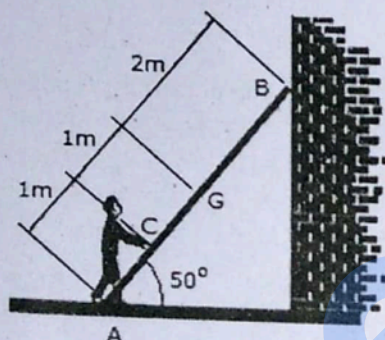


PART II — BASIC ENGINEERING AND SCIENCES

(Common to all candidates)

(Answer ALL questions)

21. A 17-kg ladder has a center of mass at G . If the coefficients of friction at A and B are $\mu_A = 0.3$ and $\mu_B = 0.2$ respectively, determine the smallest horizontal force that the man must exert on the ladder at point C in order to push the ladder forward.

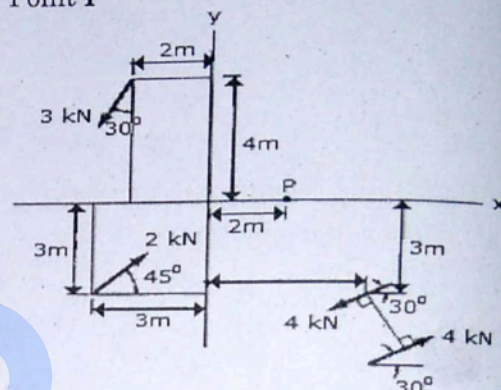


- $F = 120.2 \text{ N}$
- $F = 288 \text{ N}$
- $F = 166.8 \text{ N}$
- $F = 204 \text{ N}$

22. The horizontal range of a projectile (R) is given by

- $R = \frac{u^2 \cos 2a}{g}$
- $R = \frac{u^2 \sin 2a}{g}$
- $R = \frac{u^2 \cos a}{g}$
- $R = \frac{u^2 \sin a}{g}$

23. Replace the force and couple system by an equivalent single force and couple acting at Point P



- $F = (-0.0858 i - 1.184 j) \text{ kN}$,
 $M = 36.6 \text{ kN-m}$
- $F = (-0.0858 i - 1.184 j) \text{ kN}$,
 $M = 21.6 \text{ kN-m}$
- $F = (-0.0858 i - 1.184 j) \text{ kN}$,
 $M = 13.61 \text{ kN-m}$
- $F = (-0.0858 i - 1.184 j) \text{ kN}$,
 $M = 35.7 \text{ kN-m}$

24. The velocity of a body on reaching the ground from a height h , is

- $2\sqrt{gh}$
- $\sqrt{gh}$
- $\sqrt{2gh}$
- $2g \cdot \sqrt{h}$

25. Lami's theorem states that

- Three forces acting at a point will be in equilibrium
- Three forces acting at a point can be represented by a triangle, each side being proportional to force
- If three forces acting upon a particle are represented in magnitude and direction by the sides of a triangle, taken in order, they will be in equilibrium
- If three forces acting at a point are in equilibrium, each force is proportional to the sine of the angle between the other two

26. The state of an ideal gas was changed three times at three different temperatures. The diagram represents three different isothermal curves. Which of the following is true about the temperature of the gas?
- $T_1 > T_2 > T_3$
 - $T_1 > T_2 < T_3$
 - $T_1 < T_2 < T_3$
 - $T_1 = T_2 > T_3$
27. According to kinetic theory of heat
- Temperature should rise during boiling
 - Temperature should fall during freezing
 - At low temperature all bodies are in solid state
 - At absolute zero there is absolutely no vibration of molecules
28. The crystallographic direction $[112]$ in a cubic crystal lies in the following crystallographic plane.
- (110)
 - (111)
 - $(\bar{1}11)$
 - $(11\bar{1})$
29. The intensity of 60 dB sound is
- 1 mW/m^2
 - $6 \mu\text{W/m}^2$
 - $1 \mu\text{W/m}^2$
 - $10 \mu\text{W/m}^2$
30. Stars with a reddish color are _____ than the Sun, whereas stars that have a blue color are _____.
- cooler, hotter
 - hotter, cooler
 - larger, smaller
 - smaller, larger
31. Laser light is intense because
- it has very less number of photons that in phase
 - it has very less number of photons that are not in phase
 - it has very large number of photons that are in phase
 - it has very large number of photons that are not in phase
32. Modal dispersion is greatest in
- multimode graded-index fibres
 - multimode step-index fibres
 - single-mode graded-index fibres
 - single mode step-index fibres
33. In brittle materials, the stress required to propagate a crack is
- proportional to γ , the surface energy
 - proportional to $c^{-1/2}$, where $2c$ is the crack length
 - proportional to $c^{1/2}$
 - more than the ideal fracture stress
34. Most ferrites have
- the diamond structure
 - a layered structure
 - the inverse spinel structure
 - the perovskite structure
35. In Hall-effect measurements, the dependence of Hall voltage (V_H) on the applied magnetic field (B) is
- $V_H \propto B$
 - $V_H \propto B^2$
 - $V_H \propto B^{1/2}$
 - $V_H \propto B^{3/2}$
36. A mercury-water manometer has a gage difference of 0.6 m (difference in the elevation of the menisci). The difference in pressure, measured in metres of water is,
- 0.6
 - 7.56
 - 8.16
 - 7.86
37. The velocity in a 2 cm diameter pipe is 20 m/s. If the pipe enlarges to 5 cm diameter, the velocity, in m/s will be
- 8.0
 - 6.4
 - 3.2
 - 5.2
38. Reciprocating pumps are suitable for
- Low discharge and high head
 - High discharge and low head
 - Low discharge and low head
 - High discharge and high head

