Belilios Public School
PHYSICS
Mock Examination, 2022-2023
Marking Scheme

PHYSICS PAPER 1

Section A

1. D
2. A
3. B
4. C
5. B

6. B
7. D
8. C
9. D
10. A

11. A
12. A
13. C
14. A
15. D

16. B
17. B
18. A
19. C
20. D

21. C
22. D
23. D
24. B
25. B

26. C
27. A
28. C
29. B
30. C

31. B
32. A
33. D

Section B

1. (a)energy absorbed by octadecan-1-ol = energy released by water 1M

$0.1 \times l + 0.1 \times 2610 \times (59.5 – 25) = 1 \times 4200 \times (90 – 78)$ 1M

$l = 414000$ J K^{-1} 1A

(b) Some energy is absorbed by the test tube. 1A

(c) The layer can reduce heat loss of water by prevent evaporation. 1A

(d) Stir the water / wrap the beaker with cotton. 1A

2. (a) $n \propto V$ 1M

$n_B = 0.8 \times \frac{3V}{5V} = 0.48$ mol 1A

(b) 606 K / 333 °C 1A

(c)(i) $n_A + n_B = n_A' + n_B'$

$\frac{2p \times 5V}{606} + \frac{p \times 3V}{303} = p_f \left(\frac{5V}{606} + \frac{3V}{303} \right)$ 1M

$p_f = 1.45p \ (\frac{16}{11} p)$ 1A

(ii) As gas flows from A to B,
the number of molecules increases 1A
So the molecules collides with the inner wall of the vessel more frequently. 1A
Hence, the pressure in B increases.

3. (a)(i) By $v^2 = u^2 + 2as$ 1M

$10^2 = 0^2 + 2a(50)$

$a = 1 \text{ m s}^{-2}$ 1A

(ii) $mg \sin\theta - f = ma$ 1M

$f = 1.5(9.81)\sin 10° - 1.5(1)$

$f = 1.06$ N 1A *(1.10 N)*

(b)(i) $v_y = u_y + at$ 1M

$v_y = 10\sin 10° + 9.81 \times 3.5 = 36.1 \text{ m s}^{-1}$ 1M for either component

$v = \sqrt{36.1^2 + (10\cos 10°)^2}$

$v = 37.4 \text{ m s}^{-1}$ 1A

(ii) $\tan\theta = \frac{v_y}{v_x}$

$\theta = 74.7°$ 1A

(c) gain in K.E. = lost in PE 1M

$\frac{1}{2} \times 1.5 \times (37.4^2 - 10^2) = 1.5 \times 9.81 \times h$

$h = 44.1 \text{ m}$ 1A

4. (a)(i) $m_Q v_Q = m_P v_P$ 1M

$v_P = 8 \times \frac{250}{300} = 6.67 \text{ m s}^{-1}$ 1A

(ii) $\%\text{ loss} = \frac{\frac{1}{2}(0.25)(8)^2 - \frac{1}{2}(0.3)(6.67)^2}{\frac{1}{2}(0.25)(8)^2} = 16.7\%$ 1M

Kinetic energy of Q is transferred to kinetic energy of *P* and some is lost as heat and sound. 1A

(b)(i) $F = \frac{mv^2}{r}$ 1M

$T = \frac{0.3 \times 6.67^2}{1.5} = 8.89 \text{ N}$ 1A

(ii) No. 1A

If *P* becomes at rest, by conservation of momentum, speed of *Q* will become 8 m s^{-1}, which will violate the conservation of energy. 1A

5. (a) Diffraction 1A

(b) The path difference along PY varies. 1A
Hence, alternate constructive interference and destructive interference occurs along PY. 1A

