Answers of Full Portion Test Series 2019 – 2020

PHYSICS

Section I (40)

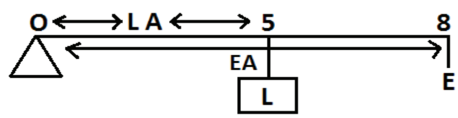
1. a.

   i. Magnetic flux density.

   ii. Specific latent heat.

   b. The man who climbs the slope works against the force of gravity because his motion is in the direction of the force and the man walking on the levelled road is moving 90° to the force, and hence does no work against gravity.

   c.



i. VR = $\frac{EA}{LA} = \frac{8}{5}$ = $\underline{\underline{1.6}}$

MA = VR = $\underline{\underline{1.6}}$

ii. VR = 1.6

η = 50%

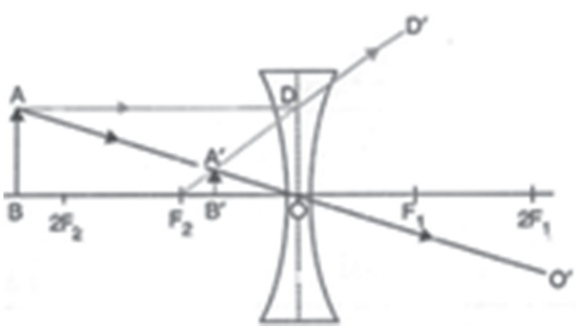
$\frac{50}{100} = \frac{MA}{1.6}$

MA = $\frac{1}{2}$ 1.6

MA = $\underline{\underline{0.8}}$

d. $\mu = \frac{1}{\sin C}$, Critical angle is the angle of incidence in the denser medium corresponding to which the angle of refraction in the rarer medium is 90°.

e.



Ray diagram for image formation by a concave lens when the object is between infinity and the lens.

2.

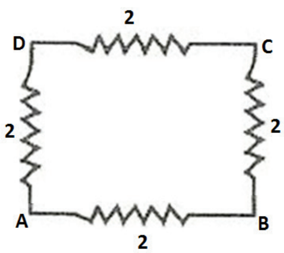
a. Figure (a) is safe as the fuse is on the live wire and in the case of voltage fluctuation (or short circuiting), if excessive current flows, the fuse blows off, the circuit becomes incomplete and no current flows in the appliance. It is unsafe to connect the fuse in the neutral wire as in figure (b) as, if due to some defect in the appliance, an excessive current flows in the circuit, the fuse blows and current stops flowing the circuit but the appliance still remains connected to the high potential point of the supply through the live wire. If a person touches the faulty appliance, he gets an electric shock because the person comes in direct contact of the mains through the live wire.

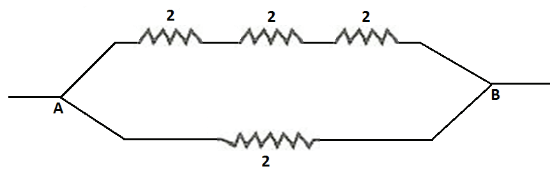
b.

i. Wave form.

ii. Frequency.

c.





$$\frac{1}{Rr} = \frac{1}{6}+\frac{1}{2}$$

$$\frac{1}{Rr} = \frac{1+3}{6}$$

$$\frac{1}{Rr} = \frac{4}{6}$$

$$R_P = \frac{6}{4}$$

$$R_P = 1.5\ \Omega$$

d.

i. 48^o

ii. (a) More than 36^o (b) More than 36^o

e.

i. $P = VI$

$$I = \frac{2000}{250}$$

$I = 8A$

ii. Cost = 2 3

= Rs. 3.00

3.

a. X has higher specific heat capacity because it takes longer to be heated by the same temperature than Y.

b. i. When slow neutrons are bombarded on uranium-235 $\left({}^{235}_{92}U\right)$, each uranium nucleus splits into two nearly equal fragments (${}^{144}_{56}Ba$ and ${}^{89}_{36}Kr$), with a release of three new neutrons and tremendous amount of energy (nearly 190 MeV). These new neutrons can fission the other uranium nuclei under the suitable conditions. Thus a chain of fission of nuclei is formed which once started, continues till the entire uranium is consumed.

ii. The chain reaction is controlled by absorbing some of the neutrons emitted in the fission process by means of moderators (such as graphite, heavy water, etc.)

c.

