Physics
Grade - 13 (2016)
Marking Scheme

FWC

Physics - I

1)	**2**	11)	**5**	21)	**2**	31)	**1**	41)	**2**
2)	**1**	12)	**5**	22)	**2**	32)	**3**	42)	**4**
3)	**3**	13)	**1**	23)	**2**	33)	**4**	43)	**1**
4)	**3**	14)	**3**	24)	**1**	34)	**3**	44)	**4**
5)	**3**	15)	**4**	25)	**1**	35)	**2**	45)	**2**
6)	**3**	16)	**3**	26)	**4**	36)	**4**	46)	**1**
7)	**2**	17)	**3**	27)	**5**	37)	**5**	47)	**1**
8)	**5**	18)	**3**	28)	**2**	38)	**2**	48)	**1**
9)	**2**	19)	**2**	29)	**2**	39)	**5**	49)	**2**
10)	**1**	20)	**4**	30)	**1**	40)	**1**	50)	**4**

$(50 \times 1 = 50)$

Physics - II
A - Structure

01)

a) Center of mass would not change
Center of gravity would change ——————— **01**

b)

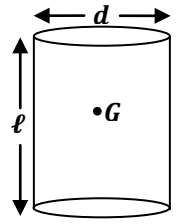
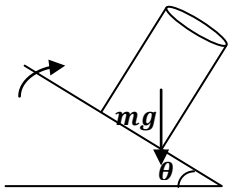


Fig - I

——————— **01**

c)

i.



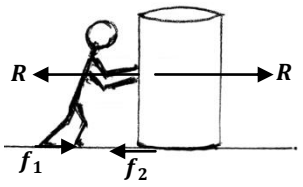
——————— **01**

ii. $\tan \frac{\frac{d}{2}}{\frac{\ell}{2}} = \frac{d}{\ell}$ ——————— **01**

d) $\tan\frac{16}{56} = \tan\frac{2}{7}$

$\theta = \tan^{-1}\frac{2}{7}$ ——————— **01**

e)

i. 

——————— **02**

ii. Coefficient of static friction $\boldsymbol{\mu_S = \frac{100}{400} = 0.25}$

Coefficient of kinetic friction $\boldsymbol{\mu_k = \frac{90}{400} = 0.225}$ ——————— **01**

iii. Not to slide down $R = f_1$ ——————— **01**

but $f_1 \leq \mu mg$

$R \leq \mu mg$

$m \geq \frac{R}{\mu g}$

$m \geq \frac{100}{0.2\times10}$

$m \geq 50\ kg$

$m_{min} = 50\ kg$ ——————— **01**

Marks -10

2)

a) To keep the steady temperature ——————— **01**

b) From upward , to be completely filled by steam ——————— **01**

c) To make good thermal contact ——————— **01**

d) It is thermal conductor ——————— **01**

e) Constant pressure head, To maintain constant rate volume flow of water (suitable reason) ——————— **02**

f) To absorb heat from the rod continuously/ To absorb heat completely from the rod ——————— **01**

g) $\frac{Q}{t} = KA\frac{\Delta\theta}{\Delta\ell} = \frac{mL}{t}$ ——— **01**

$K = \frac{\frac{mL}{t}}{A\frac{\Delta\theta}{\Delta\ell}} = \frac{30\times10^{-3}\times3\times10^{5}}{60\times180\times10^{-4}\times\frac{(86-61)}{5\times10^{-2}}}$ ——— **01**

$= \frac{500}{30}$ = 16.67 $Wm^{-1}K^{-1}$ ——— **01** **Marks -10**

3)

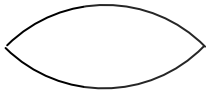
a) Transverse standing waves in violin string
Progressive longitudinal waves towards ear ——— **01**

b) Quality of sound ——— **01**

c) Presence of overtones ——— **01**

d) Transverse waves ——— **01**

e) The mechanical energy is transformed from string to the air molecules inside the sonometer box through bridges. ——— **02**

f)  ——— **01**

g) Knocked the tuning fork and place it on the sonometer box in between the bridges such as placing stem on the sonometer. ——— **01**

