PHYSICS

OBAFEMI AWOLOWO UNIVERSITY, ILE- IFE
2006 POST UME TEST

You may find the following constants useful:
Acceleration due to gravity, g, $9.8 m/s^2$
Gas constant R 8.31 *J/mol.*
Speed of light in vacuum, c $3.0 \times 10^8 m/s$ Planck constant h 6.63×10^{-34} *J.s*

1. A 70 kg man ascends a flight of stairs of height 4 m in 7 s. The power expended by the man is
a) 40 W (b) 100 W (c) 280 W (d) 400 W

2. A body accelerates uniformly from rest at 6 ms^{-2} for 8 seconds and then decelerates uniformly to rest in the next 5 seconds. The magnitude of the deceleration is:
(a) 9.6ms^{-2} (b) 48ms^{-2} (c) 24.0 ms^{-2} (d) 39.4 ms^{-2}

3. A nail is pulled from a wall with a string tied to the nail. If the string is inclined at an angle of 30^0 to the wall and the tension in the string is 50N, the effective force used in pulling the nail is
(a) 25N (b) $25\sqrt{3}$N (c) 50N (d) $50\sqrt{3}$N

4. If M and R are the mass and radius of the earth respectively and G is the universal gravitational constant; the earth's gravitational potential at an altitude H above the ground level is: (a) $-GM/H$ (b) $-GM/(R+H)$
(c) $-GM/2H$ (d) $-GM/(R-H)$

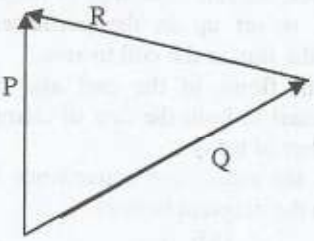
5. Which of the following statement is not true:
(a) As the slope of an inclined plane increases, the velocity ratio decreases.
(b)The efficiency of an inclined plane decreases as the slope increases.
(c)The effort required to push a given load up an inclined plane increases as the slope increases.
(d) The mechanical advantage of a smooth inclined plane depends on the ratio of the length of the height of the plane.

6. The ice and steam points of a thermometer are 20mm and 100mm respectively. A temperature of 75^0C corresponds to Y mm on the thermometer. What is Y?
(a) 100mm (b) 70mm (c) 80mm (d) 60mm

7. An electric kettle with negligible heat capacity is rated at 2000W. If 2.0kg of water is put in it, how long will take temperature of water to rise from 20^0 C to 100^0C?
[*Specific heat capacity of water* = 4200J $kg^{-1}K^{-1}$
(a) 336s (b) 420s (c) 168s (d) 84s

8. A quantity of ice at 10^0C is heated until the temperature of the heating vessel is 90^0C. Which of the following constants is NOT required to determine the quantity of heat supplied to the vessel?
(a) Specific latent heat of Vaporization
(b) Specific heat capacity of ice.
(c) Specific latent heat of fusion.
(d) Specific heat capacity of water.

9. The scent from a jar of perfume opened in one corner of a room is picked up in anther part of the room. The perfume moves through the air molecules
(a) Evaporation (b) Osmosis
(c) Diffusion (d) Convection

10.


In the diagram above, P, Q and R are vectors. Which of the following options gives the correct relationship between the vectors?
(a) $P = R - Q$ (b) $P = R + Q$
(c) $P = Q - R$ (d) $P + R + Q = 0$

11. A convex lens of focal length 10.0cm is used to form a real image which is half the size of the object. How far from the object is the image
(a) 45cm (b) 30cm (c) 15cm (d) 20cm

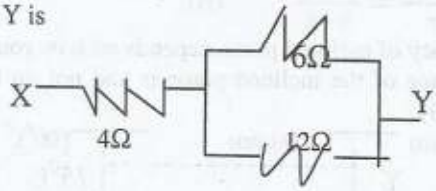
12. A diverging lens of focal length 20cm forms an image half of the size of the object. What is the object distance?
(a) 11.11cm (b) 100 cm (c) 60 cm (d) 8.71 cm

13. An object of height 3.00cm is placed 10cm in front of a biconvex lens of focal length 15cm. The image of the object is
(a)Real and 3.00cm tall (b)Virtual and 3.00cm tall
(c)Virtual and 9.00cm tall (d)Real and 9.00cm tall

14. The most suitable type of mirror used for the construction of a searchlight is the:
(a) Concave mirror (b) Convex mirror
(c) Spherical mirror (d) Parabolic mirror

15. Light waves and ripples of water are similar because both
(a) are longitudinal waves
(b) have the same velocity
(c) can be diffracted and refracted
(d) have the same frequency

16. Three 4-Ω resistors were connected in series by 'Tola while Ade connected the same set of resistors in parallel. The ratio of the value obtained by Ade to that obtained by 'Tola is (a) 1:2 (b) 1:9 (c) 1:10 (d) 1:5

17. Three resistors are connected as shown in the diagram below. The equivalent resistance between points X and Y is


(a) 8.0Ω (b) 22.0Ω (c) 4.25Ω (d) 3.27Ω

18. A coil of copper wire of N turns is kept rotating between the poles of a permanent magnet such that the magnetic flux linking the coil changes continuously. Which of the following statements is TRUE?

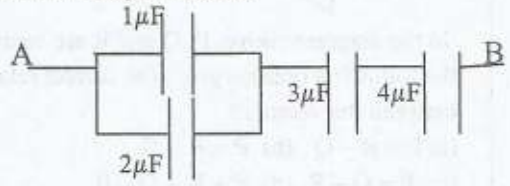
(a) An emf is induced in the coil such that when the change of flux is positive the emf is positive, and when the change of flux is negative, the emf is negative.

(b) An emf is induced in the coil whose magnitude is inversely proportional to both the number of turns in the coil and the rate of change of magnetic flux.

(c) An emf is set up in the permanent magnet which reduces the flux in the coil to zero.

(d) A current flows in the coil and an emf is set up proportional to both the rate of change of the flux and the number of turns.

19. What is the equivalent capacitance between points A and B in the diagram below?



20. The principle of operation of an induction coil is based on (a) Ohm's law (b) Ampere's law (c) Faraday's law (d) Coulomb's law

21. The equation $^{150}_{62}X \longrightarrow {}^{150}_{63}Y + k + energy$, represent (a) α-decay (b) β-decay (c) γ-decay (d) photon emission

22. Which of the following radiations cannot be deflected by an electric field or a magnetic field?

(a) (i) α-rays (ii) β-rays (iii) γ-rays (iv) X-ray
(b) (i) and (ii) only
(c) (iii) and (iv) only
(d) (i) and (iii) only

23. The half-life of a radioactive element is 9 days. What fraction of atoms has decayed in 36 days?

(a) $^{1}/_{16}$ (b) ¼ (c) ½ (d) $^{15}/_{16}$

ANSWER KEY

1. D 2. A 3. A 4. B 5. B 6. C 7. A 8. A
9. C 10. B 11. A 12. - 13. C 14. D 15. C 16. B
17. A 18. D 19. B 20. C 21. B 22. C 23. D

SOLUTIONS

1. Power is the rate of doing work or expending energy. It is represented as:

$$P = \frac{\text{Work done}}{\text{Time}} = \frac{\text{Force x Distance}}{\text{Time}}$$

$$= \frac{\text{m x a x s}}{\text{t}} = \frac{(70)(10)(4)}{7}$$

$$= 400\text{W} \quad \text{(D)}$$

2. Maximum velocity, $v = u + at$

$v = 0 + (8)(6) = 48\text{m/s}$

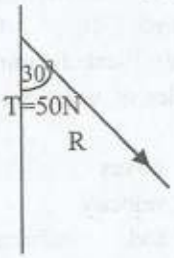
$u = 48\text{m/s}$

$v = 0$, & $t = 5\text{s}$

$$a = \frac{v - u}{t} = \frac{0 - 48\text{m/s}}{5}$$

$$= -9.6\text{m/s}^2 \quad \text{(A)}$$

3.



The effective force pulling on the nail is resolved perpendicular to the wall.

$F = T \sin 30^0$

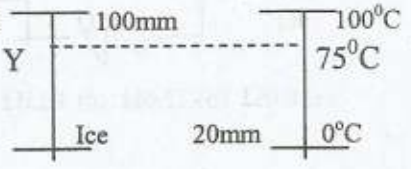
$= 50 \times ½ = 25\text{N}$ (A)

4. 4. Mass of the Earth = M_e, Radius of the Earth = R, $r = H + R$

$$V = \frac{-GM_e}{r} = \frac{-GM_e}{H+R} \quad \text{(B)}$$

5. Efficiency of inclined plane depends on how rough the surface of the inclined plane is and not on the slope (B)

6.



$$\frac{100^0C}{(100-20)mm} = \frac{75^0C}{Y-20mm}$$

$$100^0C(Y - 20mm) = 75^0C \times 80mm$$

$$Y - 20mm = \frac{75 \times 80}{100}$$

$Y = 60 + 20 = 80mm$ (C)

7. Heat supplied by the heater = Ivt = 2000 x t

Heat supplied by heater = heat gained by water

$2000 \times t = 2\text{kg} \times 4200\text{JKg}^{-1}\text{K}^{-1}\ (373 - 293)\text{K}$

$2000t = 2 \times 4200 \times 80$

$t = 336$ secs (A)

8. (A) – Specific latent heat of vapourization of a substance is the quantity of heat required to change unit mass of the substances from liquid to the vapour state at the same temperature. In this case, the temperature of heating vessel is 90°C which is below 100°C, the temperature at which water can vapourise.

9. This describes the diffusion of the perfume molecule. Diffusion describes the movement of solute particles through a medium from a region of higher concentration to a region of lower concentration. Diffusion is fastest in gaseous because gas molecules have more kinetic energy than particles in solid and liquids state and the rate of diffusion of gases is affected by their densities.(C)

10. B

11. $f = 10.0\text{cm}$ (+ve for convex lens)

$u = ½v$

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$$\frac{1}{(\frac{1}{2})v} + \frac{1}{v} = \frac{1}{10}$$

$$\frac{2}{v} + \frac{1}{v} = \frac{1}{10}$$

$$\frac{3}{v} = \frac{1}{10}$$

$v = 30\text{cm}$

$u = ½v = ½(30) = 15$cm, Therefore, the image is formed 30 cm from the lens. The distance of object from image = 30 + 15 = 45 cm (A)

f = -20cm (Negative focal length because divergent lens always produce virtual image, so V is also negative)

$m = v/u = ½, \quad \Rightarrow v = ½u$

$$\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$$

$$\frac{1}{u}+\frac{1}{(-1/2u)}=\frac{1}{-20}$$

$$\frac{1}{u}-\frac{2}{u}=-\frac{1}{20}$$

$$\frac{1-2}{u}=\frac{-1}{20},$$

$$u = 20$$

object distance = 20cm (No Correct option)

13. Focal length, f = 15cm

Object distance, u = 10cm

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$$

$$\frac{1}{v}+\frac{1}{10}=\frac{1}{15}$$

$$\frac{1}{v}=\frac{1}{15}-\frac{1}{10}=\frac{2-3}{30}$$

$$=\frac{-1}{30}$$

$$\Rightarrow \frac{1}{v}=\frac{-1}{30}$$

v = -30

$$\frac{image\ distance}{object\ distance}=\frac{height\ of\ image}{height\ of\ object}=m$$

$$m=\frac{\text{Height of Image}}{\text{Height of Object}}$$

$$3=\frac{\text{Height of Image}}{3}\Rightarrow$$

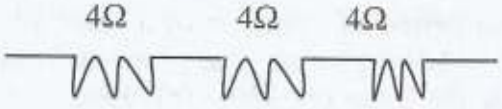
$$Height\ of\ \text{Image} = 9\text{cm}$$

