
- (4) help feed the casting until all solidification take place

Ans: 3

11. Hot rolling of mild steel is carried out

- (1) at recrystallization temperature
- (2) between 100 C to 150 C

(3) below recrystallization temperature

(4) above recrystallization temperature

Ans: 4

12. Which of the following arc welding processes does **not** use consumable electrodes

(1) GMAW

(2) GTAW

(3) Submerged Arc Welding

(4) none of these

Ans: 2

13. Trepanning is performed for

(1) finishing a drilled hole

(2) Producing a large hole in a sheet without drilling

(3) truing a hole for alignment

(4) enlarging a drilled hole

Ans: 2

14. The hardness of a grinding wheel is determined by the

(1) hardness of abrasive grains

(2) ability of the bond to retain abrasives

(3) hardness of the bond

(4) ability of the grinding wheel to penetrate the work piece

Ans:2

15. If there are m physical quantities and n fundamental dimensions in a particular process, the number of non-dimensional parameters is

(1) $m+n$

(2) mxn

(3) $m-n$

(4) m/n

Ans:3

16. The ratio of Euler's buckling load of column with the same parameters having both ends fixed, and both ends hinged is

(1) 2

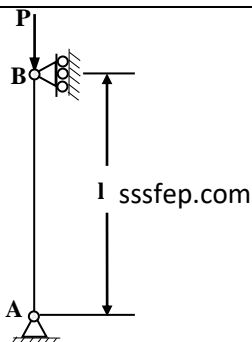
(2) 4

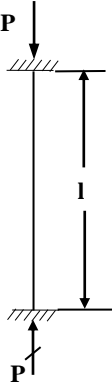
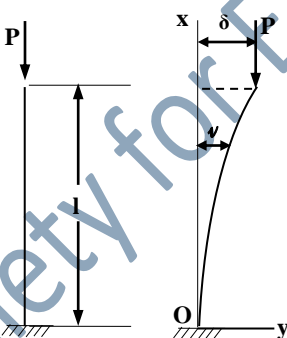
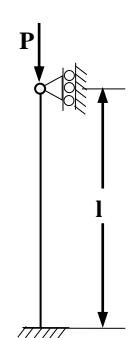
(3) 6

(4) 8

Ans: 2

Case	Diagram	P_{cr}	Equivalent length(l_e)
------	---------	----------	----------------------------



Both ends hinged/pinned		$\frac{\pi^2 EI}{l^2}$	1
Both ends fixed		$\frac{4\pi^2 EI}{l^2}$	1/2
One end fixed & other end free		$\frac{\pi^2 EI}{4l^2}$	2l
One end fixed & other pinned/hinged		$\frac{2\pi^2 EI}{l^2}$	$\frac{1}{\sqrt{2}}$

17. The element which facilitate quick disassembly and reassembly of tool elements in exactly the same relationship is called as

1. keys 2. cotters 3. dowels 4. taper pins

Ans: 3

18. A metal joining method in which the joining-edges are heated and fused together to form a permanent, homogeneous joint is

1. Soldering 2. Brazing 3. **Welding** 4. Riveting

Ans: 3

19. Brazing is carried out at a temperature above of

1. 100°C 2. 350°C 3. **450°C** 4. 750°C

Ans: 3

20. Soldering is carried out at a temperature below/lower of

1. 100°C 2. 250°C 3. 350°C 4. **450°C**

Ans: 4

21. In a lathe, identify the element mounted on the left end of the table and containing a motor for rotating the work piece

1. **Head stock** 2. Foot stock 3. Wheel head 4. Table dogs

Ans: 1

22. The principle of working of the dial test indicator is

1. the linear motion is converted into reciprocating motion using slotted link
 2. **linear motion is converted into rotary motion using rack and pinion**
 3. magnifications of small variation using lenses
 4. magnifications through electronic means

Ans: 2

23. Internal threads can be formed with

1. thread milling cutter 2. reamer
 3. **tap** 4. die

Ans: 3

24. Which one of the following is an alloy of carbon and iron, in which carbon is in a combined state?

1. **Steel** 2. Wrought iron 3. Cast iron 4. Pig iron

Ans: 1

Steel, alloy of iron and carbon in which the carbon content ranges up to 2% (with a higher carbon content, the material is defined as cast iron).