A	B
$m_1 = m$	$m_2 = M$
$K_1 = K$	$K_2 = K$
p = ?	p = ?

$$\frac{P_B}{P_A} = \sqrt{\frac{2m_2K_2}{2m_1K_1}}$$

$$= \sqrt{\frac{2MK}{2mK}} = \sqrt{\frac{M}{m}}$$

The heavier body will have a greater momentum than the lighter body as:

$$\frac{P_B}{P_A} = \sqrt{\frac{M}{m}}$$

d. $\frac{1}{R_P} = \frac{1}{20} + \frac{1}{5+R} + \frac{1}{10}$

$\frac{1}{4} - \frac{1}{20} - \frac{1}{10} = \frac{1}{5+R}$

$\frac{5-1-2}{20} = \frac{1}{5+R}$

$\frac{2}{20} = \frac{1}{5+R}$

$\frac{1}{10} = \frac{1}{5+R}$

5 + R = 10

R = 5Ω

e. The element moves to the right of the periodic table because one neutron splits to give proton and electron. The electron is released from the nucleus so mass number is retained but atomic number increases and hence it moves to the right.

4.

a.

i. 0.1 Å to 100 Å.

ii. 8000 Å to 10^7 Å.

iii. 100 Å to 4000 Å.

iv. 10^7 Å to 10^{11} Å.

b.

I	II
$\rho_1 = \rho$	$\rho_2 = \rho$
$l_1 = l$	$l_2 = l$
r_1 = 1 mm	r_2 = 2 mm
= 0.1 cm	= 0.2 cm
= 0.001 m	= 0.002 m
$A_1 = \pi r_1^2$	$A_2 = \pi r_2^2$
$= \pi\,(0.001)^2$	$= \pi\,(0.002)^2$

i.

$$\frac{R_1}{R_2} = \frac{\frac{\rho_1 l_1}{a_1}}{\frac{\rho_2 l_2}{a_2}}$$

$$= \frac{\rho \times l}{\pi(0.001)^2} \div \frac{\rho \times l}{\pi(0.002)^2}$$

$$= \frac{\rho l}{\pi(0.001)^2} \times \frac{\pi(0.002)^2}{\rho l}$$

$$= \frac{\pi(0.002)^2}{\pi(0.001)^2}$$

= 4:1

ii. $\frac{\rho_1}{\rho_2} = \frac{\rho}{\rho}$ = 1:1

c.

i. ONE KILOWATT-HOUR. One kilowatt-hour (kWh) is the electrical energy consumed by an electrical appliance of power 1kW when it is used for 1 hour.

ii. 220V.

iii. Electrical energy.

d. Y acts as the north pole; repelled.

e. $^{238}U_{92} \xrightarrow{\alpha} {}^{234}Th_{90} + {}^{4}He_{2}$

$^{234}Th_{90} \xrightarrow{\beta} {}^{234}Pa_{91}$

Section II (40)
Write each question on a new page

5.

a.

i. Variable.

ii. Variable.

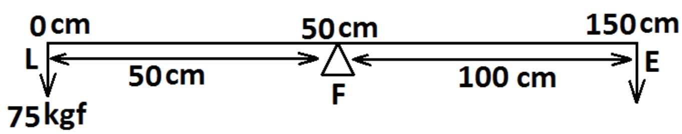
iii. Towards the centre of the circular path.

iv. Tension in the string.

v. The reaction of tension away from the centre of the circular path.

b. At a height $\frac{h}{3}$ from the base on its axis.

c.

i. 

ii. Kind of lever = Class 1 lever.

iii.