(c)(i) 1.5λ 1A

(ii) $\lambda = \dfrac{15-12}{1.5} = 2$ cm 1M

$v = f\lambda$ 1M

$v = 10 \times 2 = 2$ cm s^{-1} 1A

(d) The new wavelength = 3 cm

$\dfrac{v_1}{v_2} = \dfrac{\lambda_1}{\lambda_2}$ 1M

$v_2 = v_1 \times \dfrac{3}{2} = 1.5v_1$

$\therefore$ the percentage change of the wave speed is +50% 1A

6. (a) $R \propto T$ 1M

$R = 4000 \times \dfrac{100+273}{30+273} = 4920\ \Omega$ 1A

(b)(i) $V = 6 \times \dfrac{5000}{4000+5000}$ 1M

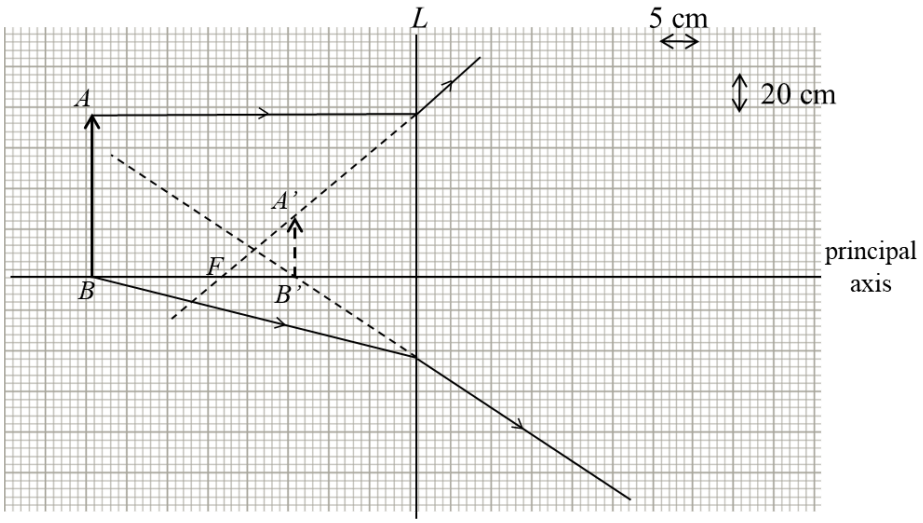
$V = 3.33$ V 1A

(ii) Lower. 1A
Current through a thermistor generates heat, which raises the temperature of the thermistor above that of its environment. 1A

7. (a) Concave. 1A

The lens bends the ray away from the principal axis. 1A

(b)(i) (Correct line) 1A



(ii) $m = \dfrac{v}{u}$ 1M

$m = \dfrac{15}{40} = 0.375$ 1A

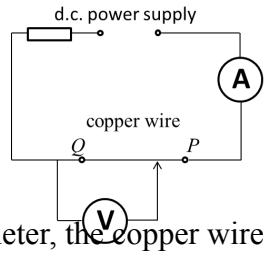
(iii)(Correct size of image) 1A

(iv)(Correct ray) 1A

(Correct position of F) 1A

$f = 24$ cm (23cm–25cm) 1A

8. (correct procedures) 2A
(Correct circuit diagram) 1A
(Correct measurements) 1A
(Correct analysis) 1A



Procedure:
1. Connect the ammeter, the copper wire and the resistor in series with the power supply while connect the voltmeter across part of the copper wire with crocodile clips.
2. Record the ammeter reading I.
3. Record the voltmeter reading V and the length of the copper wire across the voltmeter l.
4. Repeat step 3 by varying the position of the clip on the copper wire.

Analysis:
Plot a graph V/I against l.
A straight line passing through origin should be obtained.

9. (a)(i) $N_{cd} = 480 \times \frac{12}{24} = 240$ 1A

(ii) $VI \times 90\% = P_{out}$ 1M

$24I \times 90\% = 6$

$I = 0.278$ A 1A

(b) The voltage across $QX = 12$ V

So, the voltage across $XP = 12$ V

$\frac{12}{R_{XP}} = \frac{12}{R_{QX}} + \frac{6}{12}$ 1M

$\begin{cases} R_{XQ} = 100r \\ R_{XP} = 100(1-r) \end{cases}$, where r is the required ratio 1M

by solving the above equations

$r = 0.815$ 1A

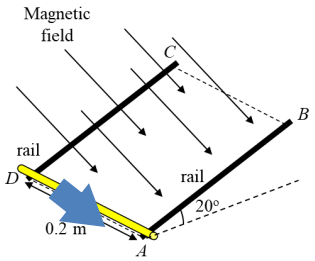
(c) Advantage:

Lower power loss in transformer than in the potential divider 1A

Limitation:

Circuit I only works in a.c. 1A

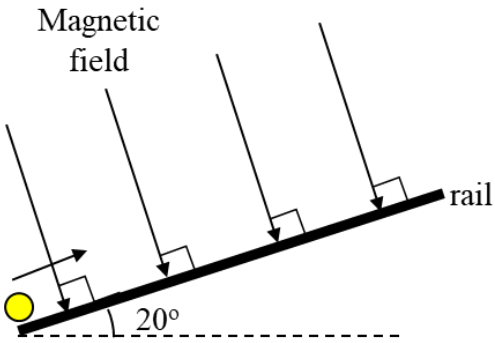
10.(a)



1A

(b)(i)

R



1A for any one
2A for all correct

mg

(ii) $F_B = BI\ell$ 1M

$F_B = 5 \times 2 \times 0.2 = 2$ N 1A

$mg \sin\theta = F_B$ 1M

$m(9.81)\sin 20° = 2$

$m = 0.596$ kg 1A

(iii)Electrical energy is converting into potential energy of the rod. 1A

11.(a) $^{210}_{84}\text{Po} \longrightarrow {}^{206}_{82}\text{Pb} + {}^{4}_{2}\alpha$ 2A

(b)mass defect:

$= 209.98286 - 205.97447 - 4.002603$ 1M

$= 5.787 \times 10^{-3}\,\text{u}$

$= 5.787 \times 10^{-3} \times 931\ \text{MeV}$

$= 5.39\ \text{MeV}$ 1A

(c) $k = \dfrac{\ln 2}{138}$

$k = 5.0228 \times 10^{-3}\ \text{day}^{-1}$ 1A

$k = 5.81 \times 10^{-8}\ \text{s}^{-1}$

$A = kN$

$250 = 5.81 \times 10^{-8} N$

$N = 4.30 \times 10^{9}$ 1M

$N = N_0 e^{-kt}$

$N = 4.30 \times 10^{9} e^{-(5.0228 \times 10^{-3})(365)}$ 1M

$N = 6.88 \times 10^{8}$

$\therefore$ number of nuclei decayed $= 4.3 \times 10^{9} - 6.88 \times 10^{8} = 3.61 \times 10^{9}$ 1A

END OF PAPER 1

PAPER 2

Section C Energy and Use of Energy

3.1 A	3.2 A	3.3 B	3.4 D
3.5 C	3.6 B	3.7 D	3.8 C

(a) (i) from outdoor to indoor 1A

(ii) Heat is absorbed by the refrigerant from the surrounding. 1A
The refrigerant evaporates into vapor. 1A

(iii) To increase the contact surface area with outdoor air to facilitate heat exchange by conduction. 1A

(b) (i) rate of heat lost:

$= UA\Delta T$

$= \frac{0.03}{0.02} \times (4 \times 2 \times 4 + 2 \times 2 \times 2) \times 40$ 1M

$= 2400 \text{ W}$ 1A

$< 2.48 \text{ kW}$

So the air conditioner has enough heating capacity. 1A

(ii) $E = \frac{150 \times 1000}{240 \times 60 \times 60} = 0.173 \text{ J}$ 1A

(iii) The minimum electrical energy consumed by an electric heater to give 2480 J of heat energy is 2480 J which is much more than 0.173 J of an RCAC air con. 1A

(iv) A fan can produce a forced convection current which enhance the energy exchange by convection. 1A

Section D Medical Physics

4.1 D	4.2 A	4.3 A	4.4 C
4.5 C	4.6 B	4.7 B	4.8 D

(a) Shooting fast-moving electrons onto heavy metal target. 1A

(b) (i) 1.36 cm 1A

(ii) Bone is much denser than soft tissue. 1A

(iii) $I = I_0 e^{-\mu x}$

$1.24\times10^{-4} I_0 = I_0 e^{-0.51x_s} e^{-2.46x_b}$, where $x_s + x_b = 10$ cm 1M

$1.24\times10^{-4} = e^{-(0.51(10-x_b)+2.46x_b)}$

$-\ln 1.24\times10^{-4} = 5.1 - 0.51x_b + 2.46x_b$

$x_b = 2.00$ cm 1A

(c) X-ray:
When X-rays pass through the body from outside, they are absorbed by different tissues. The different attenuation of X-rays gives different brightness in image. 1A

CT scan:
X-rays source and detector rotate around the patient. The maps of attenuation are obtained by back projection. 1A
Those maps of attenuation are stacked and reformats can be taken out as a cross section image of the patient. 1A

(d) (i) The difference in linear attenuation coefficient of the liver is not significant to give a good contrast in X-ray image. 1A

(ii) High radiation dosage. 1A

END OF MARKING SCHEME