EFFECTS OF CARBON

In its pure form, iron is soft and generally not useful as an engineering material; the principal method of strengthening it and converting it into steel is by adding small amounts of carbon. In solid steel, carbon is generally found in two forms. Either it is in solid solution in austenite and ferrite or it is found as a carbide. The carbide form can be iron carbide (Fe_3C , known as cementite), or it can be a carbide of an alloying element such as titanium. (On the other hand, in gray iron, carbon appears as flakes or clusters of graphite, owing to the presence of silicon, which suppresses carbide formation.)

Wente, Edward F. , Wondris, E.F. and Nutting, Jack. "steel". *Encyclopedia Britannica*, 10 Apr. 2019, <https://www.britannica.com/technology/steel>. Accessed 18 October 2021.

25. Which one of the following instrument is used to check the trueness of the turned tapers?

- | | |
|--------------------|------------------------|
| 1. Vernier caliper | 2. Micrometer |
| 3. Inside caliper | 4. Dial test indicator |

Ans: 4

26. The power factor of a purely resistive circuit is

- | | | | |
|---------|------------|------------|----------|
| 1. Zero | 2. Lagging | 3. Leading | 4. Unity |
|---------|------------|------------|----------|

Ans: 4

27. The centrifugal blower fitted in an air conditioner sucks air

1. from the room which is to be cooled
2. from the atmosphere
3. from the inner body of the cooler
4. from the fan near the condenser

Ans: 2

28. During oxy-acetylene flame-cutting, the metal is cut due to?

- | | |
|---------------------|------------------------|
| 1. Burning of metal | 2. Intensive oxidation |
| 3. Reduction | 4. None of these |

Ans: 2

29. Chromium when added to steel as an alloying element:

- | | |
|-----------------------------|----------------------------------|
| 1. softens steel | 2. improves corrosion resistance |
| 3. improves grain structure | 4. none of these |

Ans: 2

30. Nickel when added to steel as an alloying element:

- | | |
|-----------------------------|----------------------------------|
| 2. softens steel | 2. improves corrosion resistance |
| 4. improves grain structure | 4. improves toughness |

Ans: 2

31. The property of materials by which it can be rolled into sheets is called:

- | | |
|-----------------|---------------|
| 1. plasticity | 2. elasticity |
| 3. malleability | 4. creep |

Ans: 3

32. Systematic appraisal of each job in an organization during workstudy is:

- | | |
|---------------------|-------------------|
| 1. Standardisation | 2. Job evaluation |
| 3. Job satisfaction | 4. Incentive plan |

Ans: 2

33. In isothermal expansion of gases:

- | | |
|---------------------------------|------------------------------|
| 1. Temperature is lowered | 2. Temperature increases |
| 3. Temperature remains constant | 4. Temperature drops to zero |

Ans: 3

34. A 50 CFM compressor can:

- | |
|---|
| 1. Compress 50 cu. feet per min. of free air |
| 2. Delivers 50 cu. feet per min. at delivery pressure |
| 3. Compress 50 cu. feet per min. of air at 100 psi |
| 4. None of these |

Ans: 2

35. Which of the following material is used for manufacture of heavy duty helical springs:

- | | |
|---------------------------|--------------------|
| 1. plain mild steel | 2. stainless steel |
| 3. silico-manganese steel | 4. none of these |