h) $f = \frac{1}{2\ell}\sqrt{\frac{T}{m}}$ ——— **01**

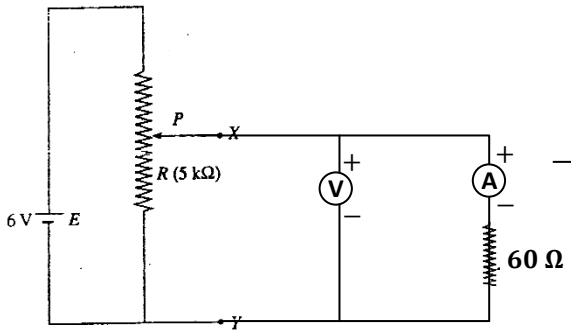
i) $\ell = \frac{1}{2f}\sqrt{\frac{T}{m}} = \frac{1}{2\times500}\sqrt{\frac{40}{1\times10^{-3}}} = \frac{2\times10^{2}}{1000}$

$\ell = 20\ cm$ ——— **01**

Marks -10

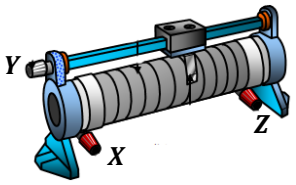
4)

a) Marks will not be provided for other circuit.

i. 

01

ii.

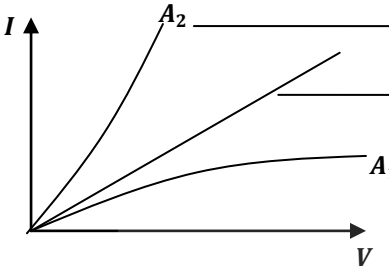


——————— **01**

iii. $I = \frac{\mathcal{E}}{60} = \frac{6}{60}\ A = 0.1\ A$ ——————— **01**

iv. Reading of the ammeter more accurate ——————— **01**

v.



——————— **01**

——————— **01**

——————— **01**

vi. Yes ,

$Gradient = \frac{I}{V} = \frac{1}{R + R_A}$ Inverse value addition of 60 resistance of the ammeter also included in the calculated value. ——————— **01**

b)

i. Resistance of the filament increases with time ——————— **01**

ii. $R = \frac{V^2}{P} = \frac{6^2}{0.36} = 100\Omega$ ——————— **01**

Marks -10

5)

a)

i. $S_1 = \frac{1}{2}(10 \times 1.5) + 10 \times 19 + \frac{1}{2}(10 + 8) \times \frac{1}{2} = 202$ ——————— **01**

$S_2 = \frac{1}{2}(8 + 10.5) \times 1 + 10.5 \times 17 + \frac{1}{2}(10.5 + 9) \times 1 = 197.5\ m$

$S_3 = \frac{1}{2}(9 + 10) \times 2 + 10 \times 17.5 + \frac{1}{2}(10 + 8) \times \frac{1}{2} = 198.5\ m$ ——————— **01**

ii. $202 = \frac{1}{2}(8 + 10) \times 1 + 10\ t_0$

$10\ t_0 = 202 - 9 = 193$

$t_0 = 19.3\ s$ ——————— **01**

Total time = 61.5 +19.3=80.8s ——————— **01**

iii. $V_1 = \frac{202}{21} = 9.62\ ms^{-1}$

$V_2 = \frac{197.5}{19.5} = 10.13\ ms^{-1}$

$V_3 = \frac{198.5}{20} = 9.93\ ms^{-1}$

$V_4 = \frac{202}{20.3} = 9.95\ ms^{-1}$ ——————— **01**

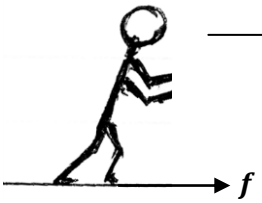
Average speed of second runner is high

iv. $t = \frac{44}{10} = 4.4\ s$ ——————— **01**

v. To have high initial acceleration
Inter change button when running high speed ——————— **01**

b)

i. By frictional force ——————— **01**

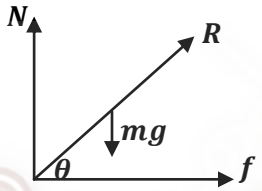


ii. $F = ma$ ⟶

$f = 60 \times \frac{10}{1.5} = 400\ N$ ——————— **01**

iii. $\tan\theta = \frac{N}{f} = \frac{600}{400} = 1.5$

$\theta = \tan^{-1} 1.5$ ——————— **01**



iv. There will be balanced force due to the drag force ,the friction which act by sliding and the force mentioned in part b (i) ——————— **01**

