

# ODECAZDEO CAMPUS-LINK TUTORIALS

17, Wulemotu Ajoke Street, behind TOTAL Petrol Station, Chemist B/Stop, Along  
UNILAG-Bariga Road, Akoka, Lagos. Tel: 08032284155. Email:  
odecazdeoclt@yahoo.com

## JUEB CLASS 2023/2024.

### PRE-FIRST INCOURSE PHYSICS EXAMINATION HELD ON SUNDAY 26TH NOVEMBER, 2023.

**INSTRUCTION: ANSWER ALL QUESTIONS    TIME ALLOWED: 2 Hours**

Use the information to answer questions 1 and 2

A car starts from rest and accelerate uniformly until it reaches a velocity of 40m/s after 5s. it then travels with uniform velocity for 10s, and is brought to rest in 5s with a uniform acceleration. using graphical method.

- What is the acceleration and retardation experienced by the car?  
a.  $13 \text{ m/s}^2$ ,  $-10 \text{ m/s}^2$       c.  $4 \text{ m/s}^2$ ,  $-18 \text{ m/s}^2$   
b.  $8 \text{ m/s}^2$ ,  $-8 \text{ m/s}^2$       d.  $15 \text{ m/s}^2$ ,  $-15 \text{ m/s}^2$
- What is the total distance travelled by the car?  
a. 400m   b. 600m   c. 300m   d. 250m
- Two vectors **a** and **b** are defined as  $3\mathbf{i} + 4\mathbf{j} - 2\mathbf{k}$  and  $2\mathbf{i} - 6\mathbf{j} + 3\mathbf{k}$  respectively, what is the cross product of **a** and **b**?  
a.  $-13\mathbf{j} - 26\mathbf{k}$       c.  $23\mathbf{j} - 26\mathbf{k}$   
b.  $21\mathbf{i} + 5\mathbf{j} - 6\mathbf{k}$       d.  $24\mathbf{i} - 5\mathbf{j} + 4\mathbf{k}$
- A man pulls a crate of mass 50kg through a distance of 40m along a horizontal floor by a constant force,  $F = 100\text{N}$ , which acts at angle  $37^\circ$  to the horizontal surface. determine the net work done.  
a. 1000J      b. 32000J  
c. 320J      d. 3200J
- A body of mass 2kg moving with a velocity of 5m/s collides with a stationary body of mass 0.5kg. if the two coalesce and move off after impact, calculate their common velocity.  
a. 3m/s    b. 4m/s    c. 8m/s    d. 15m/s
- What average net force is required to bring a 1500kg car to a rest from a speed of 100km/hr within a distance of 55m?  
a.  $-1.1 \times 10^4\text{N}$       c.  $2.6 \times 10^4\text{N}$   
b.  $-1.4 \times 10^4\text{N}$       d.  $-1.6 \times 10^4\text{N}$
- Two boxes A and B are connected by a light weight cord and are resting on a smooth (frictionless) table. the

boxes have masses of 12kg and 10kg respectively. A horizontal force of 40N was applied to the 10kg box. what is the common acceleration of the motion?

- $1.44\text{m/s}^2$       c.  $1.52 \text{ m/s}^2$
  - $1.25 \text{ m/s}^2$       d.  $1.82 \text{ m/s}^2$
- Which of the following is NOT an application of dimensions in physics?  
a. to verify the correctness of an equation  
b. to derive the unit of a physical quantity  
c. to determine the type of an equipment to measure a physical quantity  
d. to drive the exact relationship between measured quantities
  - The period of oscillation of a simple pendulum is defined as  $T = k\text{m}^x\text{l}^y\text{g}^z$ , where k is a constant. using the concept of dimensions, what is the values of x, y and z respectively?  
a. 0,  $\frac{1}{2}$ , 1      c. 1,  $\frac{1}{2}$ ,  $\frac{1}{2}$   
b. 0,  $\frac{1}{2}$ ,  $-\frac{1}{2}$       d. 0,  $-\frac{1}{2}$ ,  $-\frac{1}{2}$
  - Which of the following is correct about Newton's second law of motion?  
**I. the acceleration of an object is directly proportional to the net force acting on it, and inversely proportional to the mass of the object.**  
**II. the direction of the force is in the direction of the acceleration**  
**III.  $F = ma$**   
a. I only  
b. I and II only  
c. I, II and III  
d. none of the above
  - The pressure on a low-density gas in a cylinder is kept constant as the temperature of the gas is increased from  $10^\circ\text{C}$  to  $40^\circ\text{C}$ . What is the percentage change in the volume of gas?  
a. 10.6%    b. 23.4%    c. 89.4%    d. 50%

