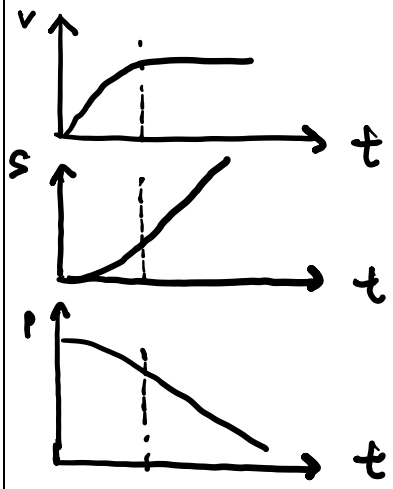
Anderson Serangoon Junior College 2020 H1 Physics Prelim Solution

Paper 1 (30 marks)

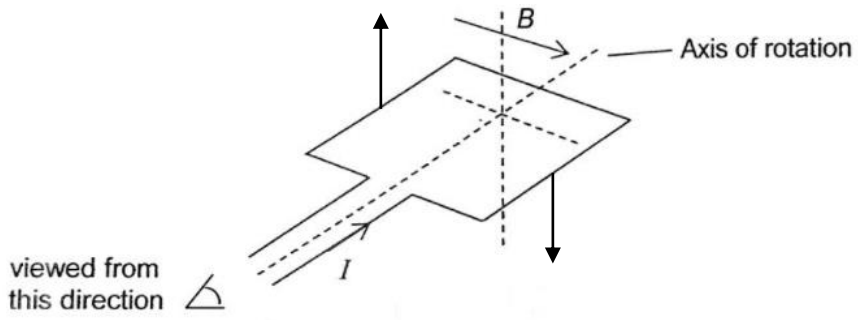
1	2	3	4	5	6	7	8	9	10
D	C	A	B	A	A	C	D	C	A
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	D	A	A	C	C	B	C	B	B
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
D	D	C	B	B	B	D	A	D	C

1	**D** mass of raindrop = ~ 0.05 g
2	**C** density of ruler = 13.78 /(31.2 × 0.32) = 1.3802 g cm^{-3} fractional uncertainty of density = $\frac{0.1}{31.2} + \frac{0.02}{0.32} + \frac{0.01}{13.78}$ = 0.066 percentage uncertainty of density = 0.066 × 100% = 6.6 % actual uncertainty of density = 0.066 × 1.3802 = 0.09 g cm^{-3} Hence, density = 1.38 ± 0.09 g cm^{-3}
3	**A** velocity of motorcyclist relative to passenger on car, $v_R = \overrightarrow{v_M} - \overrightarrow{v_C} = \overrightarrow{v_M} + (-\overrightarrow{v_C})$ Hence, answer is A.
4	**B** Area under acceleration time graph represents the change in velocity of the object. Hence, the speed at point B will be greatest.
5	**A** Both stones have the same initial horizontal velocity and hence same final horizontal velocity. In the vertical component, both stones experience the same change in displacement (s). Using $v^2 = u^2 + 2as$, the same final vertical velocity will be obtained.
6	**A** After 1 sec, $s = ut + ½ at^2$ $= 0 + ½ (9.81)(1)^2$ = 4.905 m (equivalent to 2 storeys)

	After 2 sec, $s = ut + ½ at^2$ $= 0 + ½ (9.81)(2)^2$ = 19.62 (equivalent to 8 storeys) After falling 2s, the ball will be at the 2nd storey.
7	**C** Action-reaction must be of the same type. Weight is the gravitational force on the man due to the Earth.
8	**D** Since there is no external forces acting along the horizontal direction, COM applies.
9	**C** The impulse is the product of resultant force and time the force acts.
10	**A** Constant horizontal speed implies no net force in that direction, so the only force is the normal contact force acting upwards.
11	**B** Resultant force is zero in all cases. However, taking moments about the CG, assuming length of the square is d : A will result in a 2Fd – Fd = Fd clockwise moments C will result in 2Fd – Fd = Fd anticlockwise moments & D will result in 2Fd + Fd = 3Fd clockwise moments.
12	**D** Initial extension = 1/3.5 = 0.286 m Therefore, increase in EPE = $½ (3.5)[(0.286 + 0.40)^2 – 0.286^2]$ = 0.68 J.
13	**A** Let the mass of the ruler be m grams. Using principle of moments, taking moments about the pivot, m x 10 = 20 x 60 m = 120. When the 50 g mass is now hung on the string, let the pivot be at x cm mark, Using principle of moments, taking moments about the new pivot, 120 (50 – x) = 50 (100 – x) 600 – 12x = 500 – 5x 7x = 100 x = 14 cm