Image of object is virtual (v =-30cm) & 9cm tall (C)

Spherical concave mirrors are not used as car headlamp or as searchlight because they do not provide a parallel beam of constant intensity, so PARABOLIC mirror is used. (D)

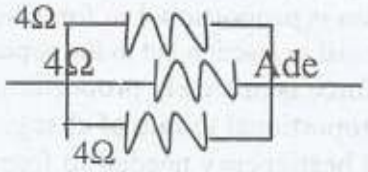
Light waves and water can be Reflected and Diffracted. Light and water wave are transverse waves (C)

Tola:



R = (4 + 4+ 4) = 12Ω

Ade:



$$\frac{1}{R}=\frac{1}{4}+\frac{1}{4}+\frac{1}{4}=\frac{3}{4}$$

$$R=\frac{4}{3}$$

Ade: Tola = $\frac{4}{3}:12 = 4:36 \Rightarrow 1:9$ (B)

17. Parallel; $\frac{1}{12}=\frac{1}{6}+\frac{1}{12}$

$$\frac{1}{R}=\frac{2+1}{12}$$

$$\frac{1}{R}=\frac{3}{12}, \quad R = 4\Omega$$

Equivalent resistance = parallel + series

Total Resistance, R = 4+4 = 8Ω (A)

18. Check relevant textbook (D)

19. In Parallel, Ceq = 1μF +2 μF = 3 μF

In Series $\frac{1}{Ceq}=\frac{1}{3\mu F}+\frac{1}{3\mu F}+\frac{1}{4}$

$$\frac{1}{Ceq}=\frac{4+4+3}{12}$$

$$\frac{1}{Ceq}=\frac{11}{12}$$

Ceq = 12/11 = 1.1μF (B)

20. Ohm's law deals with metallic conductors and its resistance, Coulomb's deals with Ampere law. In 1831, after experiments extending over a period of several years, Michael Faraday discovered that a momentary current existed in a current whenever the current in a nearby circuit was being started or stopped. Shortly afterward, by circuit he also discovered that the motion of a magnet toward or away from the circuit would produce the same effect. This phenomenon discovered by Faraday and Henry is now known as Electromagnetic Induction. (C)

21. ${}^{150}_{62}X \rightarrow {}^{150}_{63}Y + K({}^{0}_{-1}\ell) + \text{Energy}$ (B)

22. X-ray and γ-ray pass through electric and magnetic field undeflected (C)

23. $X \xrightarrow[9\ days]{\frac{1}{2}life} \frac{X}{2} \xrightarrow[9\ days]{\frac{1}{2}life} \frac{X}{4} \xrightarrow[9\ days]{\frac{1}{2}life} \frac{X}{8} \xrightarrow[9\ days]{\frac{1}{2}life} \frac{X}{16}$

$\frac{X}{16}$ - fraction is left after 36 days.

Therefore, fraction of atoms decayed in 36 days

$$= 1-\frac{X}{16}=\frac{15x}{16}$$ (D)

1. What is the dimension of pressure?
(a) $ML^{-1}T^{-2}$ (b) MLT^{-2} (c) $ML^{2}T^{3}$ (d) ML^{-3}

2. Calculate the length of a displaced pendulum bob that passes its lowest point twice every second. [g= $10ms^{-2}$] (a) 1.000m
(b) 0.253m (c) 0.450m (d) 0.58m

3. When a ball rolls on a smooth level ground, the motion of its centre is
(a) Translational (b) random
(c) oscillatory (d) rotational

4. A vehicle of mass m is driven by an engine of power P from rest. Find the minimum time it will take to acquire a speed v.
(a) $\frac{mv^2}{P}$ (b) $\frac{mv^2}{2P}$ (c) $\frac{mv}{P}$ (d) $\frac{mv}{2P}$

5. A box of mass 40kg is being dragged along by a rope inclined at 60^0 to the horizontal. The frictional force between the box and the floor is 100N and the tension of the rope is 300 N. How much work is done in dragging the box through a distance of 4m?
(a) 680 J (b) 200 J (c) 100 J (d) 400 J

6. A body is projected from the earth's surface with the hope of letting it escape from the earth's gravitational field. What is the minimum escape velocity?
(a) 11.3 kms^{-1} (b) 13.3 kms^{-1}
(c) 12.3 kms^{-1} (d) 14.3 kms^{-1}
[Earth's radius = 6.4 x 10^3km, g = 10 ms^{-2}]

7. A uniform rod PQ of mass 2 kg and length of 1 m is pivoted at the end P. If a load of 14 N is placed on it at the centre, find the force that should be applied vertically upwards at Q to maintain the rod in equilibrium horizontally.
(a) 7N (b) 28N (c) 68N (d) 17N

8. The energy contained in wire when it is extended by 0.02m by a force of 500N is
(a) 10^4J (b) 10^3J (c) 10J (d) 5J

9. What is the acceleration due to gravity 'g' on the moon, if g is 10ms^{-2} on the earth?
(a) 0.74ms^{-2} (b) 0.1ms^{-2}
(c) 10.0ms^{-2} (d) 1.67ms^{-2}

10. A 5kg block is released from rest on a smooth plane inclined at an angle of 30^0 to the horizontal. What is the acceleration down the plane? (a) 5.0ms^{-2}
(b) 8.7ms^{-2} (c) 25.0ms^{-2} (d) 5.8ms^{-2}

11. A rectangular metal block of volume 10^{-6}m^3 at 273K is heated to 573K. If its coefficient of linear expansion is 1.2 x 10^{-5}K^{-1}, the percentage change of its volume is
(a) 1.5% (b) 1.1% (c) 0.1% (d) 0.45

12. A temperature scale has a lower fixed point of 40mm and an upper fixed point of 200mm. What is the reading on this scale when a thermometer reads 60^0?
(a)136.0mm(b) 33.3mm (c) 96.0mm
(d) 36.0mm

13. A 500kg car was initially at rest travelled with an acceleration of 5ms^{-2}, what is its kinetic energy after 4s? (a) 2.5 x 10^3J (b) 10^5J
(c) 5 x 10^3J (d) 5 x 10^5J

14. The temperature at which the water vapour in the air saturates the air begins to condense
(a) melting point (b) triple point
(c) dew point (d) melting point

15. The period of a simple pendulum will increase by what factor if its inextensible length increased by a factor of four.
(a) 2π (b) 4 (c) 2 (d) $\frac{1}{4}$

16. An air column 10cm in length is trapped into the sealed end of a capillary tube by a 15cm column of mercury with the tube held vertically. On inverting the tube, the air column becomes 15cm long. What is the atmospheric pressure during the experiment?
(a)76cm (b) 75cm (c) 60cm (d) 70cm

17. An electric cell has an internal resistance of 2Ω. A current of 0.5A was measured when a resistor of resistance 5Ω was connected across it. Determine the electromotive force of the cell.
(a) 3.5V (b)2.5V (c) 4.5V (d) 2.35V

18. The speed of light in air is 3x10^8ms^{-1}. If the refractive index of light from air to water is $\frac{4}{3}$, calculate the speed of light in water.
(a) 2.25 x 10^8ms^{-1} (b) 2.25 x 10^8ms^{-1}
(c) 4.00 x 10^8ms^{-1} (d) 4.33 x 10^8ms^{-1}

19. It is known that an atomic nucleus comprises of positively charged protons. Which of the following also exist in the nucleus?
(a) A beta particle (b) An alpha particle
(c) A neutron (d) An electron

20. The silver wall of a vacuum flask prevents heat loss due to
(a) conduction (b) convection
(c) radiation (d) diffraction

21. The electromagnetic waves that are sensitive to temperature changes are
(a) ultra-violet rays (b) gamma-rays
(c) infra-red rays (d) x-rays

22. Under constant tension and constant mass per unit length, the note produced by a plucked string is 500Hz when the length of the string is 0.90m. At what length is the frequency 150Hz?
(a) 6m (b) 3m (c) 5m (d) 4m

23. Two bodies P and Q are projected on the same horizontal plane, with the same initial speed but at different angles of 30^0 and 60^0 respectively to the horizontal. Neglecting air resistance, what is the ratio of range of P to that of Q (a) 1:1 (b) 1:$\sqrt{3}$ (c) $\sqrt{3}$:1 (d) 1:2

24. A capacitor of 2.0 x 10^{-11}F and an inductor are joined in series. The value of the inductance that will give the circuit a resonant frequency of 200 kHz is
(a) $\frac{1}{16}H$ (b) $\frac{1}{8}H$ (c) $\frac{1}{64}H$ (d) $\frac{1}{32}$

SOLUTIONS

1. Pressure = $\frac{\text{Force}}{\text{Area}} = \frac{ma}{}$

$$= \frac{M \times LT^{-2}}{L^2}$$

$$= ML^{-1}T^{-2} \text{ (A)}$$

2. $T = \frac{1}{f} = 1\text{secs}$

$$T = 2\pi\sqrt{1/g}$$

$$l = g(T/2\pi)^2 = 10\left(\frac{1}{2 \times 3.142}\right)^2$$

$$= 0.253\text{m (B)}$$

3. Translational motion is the movement of the whole body from one place to another. Rotational motion is the turning of a body around a fixed point. The centre of a ball as it rolls down a plane is Rotational (D)

4. Power = $\frac{\text{Work done}}{\text{Time}} = \frac{F \times s}{t}$

$$\Rightarrow P = \frac{m \times a \times s}{t}$$

$$s = \frac{pt}{ma}$$

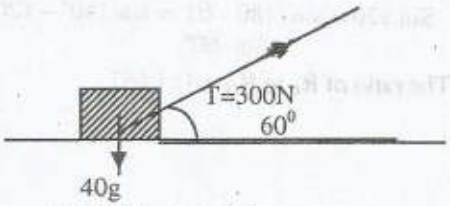
$$v^2 = u^2 + 2as$$

$$v^2 = 0 + 2 \times a \times \frac{pt}{ma}$$

$$v^2 = \frac{2pt}{m}$$

$$t = \frac{mv^2}{2p} \text{ (B)}$$

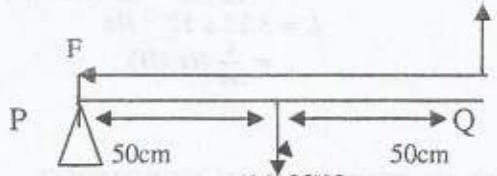
5.



T cos 60 – F_R = ma
300 cos 60 – 100 = 40a
a= 50/40 = 5/4
Work done = m x a x s
= 40 x 5/4 x 4 = 200N (B)

6. $v = \sqrt{2gr}$
$= \sqrt{2 \times 9.8 \times 10^{-3} \times 6.4 \times 10^{3}}$
Escape Velocity, v = 11.2 kms^{-1} (A)

7.



