Section A

1.

(a)

i. Gravitational Force

ii. Magnitude of force varies inversely as the square of the distance of separation.

(b)

Weight of the boy, F_b = 40 kgf
Time taken by him, t_b = 4 minutes = 4 x 60 s = 240 s
Weight of the girl, F_g = 30 kgf
Time taken by her, t_g = 3 minutes = 3 x 60 s = 180 s
Distance covered by both of them in 30 steps is
d = 30 x 20 = 600 cm

i. Work done by the boy
= F x d = 40 x 600 = 24000 J
Work done by the girl
= F x d = 30 x 600 = 18000 J
W_b/W_g = 24000/18000 = 4/3

ii. Power delivered = Work Done/Time
P_b = 24000 J/240 s = 100 W
P_g = 18000 J/180 s = 100 W
So powered delivered by them is in ratio 1:1.

(c) Velocity Ratio
It is the ratio of the velocity of the effort to the velocity of load.

(d) Let m be the mass of the ice added.
Q = m x S x (T – T')
m x 336 J/ g = 300 g x 4.2 J/g ^oC x 40 ^oC
m = 150 g

(e)

i. It means that 60 JK^{-1} of energy is required to raise the temperature of the given body by 1 K

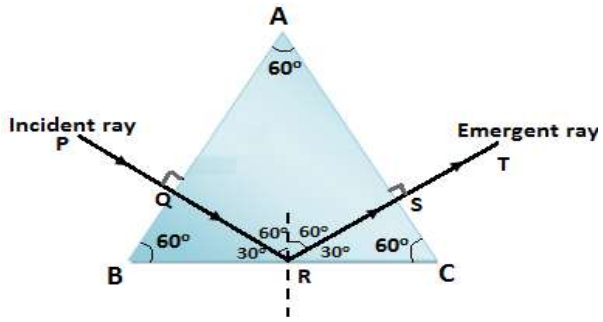
ii. It means that 130 $Jkg^{-1}K^{-1}$ of heat energy required to raise the temperature of unit mass of lead through 1 K.

2.

(a) Heat absorbed by a body depends on the mass of the body and the specific heat capacity of the body.

(b) The refractive index will be different in both cases. It is different for different colours because speed of light of different colours is different. Since the speed of blue light is less than the speed of red light. Refractive index of blue light will be more as compared to that of red light.

(c)



(d)

i. The angle of deviation increases with an increase in the refractive index of the medium.
ii. The angle of deviation decreases with an increase in the wavelength of light.

(e)

i. Intensity is proportional to the square of amplitude
So I_1/I_2 = 9:16
ii. Frequency does not depend on the amplitude of the wave so the ratio of their frequencies is 1:1.

3.

(a) The frequency of transverse vibration of a stretched string can be increased by any of the following ways:
1. Decreasing the length of the string
2. Decreasing the mass per unit length of the string
3. Increasing the tension in the string

(b) The undesirable disturbances produced due to loud sound from various sources are known as noise pollution. Traffic is one cause of noise pollution.

(c) For the same change in I, change in V is less for the line A than for the line B. So A represents a smaller resistance compared to B. So A is parallel combination because in parallel combination equivalent resistance is less than series combination.

(d)

i. I = 400 mA
V= 12 V
V= IR
R=12 V/400 mA
= 30 ohm

ii. When current drops to 320 mA
The music will stop playing when
V= IR = 320 mA x 30 ohm
=9.6 V

(e) R = 20 ohm, I=2.5Amp

t = 300 secs
H (heat produced) = I^2Rt = 37500 J

4.

(a) Characteristics are :

1. The substance should have low work function so that the e- can be emitted without heating it to a high temperature.
2. The melting point of the substance should be high.

(b) ${}_ZS^A \rightarrow {}_{85}R^{222} + 2({}^4He_2) + {}_0e^{-1}$

A = 222 + 2 x 4 + 0 = 230

Z = 85 + 2 x 2 + (-1)

Z = 88

(c) No because oxidation is a chemical process and there is no change in the nucleus of the substance

(d) 1. High Resistivity
2. Low Melting point

(e) Because in step up transformer the no. of turns in the secondary coil is more than the no. of turns in primary coil, so more current flows through the primary coil so it is made thicker as compared to the secondary coil.
$I_p/I_s = N_s/N_p$

Section B

5.

(a)
i. Uniform speed
ii. Uniform acceleration. Acceleration is towards the centre of the circle.

(b)
i. Pulley A is single movable pulley while pulley B is single fixed pulley
ii. Purpose of pulley B is to change the direction of the effort applied.
iii. Effort at C must be equal to the load because M.A of pulley B is 1.

