

**ENTRANCE EXAMINATION TO
ETHIOPIAN SCIENCE AND TECHNOLOGY UNIVERSITIES
(EEESTU)**

PHYSICS – Code-1

Time Allowed: 45 minutes

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1. In which of the following thermodynamic process the change internal energy of the system is equal to the work done on the system?
- (A) Isothermal $\rightarrow$ (B) Isobaric $\rightarrow$ (C) Adiabatic (D) Isochoric
2. If a heat engine operates between two reservoirs at a temperature of 20°C and 300°C , what is the maximum possible efficiency this engine?
- (A) 49% (B) 50% (C) 0.49% (D) 98%
3. Suppose the position of a particle is given by the expression $x(t) = [3\cos(4\pi t)]\text{m}$, the maximum speed of the particle is:
- (A) 3m/sec (B) 12m/sec (C) $4\pi\text{m/sec}$ (D) $12\pi\text{m/sec}$
4. Which one of the following cannot be taken as a precondition for the occurrence of the interference of waves?
- (A) The sources of the waves must be coherent. ✓
- (B) The wave must be monochromatic. ✓
- (C) The two waves must have maximum intensity.
- (D) The answer is not given.
5. The distance between the screen and double slit is 2m. If the separation of the two slits is $6 \times 10^{-5}\text{m}$ and distance between the central fringe and the forth order bright fringe is 9cm. Determine wave length of the light source.
- (A) $5.63 \times 10^{-6}\text{m}$ (B) $5.63 \times 10^{-9}\text{m}$ (C) $563 \times 10^{-7}\text{m}$ (D) $5.63 \times 10^{-7}\text{m}$

$x + y = 32$
 $\frac{x+y}{x} \times 6 = 48$
 $6x + 6y = 192$
 $6x + 6(32 - x) = 192$
 $6x + 192 - 6x = 192$
 $192 = 192$
 $y = 32 - x$
 $96x - 3x^2 = 15$
 $-3x^2 + 96x - 16 = 0$
 -75

EEESTU 2007/2015

Physics Code-1

6. When a dielectric material is inserted between the plates of a parallel plate capacitor, which one of the following is not true?

- (A) The capacitance will increase.
 (B) The electric field between the plates decreases.
 (C) The charge stored remains constant.
 (D) The potential difference between the plates increases.

$\frac{192}{x} = 0$
 r^2
 $\frac{2 \times 10^{-6}}{x} = \frac{2 \times 10^{-6}}{60 - x}$

7. Two point charges $q_1 = 2 \mu C$ and $q_2 = 8 \mu C$ are placed on the x axis at $x = 0$ cm and $x = 60$ cm respectively. Find the location on the x axis where the resultant electric field is zero.

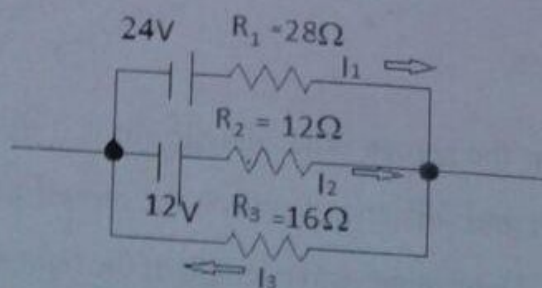
- (A) $x = 20$ cm (B) $x = 30$ cm (C) $x = 60$ cm (D) $x = 40$ cm

8. If the equivalent resistance of two resistors R_1 and R_2 when connected in series 32Ω and connected in parallel 6Ω . What are the values of R_1 and R_2 respectively?

- (A) $16 \Omega, 16 \Omega$ (B) $20 \Omega, 12 \Omega$ (C) $5 \Omega, 27 \Omega$ (D) $8 \Omega, 24 \Omega$

9. For the circuit diagram shown in the figure below, the value of the current in the 28Ω resistor is:

$R_1 + R_2 = 32$
 $R_1 = 32 - R_2$
 $\frac{R_1 + R_2}{R_1 R_2} = 6$
 $\frac{32}{R_1 R_2} = 6$
 $(32 - R_2) + R_2 = 6$
 $32 - R_2 + R_2 = 6$