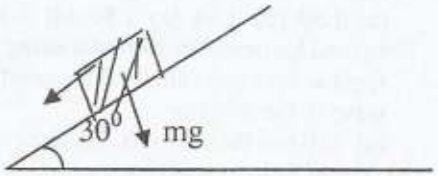
Weight of the rod = 2 x 10 = 20N
Taking the moment about the pivot gives
34(50) = F x 100

$$F = \frac{34 \times 50}{100} = 17N \quad (A)$$

8. Energy = ½Fe
= ½ x 500 x 0.02 = 5J (D)

9. On the moon, the acceleration of a freely falling body is only 1.6m/s^2 and weight of 1kg would be 1.6N (D)

10.



The resolved component of the weight down the plane is 5g sin 30^0 = ma
Net force on the mass, 5 x 10 sin 30 = 5a
a = 5m/s^2 (A)

11. Cube expansivity, $\gamma = 3\alpha$
$= 3(1.2 \times 10^{-5} K^{-1})$

$$\gamma = \frac{V_f - V_i}{V_i \theta}$$

Multiply through by $\Delta\theta$

$$\frac{V_f - V_i}{V_i} = 300 \times 3.6 \times 10^{-5} = 0.0108$$

% volume change = 0.0108 x 100%
= 1.08 = 1.1% (B)

12. $\frac{60^0}{100^0} = \frac{L-40}{200-40}$
$100^0 C(L-40) = 160(60)$
L – 40 = 96
L = 96 + 40 = 136mm (A)

13. v= u + at
v = 0 + 5 x 4 = 20m/s
K.E. = ½ mv^2 = ½ x 500 x $(20)^2$ = 10^5J (B)

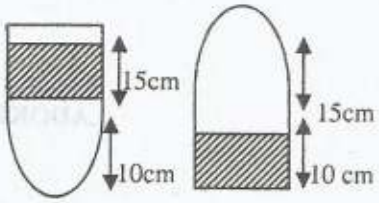
14. If air is cooled, a temperature will be reached at which the air can no longer hold the amount of water vapour initially present and some of the water vapour thus condenses (into water). The temperature at which this happen is called the dew point (C)

15. $T_1 = 2\pi\sqrt{l_1/g} = 2\pi\sqrt{l_1/g}$
$T_2 = 2\pi\sqrt{l_2/g} = 2\pi\sqrt{4\,l_1/g}$
$\Rightarrow T_1 = T_2$

$$2\pi\sqrt{\frac{4l_1}{g}} = 2\pi\sqrt{\frac{l}{g}}$$

$\sqrt{\frac{4l_1}{g}} = \sqrt{\frac{l_1}{g}}$
$2\sqrt{\frac{l_1}{g}} = \sqrt{\frac{l_1}{g}}$
$2T_2 = T_1$ i.e. the period is doubled (C)

16.



Since the tube is of uniform bore, V, volume of trapped air is proportional to length of air column
i.e. V = kl (where k is a constant).
Suppose (P_1V_1), (P_2V_2) are the pressure and volume respectively in the
P_1 = (H+15)cm of mercury, V_1 = 10K
P_2 = (H – 15)cm of mercury, V_2 = 15K
We may take the temperature of the air as constant so that Boyles' law is obeyed
$P_1V_1 = P_2V_2$
(H+15) x 10k = (H – 15) x 15k
10H + 150 = 15H – 225
(10 – 15)H = -150 – 225
-5H = -375
H =75cm (B)

17. Emf, E = I(R + r)
= 0.5(2+5) = 3.5V (A)

18. Refraction Index of water
= Speed of air / Speed of light in water
Speed of light in water = $\frac{3 \times 10^8}{4/3}$
=2.25 x 10^8 m/s (B)

19. The nucleus of an atom comprises of positively charged proton and a neutral entity, NEUTRON (C)

20. This is because silver is a poor radiator of heat.(C)

21. Heat is radiated as electromagnetic waves with wavelength which are a little longer than that of light like infrared (C)

22. T is constant

$$f_1 = \frac{1}{2L}\sqrt{\frac{T_1}{m_1}} \Rightarrow \sqrt{\frac{T_1}{m_1}} = 500(2)(0.90)$$

$$f_2 = \frac{1}{2L}\sqrt{\frac{T_2}{m_2}} \Rightarrow \sqrt{\frac{T_1}{m_1}} = 500(2)\,x\,(x)$$

{Therefore, at f_1, $\sqrt{\frac{T_1}{m_1}}$ is equal to $\sqrt{\frac{T_2}{m_2}}$ at f_2 }

Since tension and mass per unit length are constant

$$500 \times 2 \times 0.90 = 150 \times 2 \times (x)$$

$x = 3\text{cm}$ (B)

23. Range, $R_P = \frac{U^2 \sin 2\theta}{g} = \frac{U^2 \sin 2(30^0)}{g}$

$$= \frac{U^2 \sin 60^0}{g}$$

Range, $R_Q = \frac{U^2 \sin 2(60^0)}{g} = \frac{U^2 \sin 120}{g}$

Trigonometrically,

$\text{Sin } 120 = \sin(180 - \theta) = \sin(180^0 - 120^0)$

$= \text{Sin } 60^\circ$

The ratio of R_P to R_Q = 1: 1 (A)

24. $f = \frac{1}{2\pi\sqrt{LC}}$

$$200 \times 10^3 Hz = \frac{1}{2\pi\sqrt{L \times 2.0 \times 10^{-11}}}$$

$$\sqrt{L \times 2.0 \times 10^{-11}} = \frac{1}{2\pi\,(200 \times 10^3)}$$

$$L = \frac{1}{2.0 \times 10^{-11}}\left[\frac{1}{2\pi\,(200 \times 10^3)}\right]^2$$

$$L = 3.12 \times 10^{-2}\,Hz$$

$$= \frac{1}{32}\,Hz\,(D)$$

OBAFEMI AWOLOWO UNIVERSITY, IFE
2008 POST UME TEST

1. Calculate the length of a displaced pendulum bob that passes its lowest point twice every second [g=10ms^{-2}] (a) 1.000m (b) 0.253m (c) 0.450m (d) 0.58m

2. A vehicle of mass m is driven by an engine of power P from rest. Find the minimum time it will take to acquire a speed v.
(a) $\frac{mv^2}{P}$ (b) $\frac{mv^2}{2P}$ (c) $\frac{mv}{P}$ (d) $\frac{mv}{2P}$

3. When a ball rolls on a smooth level ground, the motion of its centre is
(a) translational (b) random
(c) oscillatory (d) rotational

4. A body accelerates uniformly from rest at 6ms^{-2} for 8 seconds and then decelerates uniformly to rest in the next 5 seconds. The magnitude of the deceleration is: (a) 9.6ms^{-2} (b) 48ms^{-2} (c) 24.0ms^{-2} (d) 39.4ms^{-2}

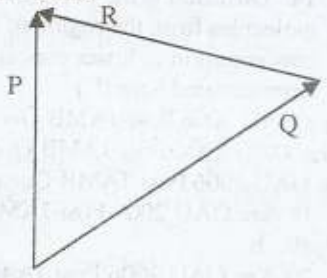
5. A nail is pulled from a wall with a string tied to the nail. If the string is inclined at an angle of 30^0 to the wall and the tension in the string is 50N, the effective force used in pulling the nail is
(a) 25N (b) $25\sqrt{3}$N (c) 50N (d) $50\sqrt{3}$N

6. A box of mass 40kg is being dragged along by a rope inclined at 60^0 to the horizontal. The frictional force between the box and the floor is 100N and the tension on the rope is 300N. How much work is done in dragging the box through a distance of 4m?
(a) 680J (b) 200J (c) 100J (d) 400J

7. A 70kg man ascends a flight of stairs of height 4m in 7s. The power expended by the man is:
(a) 40W (b) 100W (c) 280W (d) 400W

8. Which of the following statements is not true?
(a) As the slope of an inclined plane increases, the velocity ratio decreases.
(b) The efficiency of an inclined plane decreases as the slope increases.
(c) The effort required to push a given load up an inclined plane increases as the slope increases.
(d) The mechanical advantage of a smooth inclined plane depends on the ratio of the length of the plane.

9.



In the diagram above, P, Q and R are vectors. Which of the following options gives the correct relationship between the vectors?
(a) P = R – Q (b) P = R + Q
(c) P = Q – R (d) P + R + Q = 0

10. If M and R are the mass and radius of the earth respectively, and G is the universal gravitational constant, the earth's gravitational potential at an altitude H above the ground level is
(a) $-GM/H$ (b) $-GM/(R+H)$
(c) $-GM/2H$ (d) $-GM/(R-H)$

11. The ice and steam points of a thermometer are 20mm and 100mm respectively. A temperature of 75^{0}C corresponds to Ymm on the thermometer. What is Y?
(a) 100mm (b) 70mm (c) 80mm (d) 60mm

12. An electric kettle with negligible heat is rated at 2000W. If 2.0kg of water is put in it, how long will take temperature of water to rise from 20^0 to 100^0? [specific heat capacity of water = 4200 Jkg^{-1}K^{-1}] (a) 336s (b) 420s (c) 168s (d) 84s

13. A quantity of ice at -10^{0}C is heated until the temperature of the heating vessel is 90^{0}C. Which of the following constants is NOT required to determine the quantity of heat supplied to the vessel?
a) specific latent heat of vaporization
b) specific heat capacity of ice
c) specific latent heat of fusion
d) specific heat capacity of water

14. The scent from a jar of perfume opened in one corner of a room is picked up in another part of the room. The perfume moves through the air molecules by
(a) Evaporation (b) Osmosis
(c) Diffusion (d) Convection

15. A convex lens of focal length 10.0cm is used to form a real image which is half the size of the object. How far from the object is the image?
(a) 45cm (b) 30cm (c) 15cm (d) 20cm

16. A diverging lens of focal length 20cm forms an image halve of the size of the object. What is the object distance? (a) 11.11cm (b) 100cm (c) 60cm (d) 8.71cm

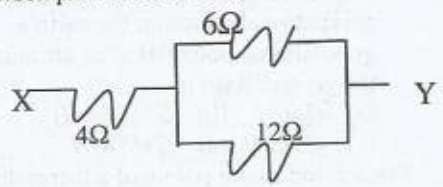
17. An object of height 3.00cm is placed 10cm in front of a biconvex lens of focal length 15cm. The image of the object is
(a) real and 3.00cm tall
(b) virtual and 3.00cm tall (c) virtual and 9.00cm tall (d) real and 9.00cm tall

18. The most suitable type of mirror used for the construction of a searchlight is the:
(a) concave mirror (b) spherical mirror
(c) convex mirror (d) parabolic mirror

19. Light waves and ripples of water are similar because both
(a) are longitudinal waves
(b) can be diffracted and refracted
(c) have the same velocity
(d) have the same frequency

20. Three 4-Ω resistors were connected in series by 'Tola while Ade connected the same set of resistors in parallel. The ratio of the value obtained by Ade to that obtained by 'Tola is
(a) 1:2 (b) 1:9 (c) 1:10 (d) 1:5

21. Three resistors are connected as shown in the diagram below. The equivalent resistance between points X and Y is



(a)8.0Ω(b)22.0Ω (c) 4.25Ω (d) 3.27Ω

22. A coil of copper wire of N turns is kept rotating between the poles of a permanent magnet such that the magnetic flux linking the coil changes continuously. Which of the following statements is TRUE?

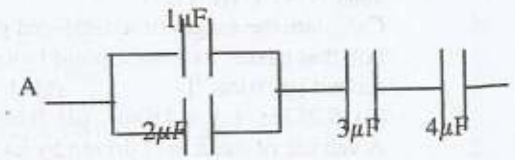
(a) An emf is induced in the coil such that when the change of flux is positive the emf is positive, and when the change of flux is negative, the emf is negative.