M.A = L/E = 1
So L=E = 20 kgf

(c)
i. This kind of arrangement is used to obtain gain in speed
ii. L = 120 N, E = 50 N, n = 3;

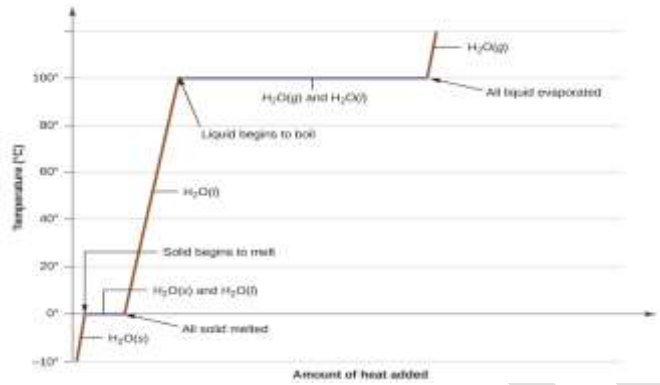
M.A=L/E = 120/50 = 2.4
Efficiency = M.A/V.R = 2.4/n (n=3) = 0.8 = 80%

6.

(a)

i. It says that heat lost by a hot body is equal to the heat gained by a cold body.
ii. Other name given to it is the principle of calorimetry.
iii. It is based on Law of Conservation of Energy.

(b)



(c) Heat lost by vessel and water in cooling water from 50 C to 5 C will be equal to heat used to melt the ice and then raise its temp. to 5 C.

Heat lost by copper vessel
Q = m x c x (T – T')
= 100 x 0.4 x (50-5)
= 1800 J

Similarly heat lost by water will come out to be 28350 J
So total heat lost = 1800 + 28350 = 30150 J
Let mg of ice is used to cool water, So heat gained by ice

= m L_{ice} + m x c_{ice} x (T-T')
= 336 x m + m x 4.2 x 5 = 336m + 21m
= 357 x m
Now Heat lost = Heat gained
Therefore, 30150 = 357 x m
m = 30150/357
= 84.45 gm.

7.

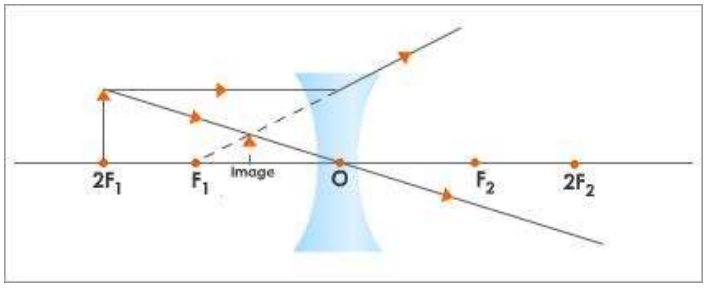
(a)

i. Sin i / Sin r = Refractive Index
ii. When a ray of light enters from one medium to another having different optical densities it bends because there is a change in the speed of light while entering in the second medium.
iii. A ray of light will not bend when is incident at angle of 90^o (normally) on the surface.

(b)

i. Concave Lens.

ii.



8.

(c)

Scattering is the process of absorption and re-emission of light.
Red colour is scattered the least and the violet colour is scattered is the most.

(a)

i. Ultraviolet waves
ii. UV waves are used because they can travel long distances without their attenuation and without being un deviated.
iii. Because they are having frequency more than 20000 Hz and human ear can hear sound having frequencies 20-20000 Hz.

(b)

i. The sound heard after reflection from a distant object after the original sound has faded is called an echo.
ii. Conditions are:

1. The minimum distance between the source of sound wave and the obstacle must be at least 17 m.
2. Reflector (obstacle) must have a large size as compared to the wavelength of the sound.

(c)

i. Resonance
ii. When the natural frequency of a body matches with the frequency of an externally applied force, the amplitude of vibration of the body is increased and this phenomenon is called resonance.
iii. Loudness is the property of a sound wave using which we can distinguish between a faint sound and a loud sound despite of both having same pitch and quality.

9.

(a)

i. Electrons
ii. Earth wire
iii. Live wire.

(b)

i. Step up transformer
ii. Alternating current (A.C)
iii. 220 V

(c) V = 12 V

R_1 (internal resistance) = 2 ohm
R_A = 4 ohm
R_B = 6 ohm

i. $I = E/ R_{net}$
$= 12/ (2+4+6) = 1$ Amp

ii. V(terminal voltage) $= E – IR_1$
$=12 – (1 \times 2) = 10$ V

iii. $V_B = I \times R_B$

$= 1 \times 6 = 6$ V

iv. Electrical energy spent per minute
t = 1 minute = 60 seconds
$Q = I^2Rt$
$= 1^2 \times 4 \times 60 = 240$ J

10.

(a)
i. Alpha < Beta < Gamma
ii. Gamma < Beta < Alpha
iii. Alpha < Beta <Gamma

(b)
i. The function of anode is to accelerate the electrons and focus them to get a fine energetic beam.
ii. Electrical energy is converted to light energy.
iii. Cathode ray tubes were used in Computer monitors and Televisions.

(c)
i. Neutron is changed to a proton emitting a Beta particle.

$${}_1n^0 \rightarrow {}_1p^0 + {}_0e^{-1}$$
(Beta particle)

ii. Isobars
iii. nucleus of an atom tend to radioactive when the number of neutrons in the nucleus exceeds the number of proton in it.