12. The amount of heat necessary to change the temperature of 1kg of a substance by  $1^{\circ}\text{C}$  is called

- a. latent heat
- b. specific heat capacity
- c. heat capacity
- d. heat of formation

13. How many joules heat must be added to 5.0kg of water at  $20^{\circ}\text{C}$  to bring it to the boiling point? specific heat capacity of water is  $4186\text{J/kg}^{\circ}\text{C}$

- a. 4186J
- b.  $5.78 \times 10^6\text{J}$
- c. 167J
- d.  $1.67 \times 10^6\text{J}$

Use the information provided below to answer questions 14 and 15

The velocity (m/s) of a body is given as a function of time as  $v(t) = 3t^3 - 6t^2$ , where t is in seconds

14. What time (s) is the velocity zero?

- a. 1 and 2
- b. 0 and 2
- c. 0.5 and 2
- d. 1 and 3

15. At what time (in seconds) is the acceleration zero?

- a. 0 and 0.75
- b. 0 and 1.33
- c. 0 and 2.41
- d. 0 and 1.35

16. Find the power developed if a constant force (2, -1, 3)N pushes a body of mass 3kg such that the velocity of the body is (1, -2, 1)m/s

- a. 21J/s
- b. 4J/s
- c. 7J/s
- d. -21J/s

Use the information below to answer question 17 and 18:

Two particles A and B of mass 0.2kg and 0.5kg respectively are moving towards each other along the same straight line on a smooth horizontal table. Particle A has a speed 12m/s and particle B has speed 2m/s. given that the coefficient of restitution between the particles is 0.5, find

17. The speed of A and B after the impact

- a.  $v_1 = 3$  and  $v_2 = 4$
- b.  $v_1 = -2$  and  $v_2 = -4$
- c.  $v_1 = 3$  and  $v_2 = -4$
- d.  $v_1 = -3$  and  $v_2 = 4$

18. The total mechanical energy of the system before and after the impact

- a. (14.2J, 4.2J)
- b. (15.4J, 5.7J)
- c. (13.3J, 5.2J)
- d. (73.0J, 4.9J)

19. Nitrogen condenses into a liquid at approximately 77K. What temperature, in degrees Fahrenheit, does this correspond to

- a.  $-321^{\circ}\text{F}$
- b.  $-177^{\circ}\text{F}$
- c.  $-196^{\circ}\text{F}$
- d.  $-139^{\circ}\text{F}$

20. A certain platinum resistance thermometer has a resistance R of  $90.35\Omega$  when its bulb is placed in a triple point of water. What is the temperature reading if the bulb is placed in an environment such that its resistance is  $96.28\Omega$ ?

- a. 290.6K
- b. 330.5K
- c. 280.6K
- d. 315.0K

21. Which of the following statements is correct?

- a. the unit of strain is  $\text{Nm}^2$  while that of Young's modulus is N/m
- b. stress and young's modulus have the same unit
- c. stress is dimensionless
- d. shear modulus and young's modulus have different units

22. A projectile is launched with an initial velocity of 35m/s at an angle of  $40^{\circ}$  to the horizontal. Find its velocity and position at time  $t = 2\text{s}$

- a. 29.2773m/s, 52.4128m
- b. 22.9312m/s, 49.1624m
- c. 26.9277m/s, 59.1624m
- d. 28.2387m/s, 52.4128m

23. The equation of a progressive sinusoidal wave can be written as  $y = (2.00\text{cm}) \sin (3.62t - 2.11x)$ , where x is in meters and t in seconds. The frequency of the wave is

- a. 1.25Hz
- b. 3.0Hz
- c. 2.56Hz
- d. 0.576Hz

24. Which of the following is/are correct about a standing wave?

- I. it results from superimposed waves moving in same direction
- II. It is a sum of two interfering light waves
- III. It is a vector sum of two reflected sound waves
- IV. It can also be called stationary wave
- a. All of the above
- b. I, II and IV
- c. III and IV
- d. I and III

25. Which of the following correctly states the newton's third law of motion?

- a. force is directly equal to velocity
- b. action and reaction are equal and opposite
- c. action and reaction are equal and in the same direction
- d. the force exerted is dependent on the friction between the surfaces