(b) An emf is induced in the coil whose magnitude is inversely proportional to both the number of turns in the coil and the rate of change of magnetic flux.

(c) An emf is set up in the permanent magnet which reduces the flux in the coil to zero.

(d) A current flows in the coil and an emf is set up proportional to both the rate of change of the flux and the number of turns.

23. What is the equivalent capacitance between points A and B in the diagram below?



(a) 12.0μF (b) 1.1μF (c) 1.6μF (d) 7.7μF

24. The principle of operation of an induction coil is based on (a)Ohm's law (b) Ampere's law (c) Faraday's law (d) Coulomb's law

25. The half-life of a radioactive element is 9 days. What fraction of atoms has decayed in 36 days? (a) $^1/_{16}$ (b) ¼ (c) ½ (d) $^{15}/_{16}$

26. Which of the following radiations cannot be deflected by an electric field or a magnetic field? (a)i. α-rays (ii) β-rays (iii) γ-rays (iv) X-rays (b) (i) and (ii) only (c) (iii) and (iv) only (d) (i) and (iii) only

27. The equation

$$^{150}_{62}X \rightarrow {}^{150}_{63}Y + K + \text{Energy}$$

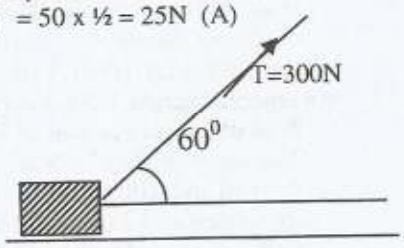
represents (a) α-decay (b) β-decay (c) γ-decay (d) photon emission

ANSWER KEY

1. B 2. B 3. D 4. A 5. A 6. B 7. D 8. B 9. B 10. B 11. C 12. A 13. A 14. C 15. A 16. – 17. C 18. D 19. B 20. B 21. A 22. D 23. B 24. C 25. D 26. C 27. B

SOLUTIONS

1. Check OAU 2007 Post JAMB Q2 (B)
2. Check OAU 2007 Post JAMB Q4 (B)
3. Check OAU 2007 Question 3 (A)
4. Check *OAU 2006 POST* JAMB Q2 (A)
5. The effective force pulling on the nail is resolved perpendicular to the wall;
   $=T \sin 30 = 50 \times ½ = 25N$ (A)
6.



Frictional force, $F_R = 100N$

$T \cos 60 - F_R = ma$

$300 \times ½ - 100 = 40a$

$a = 5/4 m/s^2$

Work done = Force x distance

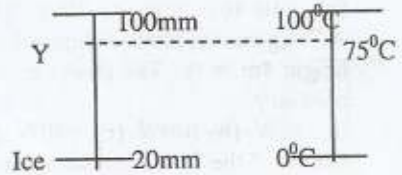
= mass x acceleration x distance

$=40 \times 5/4 \times 4 = 200N$ (B)

7. Check OAU 2006 POST JAMB Q1 (D)
8. The efficiency of inclined plane depend on how rough the surface of the inclined plane is and not on the slope. (B)
9. B
10. $r = H + R$

$$\Rightarrow V = \frac{-GM_e}{r} = \frac{-GM_e}{H+R} \quad (B)$$

11.



$$\frac{100^0C}{(100-20)mm} = \frac{75^0C}{Y-20mm}$$

$$(Y-20mm) = \frac{75 \times 80}{100}$$

$$Y = 60 + 20 = 80mm \quad (C)$$

12. Heat supplied by heater = heat gained by water

$2000 \times t = 2 \times 4200 \times (373 - 293)$

$t = 336secs$ (A)

13. Check 2006 OAU Post-JAMB Question 8 (A)
14. Diffusion is the movement of fluid/gas molecules from the region of higher concentration to lower concentration, this is demonstrated here (C)
15. See OAU 2006 Post-JAMB Question 11 (A)
16. See OAU 2006 Post-JAMB Question 12
17. See OAU 2006 Post-JAMB Question 13 (C)
18. See OAU 2006 Post-JAMB Question 14 (D)
19. B
20. See OAU 2006 Post-JAMB Question 16 (B)
21. See OAU 2006 Post-JAMB Question 17 (A)
22. D
23. See OAU 2006 Post-JAMB Question 19 (B)
24. See OAU 2006 Post-JAMB Question 20 (C)
25. See OAU 2006 Post-JAMB Question 23 (D)
26. Check OAU 2006 Question 23 (C)
27. Check OAU 2006 Question 21 (B)

1. The force with which an object is attracted to the earth is called…..
(a) Acceleration (b) Mass (c) Gravity
(d) Impulse (e) Weight

2. The refractive index of a liquid is 1.5. If the velocity of light in a vacuum is $3.0 \times 10^8 ms^{-1}$, the velocity of light in the liquid is (a) 1.5×10^8 m/s (b) 2.0×10^8 m/s (c) 3.0×10^8 m/s (d) 4.5×10^8 m/s (e) 9.0×10^8 m/s

3. A train has an initial velocity of 44m/s and an acceleration of -4 m/s. What is its velocity after 10 seconds? (a) 2 m/s (b) 4 m/s (c) 8m/s (d) 12 m/s (e) 16 m/s

4. A man of mass 50kg ascends a flight of stairs 5m high in 5 seconds. If acceleration due to gravity is $10ms^{-2}$, the power expended is
(a) 100w (b) 300w (c) 250w
(d) 400w (e) 500w

5. A machine has a velocity ratio of 5. If it requires a 50kg weight to overcome 200kg weight, the efficiency (a) 4% (b) 5% (c) 40% (d) 50% (e) 80%

6. If the force on a change of 0.2 coulomb in an electric field is 4N, then the electric intensity of the field is (a) 0.8 (b) 0.8N (c) 20.0N/C (d) 4.2N/C (e) 20.0C/N

7. The resistance of a wire depends on
(a) The length of the wire (b) The diameter of the wire (c) The temperature of the wire
(d) The resistivity of the wire
(e) All of the above

8. Which of these is not contained in a dry cell?
(a) carbon rod (b) paste of magnesium dioxide
(c) paste of ammonium chloride
(d) Zinc case (e) Copper rod

9. A simple pendulum 0.6m long has a period of 1.55. What is the period of a similar pendulum 0.4m long in the same direction?
(a) $1.4\sqrt{2/3\,s}$ (b) $1.5\sqrt{3/2\,s}$ (c) 2.25s
(d) 1.00s (e) 2.00s

10. A devise that converts sound energy into electrical energy is (a) The horn of a motor car
(b) An AC generator (c) A microphone
(d) The telephone earpiece (e) A loud speaker

11. Radio wave has a velocity of $3x10^8 ms^{-1}$. If a radio station sends out a broadcast on a frequency 800 kHz, what is the wavelength to the broadcast? (a) 375.0m (b) 267.0m (c) 240.0m (d) 37.5m (e) 26.7m

12. Which of these is not a fundamental S.I. unit?
(a) Metre (b) Ampere (c) Kelvin
(d) Second (e) Radian

13. If two masses 40g and 60g respectively, are attached firmly to the end of a light metre rule, what is the centre of gravity of the system
(a) the midpoint of the metre rule
(b) 40cm from the lighter mass
(c) 40cm from the heavier mass
(d) 60cm from the heavier mass
(e) indeterminate because the metre-rule is light

14. To find the depth of the sea, a ship sends out a sound wave and receives an echo after one

second. If the velocity of sound in water is 1500m/s, what is the depth of the sea?
(a) 0.75km (b) 1.50km (c) 2.20km
(d) 3.00km (e) 3.75km

15. What is the number of neutrons in the Uranium isotope $^{238}_{92}X$? (a) 92 (b) 146 (c) 238 (d) 330 (e) 119

16. The mode of heat transfer which does not require material medium is (a) conduction (b) radiation (c) convection (d) propagation

17. The height at which the atmosphere ceases to exist is about 80km. If the atmospheric pressure on the ground level is 760mmHg, the pressure at a height of 20km above the ground level is
(a) 380mmHg (b) 570mmHg
(c) 190mmHg (d) 480mmHg

18. Which of the following is common to evaporation and boiling? They (a) take place at any temperature (b) are surface phenomena (c) involve change of state (d) take place at a definite pressure (e) None of the above

19. Which of the following instrument has a pure tone? (a) Guitar (b) Vibrating string (c) Turning fork (d) Screen (e) Horns

20. Four lenses are being considered for use as a microscope objective lens. Which of the following focal lengths is most suitable?
(a) -5mm(b) +5mm (c) -5cm (d) +5cm (e) -5.5mm

21. The product PV where P is pressure and V is volume has the same unit as
(a) Force (b) Power (c) Energy
(d) Acceleration (e) All of the above

22. Two strings of the same length and under the same tension give notes of frequencies in the ratio 4:1. The masses of the strings are in the rates of
(a) 2:1 (b) 1:2 (c) 1:4 (d) 1:7 (e) 1:16

23. A household refrigerator is rated 200 watts. If electricity costs 5 k per kwh, what is the cost of operating it for 20 days?
(a) N4.80 (b) N48.00 (c) N480.00
(d) N4800.00 (e) N240.00

24. The resistance of a 5m uniform wire of cross-sectional area of $0.2 \times 10^{-6}m^2$ is 0.45Ω. What is the resistivity of the material of the wire?
(a) 1.80×10^{-8}ohms m (b) 4.25×10^{-6}ohms m
(c) 2.40×10^{7}ohms m (d) 1.70×10^{8} ohms m
(e) $1.40 \times 10_{-8}$ ohms m

25. When a yellow card is observed through a blue glass, the card would appear as (a) Black (b) Green (c) Red (d) White (e) Purple

ANSWER KEY

	C	6	C	11	A	16	B	21	C
2	B	7	E	12	E	17	C	22	E
3	E	8	E	13	C	18	C	23	A
4	E	9	B	14	A	19	C	24	A
5	C	10	C	15	B	20	B	25	A

SOLUTIONS

1. The force which we are in contact with in our daily lives is that which pulls us towards the earth, it is called Gravitational force – (C).

2. $Refractive\ index = \frac{velocity\ of\ light\ in\ vacuum}{velocity\ of\ light\ in\ liquid}$

Velocity of light in the liquid $= \frac{3 \times 10^8}{1.5}$

$= 2.0 \times 10^8$m/s (B)

3. $v = u + at$
$v = 44 + (-4)(10)$
$v = 44 - 40 = 4$m/s (B)

4. Power $= \frac{m \times a \times s}{t} = \frac{50 \times 10 \times 5}{5}$
$= 500$ W(E)

5. Efficiency $= \frac{L}{E} \times \frac{1}{V.R} \times 100$
$= \frac{2000}{500} \times \frac{1}{5} \times 10 = 80\%$ (E)

6. Electric Intensity,
$E = F/q = \frac{4N}{0.2C} = 20$N/C (C)

7. The resistance of a wire or rod is directly proportional to its length, and is inversely proportional to its cross-sectional area i.e. R = ρl/A. The resistance of a metallic conductor generally increases with temperature. If the resistance is R_0 at 0^0C and R at temperature T. Then $R = R_0(1 + \alpha T)$. The proportionality constant, R is called the resistivity of the material from which the wire is made, all the statements are correct (E).