14	**A** Considering the effect of viscous force, the body would eventually reach terminal velocity. Hence:  Since work has to be done against viscous force, the total energy (sum of E_p and E_k) would decrease. Considering that the velocity in viscous fluid would eventually reach terminal velocity (constant v), E_k would also reach a constant value eventually (horizontal flat graph).
15	**C** For old lamp, P_o = 0.05 □ 60 = 3.0 W For new lamp, efficiency = 3.0/ 4.0 □ 100% = 75%
16	**C** At max speed, rate of work done against air resistance = 54×10^3 W $F v = cv^2 \times v = 54\times10^3 \rightarrow v = 30$ m s^{-1}
17	**B** For a body in uniform circular motion, 1. the angular velocity is constant because the magnitude and direction of rotation are constant 2. the kinetic energy is constant because speed of body is constant and kinetic energy is a scalar 3. the linear velocity and linear momentum changes as the direction of motion changes but the magnitude remains unchanged
18	**C** For the carriage to turn left, the tension in the string must be directed to the left to provide for the necessary centripetal force. The centripetal force should not be drawn on the free body diagram.

19	**B** At the top of the track, the resultant force on the marble is given by (mg – normal contact force). For the marble to not leave the track, the centripetal force at the top of the hump must be less than or equal to the weight of the marble. ➔ $F_c \leq mg$ ➔ $v^2/r \leq g$ Hence, $v \leq \sqrt{gr}$ ➔ $v \leq \sqrt{9.81 \times 0.050} = 0.70$ m s^{-1}
20	**B** $v_e = r_e \cos 30° \ \omega$ $= 6.38 \cos 30° \times 2\pi/(24 \times 3600)$ $= 402$ m s^{-1}
21	**D** Charge is quantized. $Q = Ne$ where N is an integer.
22	**D** Effective resistance of the circuit increases when Bulb Q blows. Hence ammeter reading decreases. By PDP, the pd across P now decreases whereas pd across R increases, hence brightness of P decreases whereas R increases.
23	**C** *R = ρL/A* *For A, R= ρL/A* *For B, R= 3ρL/A* *For C, R= ρL/3A at T* *For D, R= ρL/3A at 3T* *At higher temperatures, resistance increases. Hence the resistance for D will be higher than that of C.*
24	**B** For maximum power to be delivered the value of the load resistor is equal to the internal resistance of the cell. i.e. $R = r = 2\ \Omega$ $I = \frac{E}{R+r} = \frac{10.0}{4} = 2.5$ A P = $(2.5)^2$ x 2 = 12.5 = 13 W
25	**B** The potential difference across the resistance *R* is given as $V = IR$. Hence, $IR = E - Ir$ From the data, we form two equations: (1.0) $3.0 = E - 1.0\ r$ … (1) (0.4) $12.0 = E - 0.4\ r$ … (2) Solving the equations simultaneously, $r = 3.0\ \Omega$ and $E = 6.0$ V

26	**B** For high V_T, p.d across thermistor must be low, which means resistance of thermistor must be low and hence temperature is high. For high V_L, p.d across LDR must be high, which means resistance of LDR must be high and hence light intensity is low.
27	**D** same p.d across each branch consisting of each ammeter, $2RA_1 = RA_3 = 3RA_4$ $2A_1 = A_3 = 3A_4$ $2A_1 = A_3 = 3(0.6) = 1.8$ Kirchoff's 1st law, $A_2 = A_1 + A_3 + A_4 = 0.9 + 1.8 + 0.6 = 3.3$
28	**A**  By FLHR, the direction of the forces acting on the sides of the coil are as shown in the diagram hence leading to a rotation in the clockwise direction. As the coil rotates, the perpendicular distance between the forces decrease and hence the torque decreases.
29	**D** Time for one orbit = distance / speed = $\frac{2\pi r}{v}$ ----- (1) Electromagnetic force provides centripetal force Bev = $\frac{mv^2}{r}$ v = $\frac{Ber}{m}$ Substituting into eqn 1, T = $2\pi r$ x $\frac{m}{Ber}$ = $\frac{2\pi m}{eB}$

30	**C** The compass originally points North due to the Earth's magnetic field. When a current is passed through the wire, the current produces a magnetic field. By right-hand grip rule, the direction of the magnetic flux density due to the wire is clockwise. Given that the magnetic flux density due to the Earth is pointing North, in order to have zero magnetic flux density, the magnetic flux density due to the wire must be due South, and the position will therefore be C.