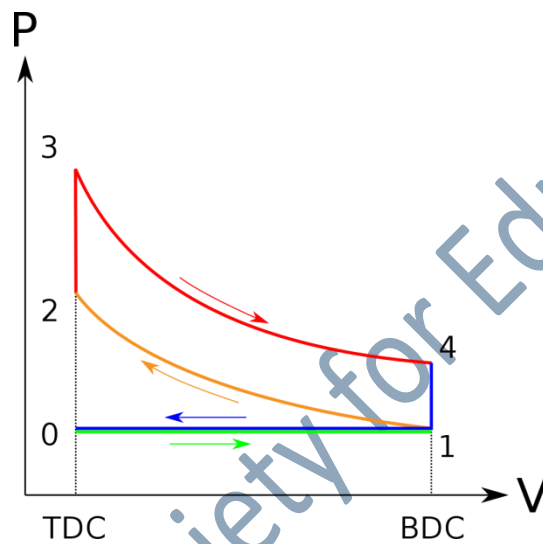
Ans: 3

36. Otto cycle consists of ----- processes:

1. Two isentropics and Two constant volumes
2. Two isentropics and Two constant pressures
3. Two adiabatic and Two isothermal
4. Two isothermal and Two constant pressures

Ans: 1

An **Otto cycle** is an idealized thermodynamic cycle that describes the functioning of a typical spark ignition piston engine.



By Luc1992 - Own work, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=41130463>

https://en.wikipedia.org/wiki/Otto_cycle#/media/File:P-V_Otto_cycle.svg

The processes are described by:

- Process 0–1 a mass of air is drawn into piston/cylinder arrangement at constant pressure.
- Process 1–2 is an adiabatic (isentropic) compression of the charge as the piston moves from bottom dead center (*BDC*) to top dead center (*TDC*).
- Process 2–3 is a constant-volume heat transfer to the working gas from an external source while the piston is at top dead center. This process is intended to represent the ignition of the fuel-air mixture and the subsequent rapid burning.
- Process 3–4 is an adiabatic (isentropic) expansion (power stroke).
- Process 4–1 completes the cycle by a constant-volume process in which heat is rejected from the air while the piston is at bottom dead center.
- Process 1–0 the mass of air is released to the atmosphere in a constant pressure process.

The Otto cycle consists of isentropic compression, heat addition at constant volume, isentropic expansion, and rejection of heat at constant volume. In the case of a four-stroke Otto cycle, technically there are two additional processes: one for the exhaust of waste heat and combustion products at constant pressure (isobaric),

https://en.wikipedia.org/wiki/Otto_cycle

37. Which of the following is a non destructive test?
- | | |
|---------------------|-----------------|
| 1. Izod impact test | 2. Cupping test |
| 2. Charpy test | 4. X-ray test |

Ans: 4 (Options 1-3 are destructive tests)

38. Which process is used for manufacturing Automobile carburetor?
- | | |
|-----------------|----------------|
| 1. Sand casting | 2. Die casting |
| 3. Forging | 4. Extrusion |

Ans: 2

39. PERT stands for
1. Project Estimation Review Techniques
 2. Project Evaluation and Review Techniques
 3. Precise Estimation Results Technique
 4. Project Examination Result Technique

Ans: 2 (Other project management tool is CPM – critical path method)

40. During adiabatic expansion, the increase in volume is associated with:
1. decrease in pressure and temperature but no heat transfer
 2. increase in both pressure and temperature
 3. decrease in pressure and increase in temperature
 4. decrease in temperature and increase in pressure

Ans: 1

41. When strength is the major consideration which of the following process favored?
- | | | | |
|------------|-----------------|------------|------------------|
| 1. Forging | 2. Sand casting | 3. Rolling | 4. None of these |
|------------|-----------------|------------|------------------|

Ans: 1

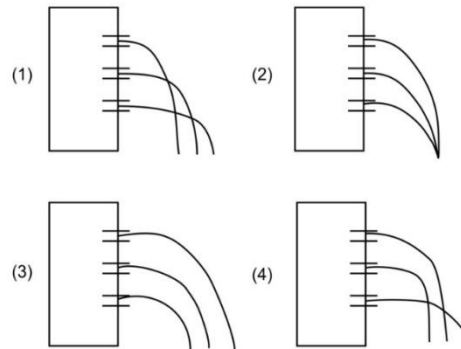
42. Die sinking is a process of:
- | | |
|-------------------|---------------------|
| 1. hardening Dies | 2. scraping of Dies |
|-------------------|---------------------|

3. cutting die impression

4. none of these

Ans: 3 (Diesinking, process of machining a cavity in a steel block to be used for molding plastics, or for hot and cold forging, die-casting, and coining, etc.)