8. In the dry cell, the electrolyte of wet Leclanche cell is substituted with a powder or jelly-like material consisting of a mixture of starch and ammonium chloride. The zinc electrode is made into a can to contain the electrode. The carbon electrode is surrounded by a mixture of manganese oxide (depolarizer). Copper rod is not used in the dry cell (E).

9. $\frac{T_2}{T_1} = \sqrt{\frac{L_1}{L_2}}$

$\frac{T_2}{1.55} = \sqrt{\frac{0.6}{0.4}} = \sqrt{\frac{6}{4}}$

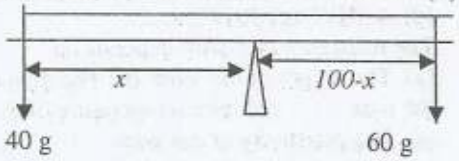
$\Rightarrow T_2 = 1.55x\sqrt{3/2}$ (B)

10. In microphone, sound vibration impinging on the diaphragm cause slight vibration of the diaphragm. This brings about some change in the pressure on the carbon granule causing corresponding changes in the resistance of the circuit (C).

11. $f = v/\Lambda \Rightarrow \Lambda = \frac{v}{f} = \frac{3 \times 10^8}{800 \times 10^3}$
$= 375$m(A)

12. Metre, Ampere, Kelvin, second are international system of units (S.I) while radian is a derived unit (E)

13.



$40(x) = (100 - x)60$

$4x = (100 - x)6$

$4x = 600 - 6x$

$4x+6x=600$

x = 60cm [i.e. 60cm from 40g and 40cm from 60g (heavier)] (C)

14. $v = \frac{2s}{t}$

$$S = \frac{vt}{2} = \frac{1500 \times 1}{2}$$

$= 750\text{m} \simeq 0.75\text{km}$ (A)

15. Mass number = 238

No. of proton + No. of Neutron = 238

:. atomic number =no of proton=92

No. of Neutron = 238 – 92

= 146 (B)

16. Conduction & convection require materials medium for heat transfer while radiation do not need materials medium, it is by electromagnetic waves (B)

17.

Pressure; P = hdg

$\frac{P}{h} = dg$

$\frac{P_1}{h_1} = \frac{P_2}{h_2}$

$\frac{760}{80} = \frac{x}{20}$

$x = \frac{760 \times 20}{80} = 190\text{mmHg}$(C)

18. Boiling takes place at a particular temperature & it takes place in the whole liquid. Then boiling and evaporation involves change of state i.e change from liquid to gases (C)

19. A well-made turning fork can produce a "pure note" that is one with a single frequency (C)

20. A compound microscope provides greater magnification than is attained with a single lens microscope. A basic compound microscope consists of a pair of converging lenses, each of which contributes the magnification. The converging lens with a relatively short focal length ($f_o < 1\ cm$) is known as the objective lens. It produces real, inverted & enlarged image of an object positioned slightly beyond its focal point. Option B (+5.5 mm) is real, and the only option less than 1 cm (B)

21. Pressure x Volume = $Nm^{-2} \times m^3$

= Nm = Joule (Unit for Energy) (C)

22. (If L and T are constant)

$F \alpha \frac{1}{\sqrt{m}} \Rightarrow f^2 \alpha \frac{1}{m}$ (If L & T are constant)

$\frac{m_1}{m_2} = (f_1/f_2)^2 = \left(\frac{1}{4}\right)^2 = \frac{1}{16}$

$= 1:16$ (E)

23. Total power consumed = (200 x 20 x 24)

= 96,000 kWh ≃ 96 kWh

Since 1 kWh is one unit at 5k

Total cost = 96 kWh x 5 kobo

= 480k (N4.80k) (A)

24. Resistivity, $\rho = \frac{RA}{l} = \frac{0.45\Omega \times 0.2 \times 10^{-6}\text{m}^2}{5m}$

$= 1.8 \times 10^{-8}\Omega\text{m}$ (A)

25. Blue glass will transmit only green light and yellow card reflects yellow i.e mixture of red and green light, no light is transmitted through the glass. So, it will be blackened

Ans: **(A).**

1. Which of the following phenomena cannot be explained by the molecular theory of matter?
(a) evaporation (b) expansion
(c) conduction (d) radiation

2. The most likely measurement of length of an object using a vernier caliper is
(a) 3.0cm (b) 3.3cm (c) 3.33cm (d) 3.333cm

3. An 0.040kg string 0.80m long is stretched and vibrated in a fundamental model with a frequency of 40Hz. What is the speed (of propagation) of the wave and the tension in the string?
(a) 64m/s (b) 340m/s (c) 32m/s (d) 128m/s

4. What is the total power output of a source with intensity 0.050 W/m^2 at a distance of 3.0 m from the source?
(a) 112W (b) 5.6 W (c) 15W (d) 30W

5. The superposition of two or more waves to produce a maximum or zero effect at a point is known as:
(a) reflection (b) refraction
(c) diffraction (d) interference

6. The acceleration due to gravity
(a) increases with increasing altitude
(b) decreases with increasing altitude
(c) increases with increase in the square of the altitude (d) is not affected by the altitude

7. Which of the following statements are correct of nuclear fission? During the process
(a) energy is released
(b) more neutrons are released than those that cause fusion (c) small nuclei merge into large nuclei (d) there is a loss of mass.

8. Which of the following statements is not true?
(a) electric field intensity is force per unit charge
(b) electric potential is a vector (c) the S.I. unit of electric field strength is N/C (d) electric field intensity is equal to potential gradient

9. Which of the following statements about electrolysis is false?
(a) liquid that conduct electricity and are split up chemically by the current are electrolyzed
(b) the current is brought into the electrolyte by the anode
(c) the current is taken away from the electrolyte by the cathode
(d) the container which holds the electrolyte and the electrode is the voltmeter

10. Which of the following is not true about the properties of x-rays?
(a) they are not deflected by magnetic or electric field
(b) they ionized a gas, making it a conductor
(c) they are massive
(d) they have high penetrating power

11. A transformer is connected to a 240V supply. The primary coil has 40 turns, and the secondary is found to be 960V. What is the ratio of the number of turns of the primary coil to the number of turns of the secondary coil?
(a) 1:4 (b) 4:1 (c) 1:6 (d) 6:1

12. If 21g of alcohol of density 0.7gcm^{-3} is mixed with 10g of water, what would be the density of the

resulting mixture? (a) 780gcm^{-3} (b) 0.78gcm^{-3} (c) 30gcm^{-3} (d) 10gcm^{-3}

13. For a particle having an x coordinate that varies in time according to the expression $x = 4t - 2t^2$. The instantaneous velocity for the particle at $t = 2.5$ is: (a) 12m/s (b) 6m/s (c) 0m/s (d) 10m/s

14. A long-jumper leaves the ground at an angle of 20^0 above the horizontal and at a speed of 11m/s. How far does it jumps in the horizontal direction? (a) 0.384m (b) 7.94m (c) 8.45m (d) 0m

15. A mass of 0.5kg is attached to one end of a helical spring and produces an extension of 2.5cm. The mass now set into vertical oscillation of amplitude 10mm. The period of oscillation is: (g =10m/s^2) (a) 0.33s (b) 100s (c) 200s (d) 280s

16. A boat is passing under a bridge. The deck of the boat is 15m below the bridge. A small package is to be dropped from the bridge onto the deck of the boat when the boat is 25m from just below the drop point. What (boat) speed is necessary to have the package land in the boat? (g = 9.8m/s^2) (a) 17m/s (b) 14m/s (c) 1.7m/s (d) 4.9m/s

17. An 0.60kg rubber stopper is whirled in a horizontal circle of 0.80m radius at a rate of 3.0 revolutions per second. What is the tension in the string? (a) 14N (b) 80N (c) 170N (d) 24N

18. An automobile is traveling at 60km/hr. Calculate the angular velocity of the 0.35m radius wheels (a) 16.67 rad/s (b) 47.6 rad/s (c) 21 rad/s (d) 171.4 rad/s

19. An air bubble at the bottom of a lake has a volume of 20cm^3, pressure of 4.9Pa, and temperature 4^0C. The bubble rises to the surface where the temperature is 20^0C and the pressure 1.0Pa. Find the volume as the bubble reaches the surface (Take 1 atm = 1.0 x 10^{5}N/m^2) (a) 124cm^3 (b) 319cm^2 (c) 60cm^3 (d) 104cm^3

20. A gas at constant pressure of 4.0 x 10^5 Pa is cooled so that its volume decreases from 1.6m^3 to 1.2m^3. What work is performed by the gas? (a) 6.4 x 10^{5}J (b) 3.2 x 10^{5}J (c) 1.6 x 10^{5}J (d) 0.4 x 10^{5}J

21. Highly polished silvery surfaces are:
(a) poor absorbers but good emitter of radiation
(b) Good absorbers and good emitters of radiation
(c) Poor emitters but good reflectors of radiation(d) Poor emitters and poor reflectors of radiation

22. Which of the following is not true about an object that is projected upwards at angle θ
(a) the velocity is maximum at the maximum height
(b) the acceleration along the horizontal direction is zero
(c) the maximum range (R_{max}) for an object moving with speed u is given by $\frac{u^2}{g}$
(d) the time it takes to get the maximum height is equal to the time it takes to come back to the point of projection.

23. When three coplanar non-parallel forces are in equilibrium. Which of the following statements is false?
(a) they can be represented in magnitude and direction by the three sides of a triangle taken in order
(b) the lines of action meet at a point
(c) the magnitude of any one force equals the magnitude of the resultant of the other two forces
(d) any one force is the equivalent of the other two.

24. Which of the following statements is not TRUE about a body performing simple harmonic motion
(a) the linear speed is the product of the angular speed and the radius or amplitude
(b) the linear acceleration is the product of the square of the angular speed and the displacement
(c) frequency is the number of complete revolution per second made by a vibrating body
(d) the S.I. unit of amplitude is Hertz (Hz).

25. If the force of gravity of an object of mass m, the gravitational field strength, g, is given by the following equation:
(a) $g = \sqrt{mF}$ (b) $g = mF$
(c) $g = m\sqrt{F}$ (d) $g = \frac{F}{m}$

ANSWER KEY

1.	B	2.	C	3.	A	4.	-	5.	D
6.	B	7.	-	8.	D	9.	D	10.	C
11.	A	12.	B	13.	B	14.	B	15.	A
16.	B	17.	C	18.	B	19.	D	20.	C
21.	D	22.	A	23.	A	24.	D	25.	D

SOLUTIONS

1. Molecules of all substances whether solid, liquid and gases are in random motion. Conduction is heat transfer by molecular vibration at a fixed position. Radiation is the transfer of heat between two bodies by means of electro-magnetic radiation. Expansion involves an increase in the separation between molecules which lead to increase in size (B)

2. Vernier caliper can be used in measuring the diameter of a rod or the inside diameter of a tube. It's reading is always in two decimal places where the second decimal place is given by the number on the vernier scale which coincides with a major scale mark.(C)

3. In fundamental note, f_0, $L = \lambda/2$

$$\lambda = 2L = (2)(0.80m) = 0.16m$$

$$v = f\lambda = 0.16 \times 40 = 6.4\text{m/s} \quad \text{(A)}$$

4. Intensity, $E = \frac{q_1}{4\pi\varepsilon_0 r^2}$

$$\frac{1}{4\pi_0} = 9 \times 10^9$$

$$q = \frac{0.05 \times 3^2}{9 \times 10^9}$$

$$q = 5 \times 10^{-11}C$$

Force = E x q = 0.05 x 5 x 10^{-11}

$$= 2.5 \times 10^{-12}N$$

Work done = Force x Distance

$$= 2.5 \times 10^{-12} \times 3 \quad = 7.5 \times 10^{-12}\text{J}$$

$$\text{Power} = \frac{\text{Work done}}{\text{Time}}$$

& time is not given.