$\frac{R_1}{x} + \frac{R_2}{60 - x} = 0$

$\frac{R_1}{x} = \frac{R_2}{60 - x}$
 $\frac{2}{x} = \frac{8}{60 - x}$

- (A) 0.64A (B) 0.15A (C) 0.5A (D) 1.28A

$120 - 2x = -8x$
 $120 = -6x$
 $\frac{120}{-6} = \frac{-6x}{-6}$

$\frac{32}{(32 - R_2) R_2} = 6$
 $32 = 6(32 - R_2) R_2$
 $32 = 192 - 6R_2^2$
 $6R_2^2 = 160$
 $R_2^2 = \frac{160}{6}$
 $R_2 = \sqrt{\frac{160}{6}}$

10. Which one of the following is not true about the a charged particle in a uniform magnetic field region?

(A) The magnetic force exerted on the charged particle is zero if it is at rest
 (B) The electric force exerted on the charged particle is zero if it is at rest.
 (C) The magnetic force exerted on the charged particle depends on the magnitude of magnetic field in the region.
 (D) The magnetic force is perpendicular to both the direction of the velocity and the magnetic field.

11. A wire carries a steady current of 2.4A. A straight section of the wire is 0.75m long and lies in the xy plane along the x axis with in a uniform magnetic field of $\vec{B} = 1.6T\hat{k}$. If the current is in the positive x direction, what is the magnetic force exerted on the section of the wire?

(A) $-2.88N\hat{j}$ (B) $2.88N\hat{j}$ (C) $-3.84N\hat{j}$ (D) $3.84N\hat{j}$

12. If long straight wire carries a steady current of 2A, what is the magnitude of the magnetic field at a perpendicular distance of 0.5m from the wire?

(A) $8 \times 10^{-7} T$ (B) $8 \times 10^{-9} T$ (C) 8 T (D) $8\pi \times 10^{-7} T$

13. Which one of the following statements is not true?

(A) An electric current can be induced in a circuit if the magnetic flux remains constant.
 (B) The induced emf in a circuit is directly proportional to the time rate of change of the magnetic flux.

(C) An emf can be induced in a circuit by changing the cross sectional area enclosed by the loop.

(D) An electric current can be induced in a circuit with a changing magnetic field.

14. An air cored solenoid has 500 turns per unit length and area of 5cm^2 . What is its self inductance?

- (A) $1.57 \times 10^{-7} \text{ H}$ (B) $1.57 \times 10^{-9} \text{ H}$ (C) 1.57 H (D) $1.57 \times 10^{-4} \text{ H}$

15. A 0.25T magnetic field is perpendicular to a circular loop of wire with 50 turns and a radius 15cm . If the magnetic field is reduced to 0.01T in 0.12sec . What is the magnitude of the induced emf?

- (A) 9.2V (B) 2.3V (C) 4.6V (D) 13.8V

16. Suppose the radioactivity decay constant for radium is 1.07×10^{-4} per year, then its half life period will be:

- (A) 2520 years (B) 6476 years (C) 7000 years (D) 8099 years

17. The frequency of the emitted photon when a hydrogen atom undergoes a transition from $n=6$ to $n=2$ state is :

- (A) $3.7 \times 10^{14} \text{ Hz}$ (B) $7.3 \times 10^{14} \text{ Hz}$ (C) 7.3 Hz (D) $7.3 \times 10^{14} \text{ Hz}$

18. The magnitude of two vectors are 4 and 3 units. Which one of the following cannot be the resultant of the two vectors?

- (A) 1 (B) 5 (C) 7 (D) 6

19. Given that $\vec{A} = 2\hat{i} + 3\hat{j} - 4\hat{k}$ and $\vec{B} = -3\hat{i} + 4\hat{j} + \hat{k}$, find the scalar projection of $\vec{A}$ on to $\vec{B}$.

Handwritten calculations for question 19:

$$A \rightarrow B \quad \frac{A \cdot B}{|B|}$$

$$= \frac{2(-3) + 3(4) + (-4)(1)}{\sqrt{(-3)^2 + 4^2 + 1^2}}$$

$$= \frac{-6 + 12 - 4}{\sqrt{9 + 16 + 1}} = \frac{2}{\sqrt{26}}$$

(A) $\frac{2}{\sqrt{26}}$

(B) $\frac{2}{\sqrt{29}}$

(C) $\frac{\sqrt{26}}{2}$

(D) $\frac{\sqrt{29}}{2}$

20. An object starts from rest accelerates uniformly along the ground before takeoff. If it moved 600 in 10 seconds, find the distance travelled during the 4th second.