v. Centripetal force $F = \frac{mV^2}{r}$

$F = \frac{60 \times 10^2}{7}$

$F = \frac{6000}{7}\ N$ ——————— **01**

By frictional force ——————— **01**

c) When overtake , take place (he take t s to overtake)

$$S_G = S_H$$

$$\frac{1}{2}(10 \times 1.5) + 10(t - 1.5) = \frac{1}{2}(2.5 \times 11.5) \times 2.5 + 11.5(t - 2.5)$$ ——————— **01**

$$t = \frac{3.75}{1.5} = 2.5\ s$$ ——————— **01**

Marks -15

6)

a)

i. The light ray travels in straight lines from each point of total internal reflection to the next. In an endoscope bundle of optical fibers is used to transmit an image formed on one end of the bundle by a small lens to other end of the bundle. ——— **02**

ii. The key to scalpel lies in the fact that the photons in a light beam from a laser all have same energy and they all travel parallel to one another, I.e. **Laser light is highly monochromatic and parallel.** ——— **03**

iii. Laser to a spot of tissue of area (nearly equal 0.01mm2) would will be sufficient to cause the tissue temperature at that point to rise large, i.e. high intensity and burnt it. ———**02**

b)

i. $I = \frac{\frac{60}{100}\times 75}{1.5\times 10^{-3}} = 50 \times 10^{-3}\ W\ mm^{-2}$ **02**

ii. Energy = P.t

$= 75\times 0.5 \times 10^{-3} = 37.5 \times 10^{-3}$

$= 3.75 \times 10^{-2} J$ ——— **02**

c)

i. The lens focuses a laser to a tiny spot when the power of the beam is concentrated at certain tissue ——— **02**

ii. To make possible spot welding due the distance between the tissue and lens is very small. ——— **02**

Marks -15

7)

i.

a) Poiseuille`s equation ——— **01**

with correct identification of symbols ——— **01**

b) vessels may not rigid

Vessels not horizontal

Density may not be uniform (compressible) any two ——— **01**

ii.

a) Average volume flow rate $= \frac{70\times 70\times 10^{-6}}{60}$ ——— **01**

$= 8.17 \times 10^{-6} m^3 s^{-1}$ ——— **01**

b) $\frac{Q}{t}(Vt)$ —Average volume flow rate

Q = AV ——— **01**

$A = \frac{\pi\, d^2}{4} = \frac{\pi\,(1\times 10^{-2})^2}{4} = 7.9 \times 10^{-5}\, m^2$

$V = \frac{Q}{A} = \frac{8.17\times 10^{-6}}{7.9\times 10^{-5}} = 0.103 ms^{-1}$ ——— **01**

Assumption—blood is incompressible/aorta has uniform cross section ——— **01**

iii.

a) Dimension of N_R is $\frac{L\times LT^{-1}\times ML^{-3}}{ML^{-1}T^{-1}} = 1$ ——— **02**

N_R is dimensionless

b) $N_R = \frac{1\times10^{-2}\times0.103\times1050}{4\times10^{-3}} = 270$ ——— **01**

As N_R is less than 2000, the flow will be laminar (stream) ——— **01**

iv.

a) $Q = 2.5 \times 10^{-6} m^3 s^{-1}$

$$\frac{\pi \times \Delta p \times (2 \times 10^{-3})^4}{8 \times 4 \times 10^{-3} \times 0.2} = 2.5 \times 10^{-6}$$

$\Delta p = 0.32 \times 10^3 Pa$ ——— **01**

b) Rate at which work is done by the heart $= Q\Delta p$ ——— **01**

$= 2.5 \times 10^{-6} \times 0.32 \times 10^3 = 8 \times 10^{-4} J\, s^{-1}$ ——— **01**