5. The principle of superposition takes place when two or more disturbances are simultaneously present in the

medium. Interference results from the superposition of two or more waves trains. Destructive interference result in the reduction or zero amplitude of waves. Constructive amplitude causes the amplitude to be larger.(D)

6. Freely falling bodies have accelerated motion. The force of gravity is the pull exerted by the earth on the bodies near it, it varies with altitude, as the altitude increases the effect of the gravitational force reduces (B)

7. All the statements are correct about nuclear fission

8. Electric field has unit of N/C & it is a vector quantity. The potential gradient at a point is the amount of work that will be done in bringing a unit charge from infinity to that point. It is not equal to Electric field intensity(D)

9. Electrolysis is the decomposition of ionic compounds by means of an electric current passed into the aqueous solution or molten form of the compound through conductors known as Electrode. The electrode (anode & cathode) through which current leaves or enters the solution. The container is never used as voltmeter (D)

10. X- rays are produced by the bombardment of fast moving electrons. They are electromagnetic waves &do not have mass, they are not deflected by magnetic or electric field. They have high penetrating power that is why they are used for observing the internal structure of human being e.g Bones. They ionize gas, making it a conductor (C)

11. $$\frac{E_s}{E_p} = \frac{n_s}{n_p} = \frac{960}{240} = \frac{n_s}{40}$$
$$n_s = \frac{960 \times 40}{240}$$
$$n_s = 160$$
Ratio $n_p : n_s = 40 : 160 = 1 : 4$ (A)

12. Density = Mass/Volume
Volume of alcohol $= \frac{21g}{0.7gcm^{-3}} = 30cm^3$
Volume of water $= \frac{10g}{1gcm^{-3}} = 10cm^3$
Total volume of mixture = 30+10=40cm^3
Mass of mixture = 21g + 10g = 31g
Density = $31/40 = 0.775gcm^{-3}$ (B)

13. $x = 4t - 2t^2$
$\frac{dx}{dt} = 4t - 2t^2$
$= 4 - 4t = 4 - 4(2.5) = -6$m/s
Velocity, v = 6m/s (B)

14. Range, $R = \frac{U^2 \sin 2\theta}{g} = \frac{(11)^2 \sin(2)(20)}{9.8}$
$= 7.94$m (B)

15. For helical spring,
$T = 2\pi\sqrt{e/g} = 2\pi\sqrt{e/g}$
$$T = 2 \times \frac{22}{7}\sqrt{\frac{0.025}{10}}$$
$$T = 0.3167s \simeq 0.32s \quad (A)$$

16. i.e the time, it takes for the package to reach the boat, is also the time the boat must take to travel to that point at its own speed.
$$S = ut + \frac{1}{2}at^2$$
$$15 = 0 \times t + \frac{1}{2} \times 9.8 \times t^2$$
$$15 = 4.9t^2$$
$$t = 1.825secs$$
$$\text{Velocity} = \frac{displacement}{time} = \frac{25}{1.825}$$
$$= 13.6m/s \simeq 14\text{m/s} \quad (B)$$

17. $v = \frac{2\pi r}{T} = \frac{2 \times 3.142 \times 0.8}{\frac{1}{3}} = 15.0816m/s$
$$T = \frac{mv^2}{r} = \frac{0.6 \times (15.08)^2}{0.8}$$
$$= 170.5\text{N} \quad (C)$$

18. Velocity in m/s $= \frac{60 \times 1000}{60 \times 60} = 16.67m/s$
$w = \frac{v}{r} = \frac{16.67m/s}{0.35m} = 47.63\,rad/s$ (B)

19. Pressure, $P_1 = 4.9\,Pa$
$V_1 = 20cm^3$
$T = 4^0C = 4^0C + 273 = 277K$
$P_2 = 1.0Pa$
$T_2 = 20^0C = 20 + 273 = 293K$
$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$
$$V_2 = \frac{293x \ 20 \times 4.9}{1 \times 277}$$
$$= 103.66 \simeq 104\text{cm}^3 \quad (D)$$

20. Work done = $P\Delta V$
$= 4.0 \times 10^5 \times (1.6 - 1.2)$
$= 1.6 \times 10^5$J (C)

21. Bright/shining surface are poor radiator & Brightly polished surfaces are poor absorber. This is demonstrated by using a ball bearing experiment (D)

22. The velocity is zero at the maximum and the P.E is maximum (A)

23. A body of three coplanar non-parallel forces are in equilibrium if the resultant of the forces is zero. i.e $\underline{F_1} + \underline{F_2} + \underline{F_3} = 0$ and the line of action have to meet for the formation of a closed triangle. The equilibrant of a group of forces is equal but in opposite in direction to the resultant of the other two. Statement A is false (A)

24. D – The S.I. unit of Amplitude is meter and Hertz is for frequency

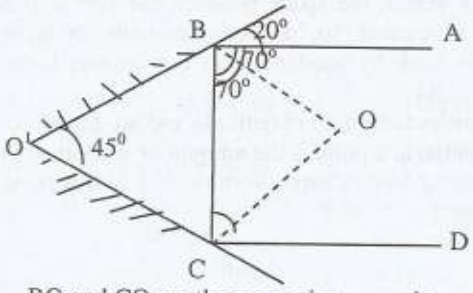
25. $F = ma = mg$
$g = {}^F/_m$ (D)

1. Two plane mirror are inclined at angle 45^0 one to another. A ray of light has incident angle 20^0 at the surface of the first mirror. The reflected ray is then incident on the second mirror. Calculate the angle of reflection at the second mirror
   (a) 65^0 (b) 45^0 (c) 25^0 (d) 20^0
2. When the length of the string of a simple pendulum is L its period is 0.5π seconds. The period when the length is increase to 4L will be
   (a) $0.5\ \pi$ seconds (b) π seconds
   (c) 2π seconds (d) 4π seconds

3. A uniform meter rule AB has a mass 15 g. A 30 g mass is suspended at the 10.0 cm mark, and another 5 g mass is suspended at the 65.0 cm mark. Calculate the position of the fulcrum that will keep the meter rule balanced horizontally.
(A) 50.0 cm (B) 32.0 cm (C) 27.5 cm (D) 17.9 cm
4. A rectangular block measures 40cm x 25cm x 5cm and is made of a material of density 7800 kgm^3. Calculate the pressure the block exert on the floor when it stand on the smallest of its surfaces
(A) 3.12×10^3 N/m^2 (B) 3.90×10^3 N/m^2
(C) 1.95×10^4 N/m^2 (D) 3.12×10^4 N/m^2
5. A ship sinks to the bottom of a 250 m deep lake. The atmospheric pressure over the lake is 1.03×10^5 Pa. Taking the density of water in the lake to be 1000kg/m^3 calculate the pressure exerted on the boat(acceleration due to gravity, g = 10m/s^2) (A) 2.60×10^6 Pa (B) 2.50×10^6 Pa
(C) 2.60×10^5 Pa (D) 1.03×10^5 Pa
6. Three knives made of steel, plastic and flat wood respectively are placed on a table for an equal amount of time. The steel knife feels coldest to touch because
(A) the steel knives has the lowest temperature
(B) the plastic and wooden knives gave absorbed more heat from the environment than the steel knives
(C) Both wooden and plastic knives have knives densities than the steel knife
(D) the steel knife conducts heat faster from the finger than the wooden and plastic knives
7. The coefficient of linear expansion of aluminum is $23 \times 10^{-6} K^{-1}$. If the volume of a pot made with aluminum at temperature T_0 is V_0, what will be the change in temperature resulting in a decrease of 0.20% in a volume of the pot?
(A) -87^0C (B) $+87^0$C (C) $+29^0$C (D) -29^0C
8. Which of the following features is used to minimize heat loss due to conduction in a thermo-flask is evacuated?
(A) the space between the two walls of the vacuum flask is evacuated
(B) the vacuum flak is separated from the outer wall with corks
(C) the surfaces of the vacuum flask are silvered
(D) the inner and outer walls of the flask are made silver.
9. Which of the following quantities is a scalar quantity?
(A) Electric field (B) Coulomb force
(C) Electric potential (D) Acceleration due to gravity
10. A car accelerates at 5.0m/s^2 for 6s, the travel at the speed attained for 20s, and comes to rest after another 4.0s. Calculate the average velocity of the car during the motion.
(A) 25.0m/s (B) 20.0 m/s (C) 1.25m/s (D) 0.16m/s
11. Which of the following quantities is equal to the area under a velocity- time graph?
(A) Acceleration (B) distance travelled
(C) Average velocity of motion (D) Total time taken
12. A 25 N force pull a 2.0kg body up a 30^0 inclined plane if the force is parallel to the plane and the body moves up the plane at constant velocity, calculate the magnitude of the frictional force between the body and the plane({g=10m/s}
(A) 35N (B) 25N (C) 20N (D) 15N
13. The process by which a solid changes directly to vapour is called
(A) Evaporation (B) fusion
(C) Condensation (D)Sublimation
14. A resonance tube is 40cm long. The second resonance is heard when the tube is three- quarter full. What is the frequency of the tuning fork placed near the mouth of the tube ? [velocity of sound in air is 334 m/s]
(A) 2511Hz (B) 1670 Hz (C) 835 Hz (D)345Hz
15. A coin is at the bottom of a bucket filled with a liquid whose refractive index is 1.35. The coin appears to be 12.0 cm below the surface of the liquid. Calculate the depth of the liquid (A) 16.2 cm (B) 13.4 cm (C) 8.9 cm (D) 5.4 cm
16. A 3.0cm object is placed 12.0cm in front of a bi-convex lens of focal length 8.0cm. Calculate the height of the image of the object (A) 3.0cm (B) 6.0cm (C) 12.0cm (D) 24.0cm
17. To use milli-ammeter to measure current at 10A, what connection need to be made?
(A) A mall resistance must be connected in series with the milli -ammeter
(B) A small resistance must be connected in parallel with the milli-ammeter
(C) A high resistance must be connected in parallel with the milli-ammeter
(D) The milli-ammeter must be disconnected fro the circuit
18. Two resistor A and B are made of the same material. The radius of A is three times that of B, and the length of A is half of B. The ratio of the resistance of A to that of B is
(A) 3/2 (B) 2/3 (C) 2/9 (D) 9/2.
19. Two 2 μF capacitors are connected in parallel. The combination is connected in series with a 6 μF capacitor. What is the equivalent capacitor for the combination?
(A) 10.0 μF (B) 8.0 μF (C) 1.5 μF (D) 2.4 μF.
20. Five 100 – Watt bulbs are put on for 45 days during which the home – owner is on vacation. If 1KW –hour of electricity costs ₦7.50, how much does it cost the home owner?
(A) ₦168.75 (B) ₦90.00 (C) ₦4050.00 (D) ₦810.00
21. To convert an a.c generator to a d.c generator, one needs to
(A) Remove the brush touching the slip rings
(B) Laminate the armature
(C) Replace the permanent magnets with soft iron-core armature (D) Replace the slip rings with split.
22. A student afraid that the substance near him is radioactive and places his lecture note between him and the substance. If truly the substance is radioactive, which of the following radiation can the notebook shield him from?
(A) Gamma rays (B) Neutrons
(C) Alpha particles (D) Energetic beta rays

Solution

1.