43. Which of the diagrams below represents flow of water a tank with 3 holes in a row :



Ans:1 ($V = \sqrt{2gh}$, for option (1), h drops progressively.

44. CPM is the

- (1) time oriented technique
- (2) event oriented technique
- (3) activity oriented technique
- (4) target oriented technique

Ans:2

The **project evaluation and review technique (PERT)** is a statistical tool used in project management, which was designed to analyze and represent the tasks involved in completing a given project. It incorporates uncertainty by making it possible to schedule a project while not knowing precisely the details and durations of all the activities. It is more of an event-oriented technique rather than start- and completion-oriented, and is used more in those projects where time is the major factor rather than cost. It is applied on very large-scale, one-time, complex, non-routine infrastructure and on Research and Development projects.

PERT and CPM are complementary tools, because "CPM employs one time estimation and one cost estimation for each activity; PERT

https://en.wikipedia.org/wiki/Program_evaluation_and_review_technique

.....
<https://www.geeksforgeeks.org/difference-between-pert-and-cpm/>

PERT is appropriate technique which is used for the projects where the time required or needed to complete different activities are not known. PERT is majorly applied for scheduling, organization and integration of different tasks within a project. It provides the blueprint of project and is efficient technique for project evaluation .

CPM is a technique which is used for the projects where the time needed for completion of project is already known. It is majorly used for determining the approximate time within which a project can be completed. Critical path is the largest path in project management which always provide minimum time taken for completion of project

45. Normalizing operation is carried out in ... and the object is cooled in...

- | | |
|-------------|---------------------------|
| (1) furnace | (2) air |
| (3) water | (4) controlled atmosphere |

Ans:1 and 2.

46. Annealing operation is carried out in ... and the object is cooled in...

- | | |
|-------------|---------------------------|
| (1) furnace | (2) furnace |
| (3) water | (4) controlled atmosphere |

Ans:1 and 2.

47. Crystal structure of metals is studied by:

- | |
|-------------------------------|
| (1) Metallographic techniques |
| (2) X-ray technique |
| (3) Ultrasonic method |
| (4) Electron microscopy |

Ans:2

Crystallography, branch of science that deals with discerning the arrangement and bonding of atoms in crystalline solids and with the geometric structure of crystal lattices. Classically, the optical properties

of crystals were of value in mineralogy and chemistry for the identification of substances. Modern crystallography is largely based on the analysis of the diffraction of X-rays by crystals acting as optical gratings. Using X-ray crystallography, chemists are able to determine the internal structures and bonding arrangements of minerals and molecules, including the structures of large complex molecules, such as proteins and DNA.

Britannica, The Editors of Encyclopaedia. "crystallography". *Encyclopedia Britannica*, 9 May. 2018, <https://www.britannica.com/science/crystallography>. Accessed 7 December 2021.

48. The hardest known material is :

- | | |
|-------------|----------------------|
| (1) ceramic | (2) high speed steel |
| (3) diamond | (4) cemented carbide |

Ans:3

49. Case hardening is not done by

- | | |
|-------------------------|---------------------|
| (1) electroplating | (2) cyaniding |
| (3) induction hardening | (4) flame hardening |

Ans:1

50. Time study is

- (1) The appraisal in terms of time, of the value of work involving human effort
- (2) Machine setting time
- (3) Time taken by workers to do a job
- (4) Method of fixing time for workers

Ans:1