39. The boundary layer thickness in turbulent flow varies as
- $X^{1/7}$
 - $X^{1/2}$
 - $X^{4/5}$
 - $X^{3/5}$
40. Dissolved organic solids in wastewater treatment may be removed by
- Coagulation
 - Hypochlorination
 - Reverse osmosis
 - Aeration
41. The purpose of providing dummy coils in a generator is
- To provide mechanical balance for the rotor
 - To reduce eddy current loss
 - To reduce hysteresis loss
 - To increase efficiency of Generator
42. What would happen if a power transformer designed for operation on 50 Hz (frequency) were connected to a 500 Hz (frequency) source of the same voltage?
- Current will be too much high
 - Transformer may start to smoke and burn
 - Eddy Current and Hysteresis loss will be excessive
 - No effect
43. While starting a synchronous motor by induction motor action, field winding is usually
- Connected to DC supply
 - Short circuited by low resistance
 - Kept open circuited
 - None of the above
44. In majority of instruments, damping is provided by
- fluid friction
 - spring
 - eddy currents
 - all of the above
45. The power factor of an alternator depends on
- Load
 - Speed of rotor
 - Core losses
 - Armature losses
46. Find the output of the following code
- ```
#include <stdio.h>
struct point
{
 int x;
 int y;
}
p[] = {1, 2, 3, 4, 5};
void foo(struct point*);
int main()
{
 foo(p);
}
void foo(struct point p[])
{
 printf("%d %d\n", p->x, p[2].y);
}
```
- junk value
  - 10
  - 11
  - 01
47. Find the output of the following code
- ```
#include <stdio.h>
int main()
{
    char n[20];
    fgets(n, 19, stdin);
    ungetc(n[0], stdin);
    scanf("%s", n);
    printf("%s\n", n);
    return 0;
}
```
- compile time error
 - Whatever string user types second time
 - The two characters the user feeds in
 - No output

48. Calling a function func with a an array variable arrVar[3] where arrVar is an array, is equivalent to
- func(arrVar [3])
 - func(*(arrVar + 3))
 - func (3[arrVar])
 - All of the above
49. Find the output of the following code
- ```
#include <stdio.h>
int *m();
void main()
{
 int *k = m();
 printf("hello ");
 printf("%d", k[0]);
}
int *m()
{
 int a[2]={5, 8};
 return a;
}
```
- hello 5
  - hello 5 8
  - hello 8
  - garbage value
50. Consider a hypothetical processor with an instruction of type LW R1, 20(R2), which during execution reads a 32-bit word from memory and stores it in a 32-bit register R1. The effective address of the memory location is obtained by the addition of constant 20 and the contents of register R2. Which of the following best reflects the addressing mode implemented by this instruction for the operand in memory?
- Immediate Addressing
  - Register Addressing
  - Register Indirect Scaled Addressing
  - Base Indexed Addressing
51. In gas chromatography, the concentration of a substance can be determined by
- comparison of the area under the peak produced by the substance with the areas under the peaks produced by standard solutions
  - comparison of the  $R_t$  of the substance with that of a standard
  - calculation of the  $R_t$  value of the substance
  - measurement of the height of the peak produced by the substance
52. Which of the following is not of the first order?
- Inversion of sucrose in the presence of acid
  - Acid catalyzed hydrolysis of ethyl acetate
  - Hydrolysis of tertiary butyl halide using alkali
  - Oxidation of  $I^-$  ion by  $S_2O_8^{2-}$
53. On carrying out the electrolysis of acidified water, the volume of hydrogen liberated at STP condition is 22.4 L. The volume of oxygen liberated is
- 22.4 L
  - 44.8 L
  - 11.2 L
  - 2.24 L
54. Why is the oxygen-hydrogen absorption of  $CH_3OH$  such a broad band in the infrared?
- Rotational energy levels broaden the absorption
  - Hyperconjugation resonance broadens the absorption
  - Resonance broadens the absorption
  - Hydrogen bonding broadens the absorption
55. Softening temperature of coal ash is a measure of the \_\_\_\_\_ of coal.
- size stability
  - clinkering tendency
  - coking tendency
  - caking tendency