BO and CO are the respective normal to each of the mirrors
Angle of incidence at B = OBA = 90-20 = 70°
Angle of reflection at B = OBC = 70°
BO^{1}C = BOC= 45°
Sum of Angles in Δ BOC= 180°
Since < BOC + < OCB + OBC = 180°

$45^\circ + \angle OCB + 70^\circ = 180^\circ$

$\angle OCB = 180^\circ - (70^\circ + 45^\circ)$

$\angle OCB = 65^\circ$

$\angle OCB$ = angle of incidence at C & Angle of incidence is equal to angle of reflection at C = 65° (A)

2. Length, $L_1 = L$

Period, $T_1 = 0.5\Pi$ Secs

when $L_2 = 4L$. & $T_1 = ?$

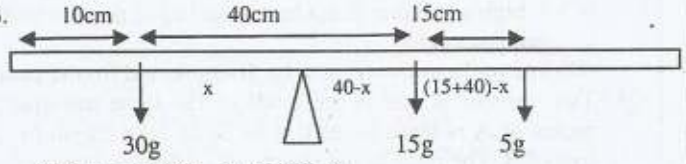
$$f = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$$

$$\frac{T_2}{T_1} = \sqrt{\frac{L_1}{L_1}}$$

$$\frac{T_2}{0.5\pi} = \sqrt{\frac{4L}{L}} = \sqrt{4} = 2$$

$\Rightarrow T_2 = 0.5.0\pi\ (2) = \pi$ (B)

3.



$(30)\ x = 15\ (40 - x) + 5\ (55 - x)$

$30x = 600 - 15x + 275 - 5x$

$50x = 875$

$x = 17.5$cm

The fulcrum position = (17.5 + 10) cm = 27.5 cm(C)

4. $P = hgd = 0.4\ m \times 10\ m/s^2 \times 7800\ kg/m^3$

$= 3.12 \times 10^4\ N/m^2$

5. Total pressure = hgd + Atmospheric Pressure

$= (250 \times 10 \times 1000) + 1.03 \times 10^5$

$= 2.603 \times 10^6$ Pa (A)

6. The heat Capacity of a substance is defined as the heat energy required to raise the temperature of the substance by 1^0C. Therefore equal masses of different substance required different quantities of thermal energy to raise them through the same temperature range. The steel will absorb or release heat fast than the other two materials

7. $\propto = 23 \times 10^{-6}\ K^{-1}$

Cubic expansivity, $\gamma = 3\alpha = 3 \times 23 \times 10^{-6}\ K^{-1}$

Cubic expansitivity $\alpha = \left(\frac{V_t - V_o}{V_o}\right) \times \frac{1}{t}$

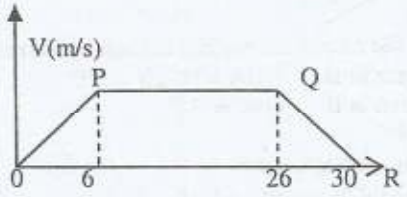
$t = \left(\frac{\Delta v}{v}\right) / \gamma$

$t = \frac{0.002}{23 \times 10^{-6}} = +86.95^\circ$C (B)

8. Heat transfer by radiation is reduced to a minimum by the silvering of the glass surface. The vacuum flask is a double-walled glass vessel, the space between the two wall being completely evacuated, so, no heat can enter or leave the liquid in the flask by conduction or convection across the vacuum (A)

9. Scalar quantities have only magnitude and no direction. The electric potential at a point is the amount of work that will be done in bringing a unit charge from infinity to that point it is a scale quantity (C)

10.



The v-t diagram is drawn above, and labelled OPQR.

Since the slope of OP is $5m/s^2$

The height of the trapezium OPQR

$= 5\ m/s^2 \times 6\ s = 30m/s$

Distance travelled = Area of the trapezium

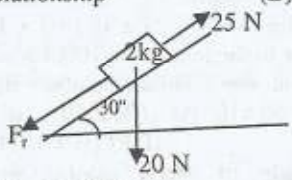
$= \frac{1}{2}(OR + PQ) \times 30$

$= \frac{1}{2}(30 + 20) \times 30 = 750m$

Average Velocity $= \frac{Distance}{time} = \frac{750}{30} = 25m/s$ (A)

11. The area under a velocity – time graph is the total time travelled Read Graphical methods of representing velocity – time relationship (B)

12.



$25\ N - F_r = mg \sin\theta$

$F_r = 25 - [2 \times 10 \times \sin 30]$

$= 25 - [20 \times 0.5]$

$F_r = 15$ N (D)

13. Some solid substances changes directly to vapour/gaseous state in the process called sublimation. Example are Iodine, Crystal, Ammonium chloride &Camphor (D)

14. For second resonance/first overtone, $L = \frac{3\lambda}{4}$

$$\lambda = \frac{4L}{3} = \frac{4 \times 40}{3}$$

$= 53.3$ cm

$= 0.533$ m

$$f = \frac{v}{\lambda} = \frac{334m/s}{0.533m} = 626.25\ Hz$$

15. Refractive Index $= \frac{Real\ depth}{Apparant\ depth}$

Real depth = 1.35 x 12 .0cm = 16.2cm (A)

16. $f = 8.0$cm

Object height = 3.0cm

Object distance from the lens, u = 12.0cm

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$$\frac{1}{12} + \frac{1}{v} = \frac{1}{8}$$

$$\frac{1}{v} = \frac{1}{8} - \frac{1}{12}$$

$$\frac{1}{v} = \frac{3-2}{24}$$

$$\frac{1}{v} = \frac{1}{24}$$

$v = 24$cm

$$\frac{\text{Image height}}{\text{object height}} = \frac{\text{Image distance}}{\text{object distance}}$$

Image height = Object height x $\frac{\text{Image distance}}{\text{object distance}}$

Image height $= 3 \times \frac{24}{12} = 6.0$cm (B)

17. This is achieved by connecting a low resistance in parallel to the milli-ammeter, this low resistance bye passes the greater part of the current through the circuit so that only a small fraction of it passes through the milli-ammeter itself (SHUNT) (B)

18.

	A	B
Radius:	$3r_B$	r_B
Length:	$\frac{1}{2}L_B$	L_B
	$R_A = \frac{\rho \times \frac{1}{2}L_B}{(3r_B)^2}$	$R_B = \frac{\rho \times L_B}{(r_B)^2}$
	$= \frac{1}{18r_B}$	$= \frac{1}{r_B}$

Ratio of resistance A to B; 1:18

19. In parallel $C_{eq} = C_1 + C_2$
$= 2\mu f + 2\mu f = 4\mu f$
In series, the total equivalence Capacitance,
$= \frac{1}{Cq} = \frac{1}{4} + \frac{1}{6} = \frac{5}{12}$
$C_{eq} = \frac{12}{5} = 2.4\mu f$ (D)

20. Total power used by the bulb = 5 x 100 = 500 Watt
No. of hours for which the bulb are used, in 45days
= 45 x 24 = 1040hrs.
Energy Consumed = (500 x 1040hrs)/1000 = 540 kWh
Cost of Energy = ₦7.50 x 540
= ₦4,050 (C)

21. This is done by simply replacing the slip rings of the a.c generator with the spilt ring of a d.c generator (D)

22. The notebook can only shield him from Alpha (α) particles because it has low penetrating power (C)

ObafemiAwolowo University, Ile Ife
2013 Post UTME Screening Exercise

1. Adeoye moves a distance of 4.0km from a point, A on a bearing of N 30° E to a point, B and then a distance of 3.0km on a bearing of S 69° E to a point, C. Calculate Adeoye's resultant displacement form point, A
A. 10km, N 60° E B. 5km, N 67° E
C. 3km, N 30°E D.4km, N 50°E

2. Which of the following is not a property of sound wave?
B. Reflection B. Diffraction
C. Polarization D. Refraction

3. A boy stands at a distance, x from a wall. When he shouted, the echo was heard 2 seconds later. Calculate the distance from the wall, given that the speed of light is 330m/s.
A. 340m B. 340m C. 250m D. 495m

4. In a 60° prism of refractive index, 1.5, calculate the angle of minimum deviation when light is refracted through the prism.
A. 40.2° B. 37.5° C. 37.2° D. 40.5°

5. Which of the following statements is true?
A. The unit of mass is Newton (N)
B. Weight of an object is a scalar quantity
C. The weight of an object varies from one place to another
D. The dimensions of weight are $M^{-2}LT^{-2}$

6. Which of the following is not an example of rotational motion?
A. Rotation of electric fan blades
B. Movement of car wheels
C. Rotation of the earth about its axis
D. Movement of a loaded spring about its equilibrium position.

7. A pin at the bottom of a beaker filled with water appeared to be elevated when viewed from the top of the beaker. Calculate the displacement of the pin from the bottom of the beaker. If the beaker is filled to 8.0cm height and the refractive index of water is 4/3.
A. 6.0 cm B. 2.0 cm C. 3.0 cm D. 4.0 cm

8. An object of mass, 5kg placed on an inclined plane (which is at an angle of 30° to the horizontal) is attached to a 10kg mass through a pulley, with the 10 kg hanging vertically. Calculate the acceleration of the mass-system in terms of the acceleration due to gravity, g, if there is no friction between the 5kg mass and the plane.
A. $\frac{2}{5}g$ B. $\frac{3}{5}g$ C. $\frac{1}{2}g$ D. $\frac{3}{4}$

9. Which of the following is not true about the mechanical energy of a system in a conservative field?
A. Total energy is zero
B. Total energy is the sum of the kinetic energy and the potential energy.
C. Total energy is equal to the maximum value of kinetic energy.
D. Total energy is equal to the maximum value of potential energy.

10. A cell of e.m.f. 4.0V is connected in series to two resistors 2 Ω and 4 Ω, which are connected in parallel. Calculate the current which flows through the 4 Ω resistor.
A. 1.0 A B. 2.0A C. 3.0 A D. 4.0 A

11. A step-down transformer is energized by a 220V a.c. supply and supplied a current of 10A to the secondary winding. Calculate the current which flows through the primary winding if the ratio of the primary winding to secondary winding is 10.3.
A. 10A B. 3 A C. 4 A D. 5 A

12. All the following properties are characteristics of X-rays except
A. They have short wavelength
B. They have no charge
C. They are electromagnetic in nature
D. They do not affect photographic plates

13. Surface tension is the
A. Pressure per unit length on either side of the imaginary line drawn on the liquid surface at rest.
B. Force per unit length on either side of the imaginary line drawn on the liquid surface at rest.
C. Current per unit length on either side of the imaginary line drawn on the liquid surface at rest.
D. Area per unit length on either side of the imaginary line drawn on the liquid surface at rest.