Marks -15

8)

a)

i. $F = BIl \sin\theta$ ——— **02**

ii. $F = QVB \sin\theta$ ——— **01**

b)

i. Force act on boat forward direction ——— **01**

ii. Fleming's left handle rule ——— **01**

iii. Increasing current ——— **01**

Increasing number of turns ——— **01**

iv. No, There will be action and reaction according to the Newton's thirds law, i.e., but, these two act on the boat so, resultant zero. ——— **02**

c)

i. Breaking the molecules into positive and negative ions , is called ionization. Current is produced by flowing positive ions toward cathode and negative ions towards anode. ——— **02**

ii. Magnetic force acts backward on the flowing ions (sea water) then, reaction act on the boat forward direction. ——— **02**

iii. $F_m = Drage\ force$

$BIl \sin 90^0 = 12000$ ——— **01**

$B = \frac{12000}{1000\times1.5} = \frac{12}{1.5} = 8\,T$ ——— **01**

Marks -15

9) A

a)

i. $P_1 = {I_1}^2 R = \left(\frac{P}{V}\right)^2 R$

$= \left(\frac{25\times10^6}{25\times10^3}\right)^2 10 = 10\times10^6 W = 10MW$ ——— **02**

ii. $P_1 = \left(\frac{25\times10^6}{25\times10^4}\right)^2 10 = 10\times10^4 W = 0.1MW$ ——— **02**

b)

i. DC current cannot be stepped up or stepped down, so , power dissipation is high ——— **02**

ii. $25000 - V_X = 1000\times10$

$V_X = 15000V$ ——— **01**

iii. $250000 - V_Y = 100\times10$

$V_Y = 249000\,V$ ——— **01**

c)

i. $V_{peak} = 380\times10^3\sqrt{2}\,V$ ——— **01**

ii. $E = -\frac{\delta V}{\delta x} = \frac{380\times10^3\sqrt{2}}{3.5}$ ——— **02**

d)

i. If humidity is high ,more crackling sound because breaking field strength is low for moisture air ——— **02**

ii. For the explanation of corona discharge ——— **02**

Marks -15

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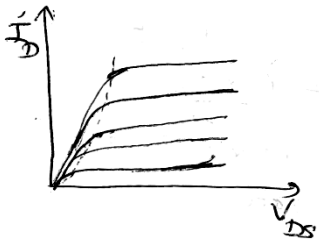
9) B

a)

JFET	BJT
One p-n junction	two p-n junction
Charge carrier electron or hole	Charge carrier both electron and hole
Controlled by field	Controlled by current ——— **02**

b)

i. 

——— **02**

ii. V_{Gs}-Gate –source voltage ———— 01

iii. Marking linear region, saturation region and cut off region all correct ———— 01

c)

i. Identifying zero gate current ,I_G =0

Voltage drop across R_G =0 ($I_G R_G$=0)

V_G=0 ———— **01**

ii. $I_D = I_S$ ———— **01**

$V_S = I_D R_S$ ———— **01**

$V_{GS} = V_G - V_S = 0 - I_D R_S$

$$I_D = \frac{-V_{GS}}{R_S}$$

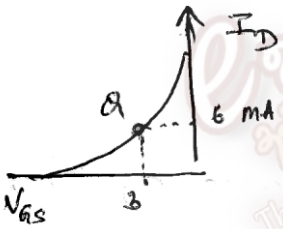
iii. Applying the Kirchhoff's laws $V_{DS} = V_{DD} - I_D(R_D + R_S)$ ———— **01**

d)

i. Cut-off voltage $V_{GS(off)} = -8V$

$I_{DSS} = 16mA$ ———— **01**

ii. Denoting Q ———— **01**



iii. $V_{GS} = -3V (accept\ value\ between -2.5\ to -3.5)$ ———— **01**

$$I_D = \frac{-V_{GS}}{R_S}$$

$$-6 \times 10^{-3} = \frac{-3}{R_S}$$

$R_S = 500\Omega$ ———— **01**

iv. $V_{DS} = V_{DD} - I_D(R_D + R_S)$

$= 10 - 6 \times 10^{-3}(500 + 500) = 4V$ ———— **01**

Marks -15

10) A

i. $Pv = \frac{w}{m} RT$ _____ **01**

$$w = \frac{PVm}{RT} = 1 \times \frac{10^5 \times 100 \times 10^{-6} \times 30 \times 10^{-3}}{8.3 \times 300}$$