(A) 12 m

(B) 96 m

(C) 54 m

(D) 42 m

21. An air craft flying at steady velocity of 50 m/s east ward at the height of 8000 m drops a package of supplies. Determine the horizontal distance of the package when it reaches the ground.

(A) 4000 m

(B) 2000 m

(C) 1000 m

(D) 5000 m

22. A body of mass 30 kg explodes and split in to three pieces. The first piece has 5 kg and velocity of $-4\mathbf{m}/\mathbf{s}\hat{i}$, the second piece has a mass of 15 kg and velocity of $2\mathbf{m}/\mathbf{s}\hat{i}$. What is the velocity of the third piece?

(A) $5m/s\hat{i}$

(B) -10 m/s^2

~~(C) = 1 m/si~~

(D) $3m/s$

23. A block of mass m slides on the rough 45° inclined plane. The coefficient of friction between the block and the plane is μ . What is the ratio of acceleration when the block projected up to down the inclined plane?

$$(A) \frac{\mu - 1}{\mu + 1}$$

(B) $\frac{\mu + 1}{\mu - 1}$

$$(C) \frac{1-\mu}{1+\mu}$$

(D) $\frac{1 + \mu}{1 - \mu}$

24. A spring has a spring constant 200 N/m and a mass is 100 g attached to it. The spring sits on a horizontal frictionless surface and the other end of the spring

attached to a solid block. The mass is pulled by 10 cm to stretch the spring and then let go. What is the maximum velocity of the mass?

- (A) $\sqrt{10}$ m/s (B) $\sqrt{2}$ m/s (C) $2\sqrt{5}$ m/s (D) $5\sqrt{2}$

25. If the speed of a mass is increased by three fold, by what factor does the kinetic energy change ?

- (A) 9 (B) 1/9 (C) 3 (D) 1/3

26. A hoop of mass M and radius R is at rest on the top of an inclined plane whose height is h . The hoop rolls down the plane without slipping. What is the angular velocity of the hoop at the bottom of the inclined plane?(moment inertia of the hoop, $I = MR^2$)

- (A) $\frac{\sqrt{2gh}}{R}$ (B) $\frac{\sqrt{gh}}{R}$ (C) $\frac{\sqrt{gh}}{R^2}$ (D) $\frac{\sqrt{2gh}}{R^2}$

27. The moment inertia of the uniform sphere is $\frac{2}{5} MR^2$. Find the moment of inertia of the sphere at any point on its surface.

- (A) $\frac{2}{5} MR^2$ (B) $\frac{3}{5} MR^2$ (C) $\frac{7}{5} MR^2$ (D) $\frac{1}{5} MR^2$

28. Two discs of moments of inertia I_1 and I_2 about their respective axes (which are normal to the disc and passing through the center), and rotating with angular speed ω_1 and ω_2 are brought into contact face-to-face with their axes of rotation coincident. assume $\omega_1 \neq \omega_2$. What is the angular speed of the two disc system after contact?

- (A) $\frac{I_1\omega_1 + 2I_2\omega_2}{I_1 + 2I_2}$ (C) $\frac{I_1\omega_1 + I_2\omega_2}{I_1 + I_2}$

(B) $\frac{I_1 \omega_1 + 2I_2 \omega_2}{I_1 - 2I_2}$

(D) $\frac{I_1 \omega_1 + I_2 \omega_2}{I_1 - I_2}$

29. Young's Modulus is the

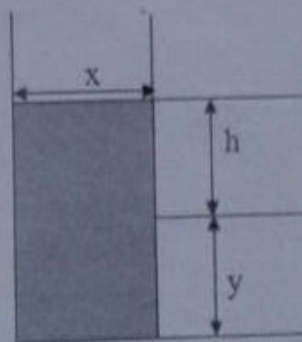
(A) ratio of stress to strain

(B) force per unit area

(C) ratio of strain to stress

(D) force per unit elongation

30. An open tank a liquid of density ρ has a small hole in its side at a distance y from the bottom. What is the speed at which the fluid leaves the hole when the liquid level a distance above the hole as shown in fig below?



(A) $\sqrt{gh}$

(B) $\sqrt{gy}$

(C) $\sqrt{2gy}$

(D) $\sqrt{2gh}$

Good
Luck

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