1. Load arm = 50 cm or 0.5 m
2. E.A. = 100 cm or 1.0 m
3. M.A. $= \frac{E.A}{L.A}$

   $= \frac{100}{50}$

   $= 2$

4. By the principle of machines,

   L × L.A. = E × E.A

   75 × 50 = E × 100

   $E = \frac{75 \times 50}{100}$

   = 37.5 kgf

6.

a.

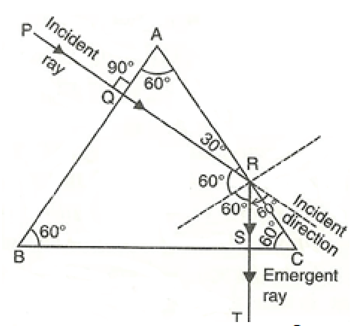
i. Diagram alongside

ii. At the face AB, = 0˚ and at the face AC, = 60˚.

iii. At the face AB – refraction.

At the face AC – total internal reflection.

At the face BC – refraction.



Deviation through 60^0 by an equilateral prism

b.

i. The lens is convex lens.

ii. The object is placed between first focal point and the optical centre.

iii. F = 2cm   u = between F_1 and optical centre   ht. of O = 2cms

2F = 4 cm   v = beyond F_1, on same side behind the object   ht. of I = -

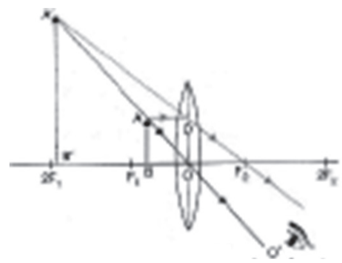


Image formation by a convex lens for the object between the optical centre and the focus.

iv. The device is magnifying glass.

c.

i. C = $3 \times 10^8 ms^{-1}$

f = ?

λ = 0.01

= $0.01 \; 10^{-10}m$

C = $f \lambda$

$3 \times 10^8 = f \times 0.01 \times 10^{-10}$

$$\frac{3\times10^8}{0.01\times10^{-10}} = f$$

$$\frac{3\times10^{10}}{1\times10^{-10}} = f$$

3×10^{20} Hz = f

Assumption: Speed of X – rays = 3×10^8 m s^{-1}

ii. The light fromthe sun has to travel a long distance of the earth's atmosphere before reaching us. As the light travels through the atmosphere, it gets scattered in different directions by the air molecules present in its path. The blue (or violet) light due to its short wavelength is scattered more as compared to the red light of long wavelength. Thus the light reaching our eye directly from the sun is rich in red colour while the light reaching our eye from all other directions is the scattered blue light. Therefore the sky in any direction, other than the direction of sun, is seen blue. Further at night there is no sunlight reaching directly to us. Then the blue scattered light makes the sky appear blue / black.

7.

a. Frequency = 5 vibrations per second

$\therefore$ The frequency of the pendulum is 5 vibrations per 1 second

$\therefore$ The time taken for the echo is 8 vibrations per x second

$\therefore t = \frac{8 \times 1}{5}$

$t = \frac{8}{5} S$

$v = 340\ ms^{-1}$

$v = \frac{2d}{t}$

$340 = \frac{2d}{t}$

$340 = \frac{2d}{\frac{8}{5}}$

$340 \times \frac{8}{5} = 2d$

$68\ 8 = 2d$

$d = \frac{68 \times 8}{2}$

$= 68\ 4 = 272\ m$

b.

i.

	Resistance	**Specific resistance**
Length of wire	Directly proportional	Unit length
Radius	Inversely proportional	Unit radius

ii.