$$= 0.12 \times 10^{-4} kg$$ _____ **01**

ii. $Q = ms\theta = 0.12 \times 10^{-4} \times 1000 \times 150 \times 750 = 1350J$ _____ **01**

iii. $Q = ms\theta = 1 \times 250 \times 150 = 3.75 \times 10^4$J _____ **01**

iv. $P = \frac{1350+3.75\times10^4}{60}$ _____ **01**

$P = \frac{3.885\times10^4}{60} = 0.06 \times 10^4 W = 0.6\, kW$ _____ **01**

v. $\frac{P_2}{T_2} = \frac{P_1}{T_1}$

$\frac{P_2}{450} = \frac{1 \times 10^5}{300}$

$P_2 = 1.5 \times 10^5 Pa$ _____ **01**

Additional thrust = $(P_2 - P_1)A = (1.5 \times 10^5 - 1 \times 10^5) \times 20 \times 10^{-4} = 100N$ _____ **01**

vi. $P_1V_1 = P_2V_2$

$1.5 \times 10^5 \times 100 = 1 \times 10^5 V_2$

$V_2 = 150cm^3$ _____ **01**

vii. $P = P\,\Delta V \times \frac{750}{60}$ _____ **01**

$P = 1 \times 10^5 \times 50 \times 10^{-4} \times \frac{750}{60} = 12.5W$ _____ **01**

viii. $\frac{Q}{t} = \frac{ms\theta}{t}$

$\frac{3.75\times10^4}{60} = \frac{m}{t} \times 4200 \times 60$ _____ **01**

$\frac{m}{t} = 2.48 \times 10^{-3} kgs^{-1}$ _____ **01**

ix. Increase the area _____ **01**

x. Specific heat capacity of water is high _____ **01**

Marks -15

10) **B**

a)

i. Nuclear fusion

Assembling less weight nucleus into heavy nucleus

Take place at high temperature

Nuclear fission

Splitting heavy nucleus into lighter nucleus ——— **01**

Bombardment by slowly moving neutrons with nucleus ——— **01**

ii. $4{}_1^1H \rightarrow {}_2^4He + 2{}_{+1}^{0}e + energy$ ——— **01**

iii. Defect mass=(4X1.007825u-4m_e) – (4.002603u-2m_e)+2m_e ——— **01**

=4.0313u- 4.002603u

=0.02867u ——— **01**

Released energy = 931 $\frac{MeV}{c^2}$X0.02876Xc^2 =26.69X10^6X1.6X10^{-19}J=42.71X10^{-13} J ——— **01**

iv. The rate of consumed Hydrogen =$\frac{4\times1\times10^6}{42.71\times10^{-13}} = 9.37 \times 17/_{sec}$ ——— **01**

b)

i. For the suitable explanation. ——— **01**

ii. $x = 3$ ——— **01**

iii. $Intial\ mass = (392.61 \times 10^{-27} + 1.685 \times 10^{-27})kg$

$Final\ mass = (388.94 \times 10^{-27} + 3 \times 1.685 \times 10^{-27})kg$

$Defect\ mass = 0.307 \times 10^{-27}kg$ ——— **01**

iv. $E = \Delta mc^2$

$E = 0.307 \times 10^{-27}(3 \times 10^8)^2$ ——— **01**

$E = 2.763 \times 10^{-11}J$ ——— **01**

v. $2.763 \times 10^{-11} \times \frac{10}{100} \times \frac{25}{100} = \frac{2.763}{4} \times 10^{-12}J$ ——— **01**

$The\ energy\ converted\ into\ electricity\ in\ one\ second = 6.907 \times 10^{-13}J$

$The\ energy\ obtained\ by\ 1\ U\ nucleus = 6.9 \times 10^{-13}J$

$The\ energy\ converted\ into\ electricity\ in\ one\ second\ by\ 392.617 \times 10^{-27}kg\ U\ nucleus$

$= 6.9 \times 10^{-13}J$ ——— **01**

$Mass\ of\ U = \frac{300\times10^6}{6.9\times10^{-13}} \times 392.617 \times 10^{-27}kgs^{-1} = 170.69 \times 10^{-6}kgs^{-1}$ ——— **01**

Marks -15