Anderson Serangoon Junior College 2023 H2 Physics Prelim P1 Exam Solution

Paper 1 (30 marks) **E – Easy, A – Average, D – Difficult**

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
D	A	B	B	B	B	C	A	C	C
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	B	C	C	A	D	C	D	D	A
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
D	C	C	D	A	D	A	B	C	A

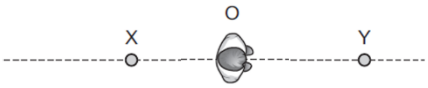
Easy: 6, Average: 15, Difficult: 9

1	**D** $V = \frac{W}{Q} = \frac{Fs}{\mathrm{I}t} = \frac{mas}{\mathrm{I}t}$ Base units of V = $\frac{\text{kg} \times \text{ms}^{-2} \times \text{m}}{\text{A} \times \text{s}} = \text{kgm}^2\text{s}^{-3}\text{A}^{-1}$	**E**
2	**A** $R = \frac{V}{\mathrm{I}} = \frac{1.200}{0.48} = 2.5\Omega$ Reading in ammeter is recorded to 2 dp. For division, the s.f. of calculated data is recorded to the lowest s.f. of the raw data	**A**
3	**B** Using $s = ut + ½ t^2$ $9 = u(2) + ½ a(2)^2$ --- (1) $21 = u(4) + ½ a(4)^2$ --- (2) Solving (1) & (2), a = 0.75 m s^{-2}	**D**
4	**B** Initial vertical velocities for both stones, $u_y = 0$ $s_y = u_y t + ½ gt^2 = ½ gt^2$ Both stones will take the same time to fall through the same height since they experience the same gravitational acceleration g.	**E**
5	**B** Change in momentum = 2(5.0 – 30) = -50 Area under F-t graph = Change in momentum $-F$ x (4 + 6) / 2 = -50 F = 10 N	**A**

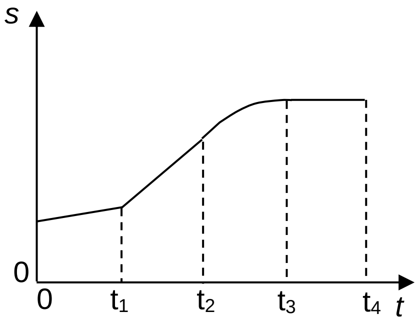
6	**B** Due to smaller weight, a smaller air resistance is needed by the foam ball to achieve zero net for to reach terminal velocity. Hence time required to reach terminal velocity is shorter. So option A and C are eliminated. In addition. since air resistance depends on speed, a smaller air resistance will require a smaller terminal velocity. Hence option D is eliminated.	**D**
7	**C** Tension in string is 3.0*W* (2.0 *W* + 1.0*W*) Let distance between string and CG be *d* Taking moments abouts the CG (which is at 0.5x) (2.0 W) × (0.3x) = (3.0 W) × *d* *d* = 0.2x When load is moved, it will be 0.3x away from the CG (but on the other side) Hence, the string needs to be placed 0.2x from the CG (but on the other side) for rod to be in equilibrium. Distance moved by string = 0.2x + 0.2x = 0.4x	**A**
8	**A** <u>Option A:</u> WD to change speed of object from 2 m s^{-1} to 3 m s^{-1} = ½ m ($3^2 – 2^2$) = ½ m (5) WD to change speed of object from 1 m s^{-1} to 2 m s^{-1} = ½ m ($2^2 – 1^2$) = ½ m (3) So option A is correct. <u>Option B:</u> When an object slows down, there has to be negative work done by a force (opposing the motion of the object). Hence option B is not correct. <u>Option C:</u> When lifting an object 1 m at constant velocity, WD = mgh = mg(1) When moving an object 1 m across a smooth horizontal surface at constant speed, there is no need for a force to keep it at constant velocity. Therefore, WD is zero. Hence option C is not correct. <u>Option D:</u> When an object is dropped, the force of gravity is in the direction of the motion of the object. There is WD by the force of gravity and is given by W×d. Hence option D is not correct.	**A**
9	**C** Distance moved in 60° = 0.40 × $\frac{60}{360}(2\pi)$ = 0.4189 m Since both masses were displaced vertically by 0.4187, the net increase in total GPE of the weights = *m g h* = (20 – 15) / 9.81 × 9.81 × 0.4189 = 2.1 J	**D**