Wire 1	**Wire 2**
$R_1 = 1\ \Omega$	$R_2 = ?$
$\rho_1 = p$	$\rho_2 = p$
$l_1 = l$	$l_2 = 2\ l$
$a_1 = a$	$a_2 = \frac{a}{2}$

$\rho_1 = \rho_2$

$\frac{R_1 a_1}{l_1} = \frac{R_2 a_2}{l_2}$

$\frac{l \times a}{l} = \frac{R_2 a}{2} \times \frac{1}{2l}$

$\frac{a}{l} = \frac{a R_2}{4l}$

$$R_2 = \frac{a \times 4l}{la} = 4\ \Omega$$

c.

i. $1 \rightarrow E$, $2 \rightarrow N$, $3 \rightarrow L$.

ii. (Metal body)

iii. The fuse is joined to the 3 – live wire.

The fuse is always connected in the live wire of the circuit. If the fuse is put in the neutral wire then due to some fault and excessive current flows through the circuit and the fuse burns off, current stops flowing in the circuit, but the appliance remains connected to the high potential point of the supply through the live wire. Now if a person touches the appliance, he may get a shock as the person will come in contact with the live wire through the appliance.

8.

a.

i.

1. A deflection is observed in the galvanometer towards the right.
2. The deflection becomes zero.
3. The deflection again occurs in opposite direction.

ii. The deflection is increased.

b.

i.

1. Average kinetic energy of molecules increases,
2. Average potential energy of molecules increases.

ii. At high altitudes, such as hills and mountains, atmospheric pressure is low, therefore water boils at a temperature lower than 100˚C and so it does not provide the required heat energy for cooking. Thus cooking there becomes very difficult and it takes a much longer time.

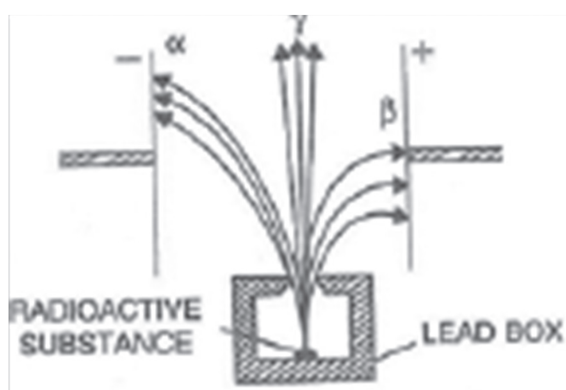
iii. By making the base of the cooking pan thick, its thermal capacity becomes large and it imparts sufficient heat energy at a low temperature to the food for its proper cooking. Further it keeps the food warm for a long time, after cooking.

c.

i. Diagram alongside

ii. The source S is kept in lead because lead absorbs the radiations.

It is narrow so that less radiation are given out.



Deflection of radioactive radiations in an electric field

9.

a.

i. $\frac{1}{R_P} = \frac{1}{A} + \frac{1}{B}$

$= \frac{1}{4} + \frac{1}{6}$

$= \frac{6+4}{24}$

$\frac{1}{R_P} = \frac{10}{24}$

$R_P = 2.4$

$I = \frac{\varepsilon}{R+r}$

$I = \frac{6}{2.4+0}$

$I = \frac{60}{24}$

$I = 2.5$ A

Power supplied by battery $= V I$

$= 6 \times 2.5$

$= 15$ W

ii. Since r is 0, T. V. = e. m .f

= 6 V

$\therefore$ Power dissipated in A $= \frac{V^2}{R}$

$= \frac{6 \times 6}{4}$

$= 9$ W

Power dissipated in B $= \frac{V^2}{R}$

$= \frac{6 \times 6}{6}$

$= 6$ W

b.

i. One kilowatt-hour is the electrical energy consumed by an electrical appliance of power 1kW when it is used for 1 hour. 1 kWh = 3.6×10^6 Joule.

ii. (1 hour)

iii. The amount of heat produced in a wire depends on three factors

1. On the amount of current passing through the wire - Directly proportionali.e., $H \propto I^2$.
2. On the resistance of the wire - Directly proportional. i.e., $H \propto R$.
3. On the time for which current is passed in the wire - Directly proportional i.e., $H \propto t$.