26. In projectile motion, the maximum height can be defined as

- a.  $\frac{v \sin \theta}{2g}$
- b.  $\frac{v^2 \sin^2 \theta}{2g}$
- c.  $v \sin^2 \theta$
- d.  $\frac{v^2 \sin^2 \theta}{g}$

**Use the information to answer questions 27 and 28: A ball is projected horizontally from the top of a vertical cliff 80m high with a velocity of 25m/s [ $g = 10\text{m/s}^2$ ]**

27. Calculate the time taken by the ball to reach the ground surface.

- a. 3.2s      b. 5s      c. 4s      d. 10s

28. Calculate the distance of the ball from the foot of the cliff at impact with the ground surface.

- a. 100m    b. 200m    c. 80m    d. 1000m

29. A body of mass  $M_1$  moving with a velocity of  $U$  collides with a stationary body of mass  $M_2$ . Both bodies move together after the collision with a common velocity of

- a.  $\frac{M_1}{M_1 - M_2} u$       c.  $\frac{M_1}{M_1 + M_2} u$   
b.  $\frac{M_2}{M_1 + M_2} u$       d.  $\frac{M_2}{M_1 - M_2} u$

30. Add the following vectors:  $(6, 30^\circ)$ ,  $(6.5, 130^\circ)$  and  $(5.5, 280^\circ)$

- a.  $(3.23, 52.45^\circ)$       c.  $(2.34, 32.57^\circ)$   
b.  $(3.23, 61.78^\circ)$       d.  $(2.34, 61.78^\circ)$

31. A loose bolt falls from a high-flying helicopter that is rising at a constant 8.76m/s. How far is the bolt below the helicopter 3.05 seconds later?

- a. 42.87m    b. 36.58m    c. 23.29m    d. 18.86m

32. 550g of water at  $75^\circ\text{C}$  are poured into 855g aluminum container with an initial temperature of  $110^\circ\text{C}$ , the specific heat of aluminum is  $900\text{J/kg}\cdot\text{K}$ . how much heat flow from the aluminum to water? assuming no heat is exchanged with the surrounding

- a. 36kJ  
b. 21kJ  
c. 37kJ  
d. 46kJ

33. A string produces waves with a frequency of 5.00Hz and has amplitude 12.0cm. If the speed of the wave is 20.0m/s, the angular frequency of the waves will be?

- a. 3.0rad/sec  
b. 15.0rad/sec  
c. 15.7 rad/m  
d. 31.4rad/sec

34. When you move away from a fixed source of sound, the frequency of the sound you hear

- a. Is greater than what the source emits  
b. Is less than what the source emits  
c. Is the same as what the source emits  
d. Is equal to what the source gives

35. Sinusoidal water waves are generated in a large ripple tank. The waves travel at 20cm/s and their adjacent crests are 5.0cm apart. The time required for each new whole cycle in be generated is

- a. 100s      c. 0.25s  
b. 2.0s      d. 0.5s

36. The antenna of a cell phone is often  $\frac{1}{4}$  wavelength long. A particular cell phone has an 8.5cm long straight rod its antenna. Estimate the operating frequency of this phone.

- a. 220.35MHz  
b. 352.94MHz  
c. 110MHz  
d. 882.35MHz

37. In what order does the velocity of sound increase in these media

- a. Water, air and iron  
b. Air, water and iron  
c. Water, iron and air  
d. None

38. A point source emits sound waves with an average power output of 80W. What is the intensity 3m away from the source?

- a.  $0.71\text{W/m}^2$       b.  $7.1\text{W/m}^2$   
c.  $0.071\text{W/m}^2$       d.  $0.0071\text{W/m}^2$

39. A stationary source emits a sound wave of frequency  $f$ . if it were possible for a man to travel toward the source at the speed of sound, he would observe the emitted sound to have a frequency of \_\_\_\_\_

- a. Zero    b.  $f/2$     c.  $2f/3$     d.  $2f$

40. The sound level measured 30m from a jet plane is 140dB. What is the sound level at 300m?

- a. 100dB      c. 140dB  
b. 120dB      d. 90dB

### **THEORY PART** Answer all questions in this part.

1(a). A projectile is fired with a velocity of 120m/s at an angle of  $30^\circ$  to the horizontal from the top of a building of height 8m above the ground. Determine the distance from the foot of the building where the projectile hits the ground and the velocity of impact.