14. A machine has an efficiency of 60%. If the machine applied a force of 2000 N to overcome a load of 5000 N, calculate the velocity ratio of the machine.
A. 2.4 B. 3.3 C. 4.2 D. 5.5

15. Which of the following statements is true about the hydrostatic pressure?
(i) Pressure increases with height
(ii) Pressure is independent of the shape and volume of the vessel
(iii) Pressure is the same at all points on the same horizontal plane in a fluid
(iv) Pressure is independent of the surface area in contact
A. (i), (ii), (iii) and (iv) B. (i), (ii) and, (iii) only
C. (ii), (iii) and (iv) only. D. (i), (ii) and (iv) only

16. The resistance of a platinum resistance thermometer is 160.5 Ω at steam point and 60.5 Ω at the melting point of ice. Calculate the resistance of the thermometer at 80'C.
A. 160.5 ΩB. 165.5 ΩC. 130.5Ω D. 170.5 Ω

17. Which of the following is not an application of expansion of solids?
A. Rivets B. Bimetal strips
C. Fitting of wheels on rims in railway coaches
D. Regelation.

liquid?

A. The presence of dissolved impurities increases the melting of a pure solid.

B. An increase in pressure decreases the melting of a substance that contracts in volume on freezing, more than the one that expands in volume.

C. The melting point is not the same as the solidification of a substance.

D. The presence of the dissolved impurities does not change the melting point of a pure solid.

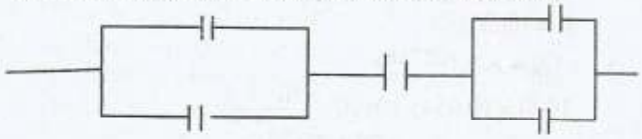
19. The wall separating a bakery oven and its environment is of h, 10 m, breadth, 10 m; and thickness, 25 cm. If the rate of heat exchange between the oven and its environment is 1000 watt and the temperature of the environment is 27°C, calculate the temperature of the oven, given that the coefficient of thermal conductivity of the wall is 0.054 $Wm^{-1}K^{-1}$.

A. 27.3°C B. -40.2°C C. 40.2°C D. 73.3°C

20. A boy preparing to have his bath mixed 50 kg of water at a temperature of 80°C with 70 kg of water at a temperature of 20°C. What is the temperature of the water mixture?

A. 45°C B. 75°C C. 65°C D. 35°C

21. Calculate the resultant capacitance of the capacitor network, if each capacitor has a capacitance of 2μF



A. 2.0μF B. 1.0μF C. 2.5μF D. 2.3μF

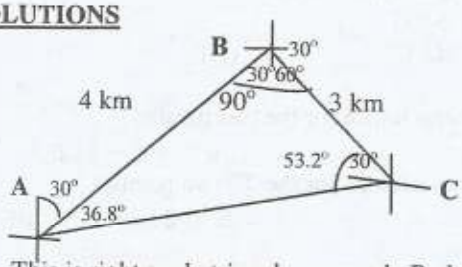
22. $^{238}_{92}U \rightarrow {}^{234}_{90}Th + X$

What particle is emitted in radioactive decay process show above?

A. β - particle B. X-ray C. α particle D. γ- ray

SOLUTIONS

1.



This is right angle triangle, we apply Pythagoras theorem

$AC^2 = BC^2 + AB^2$

$= 3^2 + 4^2$

$AC = \sqrt{9 + 16}$

$AC = 5$ km

→for the bearing

$A = \tan^{-1}(3/4)$

$= 36.8°$

The bearing of C from A is $30° + 36.8 = 66.8°$

$\simeq$ N 67 E

⇒ 5Km, N67° E (B)

2. Sound waves are longitudinal waves, they travel parallel to the direction of propagation. It is only transverse wave that can undergo polarization which distinguish them from longitudinal waves (C)

3. Velocity of sound, V = 330 m/s time taken for the echo to be received, t = 2 seconds. Thus, the time taken for the sound to travel from the men to the cliff

$= t/2 = 2/2 = 1$s

Distance between men and wall

$S = \frac{vt}{2}$

$= 330 \times 1 = 330$ m

4. Refraction index, $n = \frac{\sin \frac{1}{2}(A + D_{min})}{\sin \frac{1}{2} A}$

A = Angle of the prism

$1.5 = \frac{\sin \frac{1}{2}(60 + D_{min})}{\sin \frac{1}{2}(60)}$

$\sin \frac{1}{2}(60 + D_{min}) = 1.5 \times \sin 30$

$= 1.5 \times \frac{1}{2}$

$\frac{1}{2}(60 + D_{min}) = \sin^{-1}(0.75)$

$60 + D_{min} = 2(48.59)$

$D_{min} = 2(48.59) - 60$

$D_{min} = 37.18$

$D_{min} \simeq 37.2°$ (C)

5. The unit of mass is kilogram, kg not Newton. Weight is a vector quantity, it is the measurement of an object under gravity and it varies from one place to another for example, the weight of a man on earth varies from when measured on the moon because the mass of the earth exceeds that of the moon. The dimension of weight is MLT^{-2} not $M^{-2}LT^2$ (C)

6. Rotational motion is the turning of a body around a fixed point e.g. the blade of an electric fan (A)

7. Refractive index = $4/3$

Real depth = 8 cm

Apparent depth is the false depth of the pin, the pin appears upward than its actual depth.

Refractive index = $\frac{\text{Real depth}}{\text{Apparent depth}}$

Apparent depth = $\frac{8}{(4/3)}$

$= 8 \times \frac{3}{4} = 6$ cm

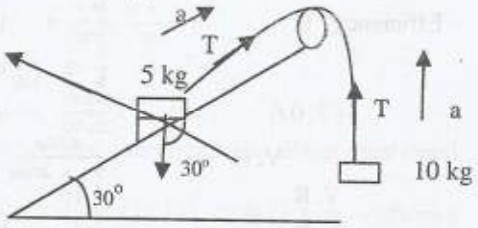
⇒ The depth displacement from the bottom of the water

= Real depth - Apparent depth

= 8 - 6

= 2.0 cm (B)

8.



Referring to the diagram,

For 5 kg, (m_1), Forces acting on the block parallel to the inclined are the resolved component of its weight down the plane

$T - m_1 g \sin 30 = ma$ (i)

For 10 kg

$M_2 g - T = ma$ (ii)

From (i)

$T - 5g \times 0.5 = 5a$ (iii)

From (ii)

$10g - T = 10a$ (iv)

Add eqn (iii) + (iv)

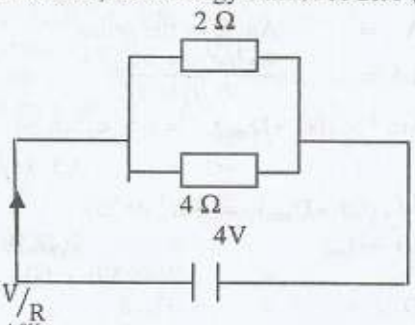
$10g - 2.5g = 10a + 5a$

$7.5g = 15a$

$a = \frac{7.5}{15} g = \frac{1}{2} g$ (C)

9. Principle of conservation of energy states that energy cannot be created or destroyed but it may be converted from one form to another. At different point, the mech - anical energy might be equal to kinetic energy or poten - tial energy. Therefore, total energy cannot be zero (A)

10.



$I = {}^{V}/_{R}$

$= \frac{4.0V}{4.0\Omega} = 1.0\ A$ (A)

11. $N_S:N_p = 3:10$

$\frac{V_s}{V_p} = \frac{N_s}{N_p}$

$\frac{V_s}{220} = \frac{10}{3}$

$V_s = \frac{220 \times 10}{3}$

$V_s = 733.3V$

$\frac{V_s}{V_p} = \frac{I_p}{I_s}$

$\Rightarrow \frac{733.3}{220} = \frac{10}{I_s}$

$I_s = \frac{220 \times 10}{733.3} = 3\ A$ (B)

12. X-rays possess properties which are common to all electromagnetic waves. They travel in straight line and have short wavelength. They are not deflected by electric field or magnetic field. They affect photographic plates and paper causing them to become fogged as if they are exposed to light (D)

13. The surface tension of a liquid is the force per unit length perpendicular to a line in the surface of the liquid (i. e. $\gamma = {}^{F}/_{l}$) (B)

14. Efficiency = 60%

Force, F = 2,000 N, Load, L = 5,000 N

Efficiency, $E = \frac{MA}{VR} \times 100\%$

$= \frac{L}{E} \times \frac{1}{V.R} \times 100\%$

$0.6 = \frac{5000}{2000} \times \frac{1}{V.R}$

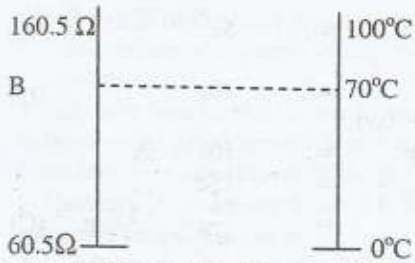
$V.R = \frac{5000}{0.6 \times 2000}$

$V.R. = 4.16$

$V.R \simeq 4.2$ (C)

15. Pressure depends on the density and height of a liquid column, pressure at lower part of the column is greater than at the upper part (P = hgd), pressure decreases with height and not on the shape of the container or total volume of liquid. So pressure varies at different length and constant at all points on the same horizontal plane. Therefore, statement ii, iii & iv are correct (C)

16.



B = reading on the platinum resistance

$\frac{B - 60.5}{160.5 - 60.5} = \frac{70}{100}$

$100(B - 60.5) = 70(160.5 - 60.5)$

$B = \frac{70 \times 100}{100}$

$B = 70 + 60.5 = 130.5\ \Omega$ (C)

17. Rivets, Bimetal strips, fitting of wheels on rims in railways coaches are application of expansion of solid. When ice is subject to high pressure, it melts but when the pressure is recovered, the ice refreezes. This phenomenon is known as regelation. Hence a plane of wire with heavy weight attached to both ends can cut through a block of ice but the block of ice remains solid behind the wire (D)

18. Pure solid substances have sharp melting point or very narrow melting range. However, impurities cause a depression (decrease) in melting points and widening of the melting range of solid. If ice is subjected to pressure, its melting point is lowered conversely, if a substance contracts on freezing, increase pressure raises its melting point (B)

19. Q_k = Rate of heat flow

K = the proportionality constant is the thermal conductivity

T_H = temperature of hot OVEN

T_C = temperature of cold (environment)

A_c = cross sectional area

L = thickness

$Q_k = KA_c(\frac{T_H - T_C}{L})$

$1000 = (0.054)(10x10)(\frac{T_H - 27}{25 \times 10^{-2}})$

$\frac{1000 \times 0.25}{5.4} = T_H - 27$

$T_H = 46.3 + 27 = 73.3°C$ (D)

20. Heat loss = Heat gain

$50\ C_w(80 - \theta_2) = 70C_w(\theta_2 - 20°C)$

$4000 - 50\theta_2 = 70\theta_2 - 1400$

$-50\theta_2 - 70\theta_2 = -1400 - 4000$

$-120\theta_2 = -5400$

$\theta_2 = 45°C$ (A)

21. Resultant capacitance for the two parallel $= 2 + 2 = 4\ \mu F$

Resultant capacitance for the 2nd two parallel $= 2 + 2 = 4\mu F$

All in series,

$\frac{1}{R_x} = \frac{1}{4} + \frac{1}{4} \times {}^{1}/_{2}$

$= \frac{1 + 1 + 2}{4}$

$\frac{1}{R} = {}^{4}/_{4}$

$R = 1\mu F$ (B)

22. Superscripts: $238 = 234 + x$

$x = 4$

Subscript: $92 = 90 + x$

$x = 2$

x is a helium particle (^4_2He), an α - particle (C)