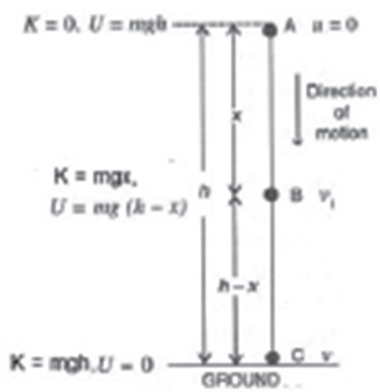
c.

0^oC ice - 0^oC water	0^oC water - 20^oC water
m = 200 g $T_1 = 0^oC$ $T = 0^oC$ t = 1 min = 60 sec $L_f = 336$ J/g	m = 200 g $T_1 = 0^oC$ $T = 20^oC$ t = ? P = 1120 w c = 4.2 J/gk $\Delta T = 20 - 0$ $= 20^oC$
EE = HE $P \times t = m L_f$ $P \times 60 = 200 \times 336$ P = 1120 w	EE = HE $P \times t = m c \Delta T$ $1120 \times t = 200 \times 4.2 (20 - 0)$ $t = \frac{200 \times 4.2 \times 20}{1120}$ = 15 sec

10.

a.

i. Let a body of mass m be falling freely under gravity from a height h above the ground (i.e., from position A in the figure given below).



Free fall of a body

ii. Let us calculate the sum of kinetic energy K and potential energy U at various positions.

iii. At A (a height h above the ground), at B (when it has fallen through a distance x) and at C (on the ground).

iv. **At the position A (at a height h above the ground):**

1. Initial velocity of body = 0 (since bodyis at rest at A).
2. Kinetic energy K = 0.
3. Potential energy U = mgh.
4. Hence total mechanical energy =

   K + U = 0 + mgh = mgh---(i)

v. At the position B (when it has fallen through a distance x):

1. Let v_1 be the velocity acquired by the body at B after falling through a distance x.
2. Now: u = 0, S = x, a = g.
3. Substituting in the equation, $v^2 = u^2 + 2as$

   $v_1^2 = 0 + 2gx = 2gx.$
4. $\therefore$ Kinetic energy $K = \frac{1}{2}mv2; = \frac{1}{2}m \times (2gx) = mgx$
5. At 'B', height of the body above the ground = h – x
6. Potential energy U = mg (h – x).
7. Hence total mechanical energy = K + U

   = mgx + mg (h – x) = mgh ...(ii)

vi. At the position C (on the ground):

1. Let the velocity acquired by the body on reaching the ground be v.
2. Then u = 0, S = h, a = g.
3. Substituting in equation, $v^2 = u^2 + 2aS$.

   $v^2 = 0 + 2gh.$

   $v^2 = 2gh.$
4. Kinetic energy $K = \frac{1}{2}mv^2 = \frac{1}{2}m \times (2gh)$
5. And potential energy U = 0 (at the ground)
6. Hence total mechanical energy = K + U = mgh + 0 = <u>mgh</u> ---- (iii)

vii. Thus from equations (i), (ii) and (iii), the total mechanical energy always remains constant at each point of motion and it is equal to the initial potential energy at height h.

b. The 2 reasons are:

i. The weight of the pulley and rope.

ii. Friction between the wheel and the tackle.

Both the above reduce the efficiency of the pulley.

c.

i. The intensity at any point of the medium is measured as the amount of sound energy passing per second normally through unit area at that point. Its unit is microwatt per meter square which is equal to 10^6 joule per second per meter square.

ii. The length of the air column is inversely proportional to the frequency of sound produced. As the water level in a bottle kept under a water tap rises, the length of the air column decreases sothe frequency of sound produced increases i.e., the sound becomes shriller and shriller. Thus by hearingthe sound from a distance, one can get an idea of water level in the bottle.