1(b). A tall glass vessel is filled with a liquid of density  $\sigma$  and coefficient of viscosity  $\eta$ . A small ball-bearing of radius  $r$  and density  $\rho$  is dropped gently into the liquid so that it falls along the axis of the vessel. Towards the middle of the liquid, the ball-bearing reaches its terminal velocity  $V_0$ .

Show that  $V_0 = \frac{2gr^2(\rho-\sigma)}{9\eta}$  is a homogeneous equation.

1(c) At what distance from the earth's surface will the value of the acceleration due to gravity be equal to 75% of the value at the earth's surface?

1(d) A ball is kicked into the air, when it reaches the vertical height of 7.5m the velocity is measured to have a horizontal component  $10.4\text{ms}^{-1}$  and vertical component  $3.7\text{ms}^{-1}$ . Calculate the maximum height and horizontal distance which the particle travels.

2(a) (i) State the three Newton's Laws of motion.

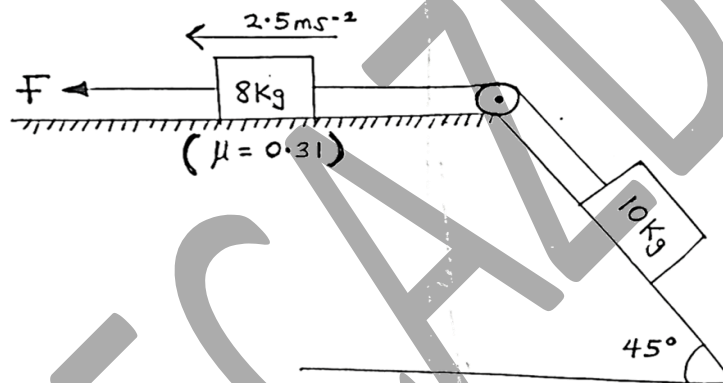
(ii) Define the following quantities; speed, velocity, acceleration, momentum and impulse.

2(b) The displacement  $x(t)$  of a particle as a function of time  $t$  is given as  $x(t) = (6t^2 - t^3 + 1)\text{m}$ . Find the displacement, velocity and acceleration at  $t = 0$ ,  $t = 2\text{s}$ ,  $t = 4\text{s}$  and  $t = 6\text{s}$ . sketch your results on the graph sheet provided.

2(c) (i). State parallelogram law of vectors.

(ii). The resultant of two vectors inclined at  $60^\circ$  is 11.7m, if one of them is 7.7m, find the second vector.

2(d).



From the figure above, find the tension in the rope and the magnitude of the force  $F$ .

3(a) Differentiate between specific heat capacity and specific latent heat.

3(b) Aluminum melts at  $628^\circ\text{C}$  and has specific heat of  $910\text{J/kg.K}$  and specific latent heat of  $3.93 \times 10^5\text{J/kg}$ .  $4.29 \times 10^7\text{J}$  of heat is supplied to  $50\text{kg}$  aluminum, initially at  $25^\circ\text{C}$ . How much of the aluminum remains as solid?

3(c) Iron melts at  $1350^\circ\text{C}$ . Calculate the minimum heat needed to melt  $500\text{kg}$  of scrap iron initially at  $30^\circ\text{C}$ . specific heat of iron is  $470\text{J/kg.K}$  and the specific latent heat is  $2.05 \times 10^5\text{J/kg}$ .

3(d) A Carnot engine operates between a hot reservoir at  $120^\circ\text{C}$  and a cold reservoir at  $10^\circ\text{C}$ . Calculate (i) its efficiency, and (ii) the heat it rejects into the cold reservoir when it absorbs  $2.6 \times 10^5\text{J}$  of heat from the hot reservoir.

4(a) (i) What is Doppler effect?

(ii) the siren of a police car at rest emits at a predominant frequency of  $1800\text{Hz}$ . What frequency will be heard by an observer if the observer is at rest and the police car moves at  $32\text{m/s}$

(I) toward the observer (II) away from the observer? (Speed of sound in air =  $340\text{m/s}$ )

4(b) Red light of wavelength  $700\text{nm}$  in a vacuum travel into glass, where its speed decreases to  $2.0 \times 10^8\text{m/s}$ . Determine (i) the frequency of the light in a vacuum and (ii) its frequency and wavelength in the glass

4(c)(i) Define Loudness of a sound. (ii) Write an expression for the loudness of the sound in terms of intensity.

4(d) A trumpeter plays at a sound level of  $85\text{dB}$ . Three equally loud players join in. What is the new sound level?