10	**C** If the roller coaster have lost contact, the normal contact force of track on roller coaster must be zero. Centripetal force will be provided by component of weight pointing towards O, if it just remains in contact. At position P, Component of weight towards O = mg cos 30° To maintain contact, $mg\cos 30° = \frac{mv^2}{r}$ $v = \sqrt{rg\cos 30°}$ $= \sqrt{1.0(9.81)\cos 30°}$ $= 2.91\text{ m s}^{-1}$ So, option C will be the best option.	**D**
11	**C** $g_N = g_E$ and $g = \frac{GM}{R^2}$ $\frac{GM_N}{R_N^2} = \frac{GM_E}{R_E^2}$ $\frac{R_N}{R_E} = \sqrt{\frac{M_N}{M_E}} = \sqrt{17} = 4.1$	**A**
12	**B** $\frac{p_2}{T_2} = \frac{p_1}{T_1}$ $\frac{p_2}{50 + 273} = \frac{200000 + 100000}{25 + 273}$ p_2 = 325000 Pa Hence the gauge reading is 225 kPa. Percentage increase is (225 – 200) / 200 x 100% = 12.5%	**A**
13	**C** 1st Law of Thermodynamics $\Delta U = Q + W$ Since no work is done by or done on the blocks, $W = 0$ $\Delta U = Q$ Energy exchange with surroundings is negligible, so	**A**

	Heat gained by copper = Heat loss by iron $Q_{copper} = -Q_{iron}$ $\Delta U_{copper} = -\Delta U_{iron}$ Also, $Q_{copper} = mc_{copper}\Delta\theta_{copper}$ $Q_{iron} = mc_{iron}\Delta\theta_{iron}$ Since $c_{copper} \neq c_{iron}$, $\Delta\theta_{copper} \neq \Delta\theta_{iron}$	
14	**C** $v = \pm\omega\sqrt{x_o{}^2 - x^2}$ $\frac{30}{20} = \frac{\sqrt{x_0^2 - 20^2}}{\sqrt{x_0^2 - 30^2}}$ $x_0^2 = 1300$ $\frac{v}{30} = \frac{\sqrt{x_0^2 - 25^2}}{\sqrt{x_0^2 - 20^2}} = \frac{\sqrt{675}}{\sqrt{900}} = 0.866$ $v = 0.866 \times 30 = 26 \text{ mm s}^{-1}$	**A**
15	**A** $I \propto \frac{1}{r^2}$ $\frac{I_x}{I_{4x}} = \left(\frac{4x}{x}\right)^2 = 16$ $I_{4x} = \frac{1}{16}I$ $I \propto A^2$ Since $I_{4x} = \frac{1}{16}I$, $\frac{I_{4x}}{I} = \left(\frac{A_{4x}}{A}\right)^2$ $\frac{1}{16} = \left(\frac{A_{4x}}{A}\right)^2$ $\frac{A_{4x}}{A} = \frac{1}{4} \quad \Rightarrow \quad A_{4x} = \frac{A}{4}$	**A**
16	**D** For zero resultant amplitude, two waves of the same type must meet in antiphase and have the same amplitude. When that happens, destructive interference occurs, and the resultant amplitude is the difference between the individual amplitude of the two waves. When two waves are emitted from their sources with the same intensity, they can travel different distances to meet at a point. Since intensity and hence amplitude decreases with distance from the source, they will meet with different amplitude. So Option A is incorrect. Two waves must be in antiphase with each other when they meet, so Option B is incorrect. Two waves do not need to travel in opposite directions for resultant amplitude to be zero. They can travel in any directions, as long as they fulfil the conditions stated in the first paragraph, to give zero resultant amplitude. So Option C is incorrect.	**E**

17	**C** Since loudspeakers emit waves that are in antiphase, the condition for waves to meet in phase is path difference = (n + ½) λ For Options A and C, since OY < XY, observer O is in between X and Y as shown.  For Option A, OX = XY – OY = 3.70 – 1.25 = 2.45 m Path difference of the waves from their respective sources to the observer = OX – OY = 2.45 – 1.25 = 1.20 m = 2 λ, so not correct. For Option C, OX = XY – OY = 2.50 – 2.00 = 0.50 m Path difference of the waves from their respective sources to the observer = OY – OX = 2.00 – 0.50 = 1.50 m = 2.5 λ, so correct. For Options B and D, since OY > XY, observer is to the left of X as shown in original diagram. Path difference of the waves from their respective sources to the observer = XY Option B: Path difference = 1.20 = 2 λ, so incorrect. Option D: Path difference = 1.60 m = 2.7 λ, so incorrect.	**D**
18	**D** $y = \frac{1}{2}at^2$ ………..(1) $x = ut$ …………(2) from (1) & (2) $y = \frac{ax^2}{2u^2}$, i.e $y \propto x^2$ $p : q : r : s = x^2 : (2x)^2 : (3x)^2 : (4x)^2$ = 1: 4: 9: 16	**D**
19	**D** $I = nevA$ $v = I / neA$ since I , n, e are constants $v \propto 1/A \propto 1/d^2$ $\frac{v_x}{v_y} = \frac{d_y^2}{d_x^2}$ $\frac{v_x}{v_y} = \frac{(2d)^2}{d^2} = \frac{4}{1}$	**E**

20	**A** Rate of arrival of electrons per unit area = number of electrons per unit time per unit area = $\dfrac{n}{tA}$, where n is the number of electrons, t is time and A is area Since current, $I = \dfrac{ne}{t} \quad \Rightarrow \quad \dfrac{n}{t} = \dfrac{I}{e}$ Therefore, rate of arrival of electrons per unit area = $\dfrac{I}{eA}$	**E**
21	**D** Volume, $V = \pi d^2 L$ When V is constant, $L \propto 1/d^2$ $R = \dfrac{4\rho L}{\pi d^2}$ $R \propto \dfrac{L}{d^2} \propto \dfrac{L}{1/L} \propto L^2$	**A**
22	**C** Option A: Resistance of thermistor increases. By potential divider, p.d across thermistor increases. Hence voltmeter reading is negative. Option B: By potential divider, p.d across fixed resistor will decrease. Voltmeter reading will be negative. Option C: Resistance of LDR increases. By potential divider, p.d across thermistor decreases. Hence voltmeter reading is positive. Option D: same effect as Option B.	**D**
23	**C** Since the net magnetic field at d from wire Y is zero, I_X and I_Y flow in opposite directions. $B \propto I$ and $B \propto \dfrac{1}{r}$ At d away from wire Y, $\dfrac{I_X}{(L+d)} = \dfrac{I_Y}{(d)}$ $\dfrac{4}{L+d} = \dfrac{1}{d}$ $L = 3d$	**D**
24	**D** $Bqv = mv^2 / r$ $v = Bqr / m$	**A**

	Since both X and Y have the same mass to charge ratio, $\frac{KE_X}{KE_Y}=\left(\frac{v_X}{v_Y}\right)^2=\left(\frac{R_X}{R_Y}\right)^2=\left(\frac{1}{2}\right)^2=0.25$	
25	**A** $E = Blv$ Gradient of s-t graph = speed  The speed of the rod between 0 and t_1 is constant and is a positive value. The speed of the rod between t_1 and t_2 is constant and is greater than speed of the rod between 0 and t_1. The speed of the rod between t_2 and t_3 decreases to zero. The speed of the rod between t_3 and t_4 is zero.	**D**
26	**D** $\frac{I_p}{I_s}=\frac{N_s}{N_p}$ $\frac{I_p}{\left(\frac{80}{100}\right)}=\frac{1000}{200}$ $I_p = 4.0\text{ A}$	**A**
27	**A** Loss in EPE = Gain in KE = max E_p $eV_{acc}=\frac{hc}{\lambda_{\min}}$ $\lambda_{\min}=\frac{hc}{e}\left(\frac{1}{V_{acc}}\right)$ Since hc/e is a constant, the graph should be a curve showing inversely proportional relationship between $\lambda_{\min}$ and V_{acc} .	**A**

28	**B** $P = \frac{E}{t} = \frac{n_p E_p}{t}$ $\frac{n_p}{t} = \frac{P}{E_p} = \frac{P\lambda}{hc}$ $\frac{n_e}{t} = \frac{1.5}{100}(\frac{n_p}{t}) = \frac{1.5}{100}(\frac{P\lambda}{hc})$ $I = \frac{n_e e}{t} = \frac{1.5}{100}(\frac{P\lambda}{hc})e$ $= \frac{1.5}{100}(\frac{0.080(546 \times 10^{-9})}{hc})e$ $= 5.27 \times 10^{-4}$ A $= 0.53$ mA	**A**
29	**C** Option A: can be drawn from the observation that most of the α-particles go straight through or are deflected by a small angle. Option B: can be drawn from the observation that a very small proportion are deflected by more than 90°, effectively rebounding towards the source of the α-particles, so the nucleus must be massive to cause the rebounding of the α-particles. Option C: the deflection and rebounding of α-particles can show that the nucleus is positively charged, but it cannot show that there are neutrons in the nucleus. At the time of the experiment, the neutron has not yet been discovered. Option D: can be drawn from the observation that there are α-particles which are deflected or rebounded.	**E**
30	**A** $A = \lambda N = \frac{\ln 2}{T_{1/2}} N$ where N is the number of molecules in the sample $N = n N_A$ And the A of each can be compared by finding the nuclide with the greatest ratio of $\frac{n}{T_{1/2}}$ Option A: $\frac{n}{T_{1/2}} = \frac{0.003}{10} = 0.0003$ Option B: $\frac{n}{T_{1/2}} = \frac{0.1}{400} = 0.00025$ Option C: $\frac{n}{T_{1/2}} = \frac{0.6}{2100} = 0.00029$ Option D: $\frac{n}{T_{1/2}} = \frac{1.0}{4800} = 0.00020$	**A**