<u>Anderson Serangoon Junior College 2021 H2 Physics Prelim Mark Scheme</u>

Paper 1 (29 marks)

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

1 **C**

coin mass – 10^{-3} kg; paper thickness – 10^{-4} m; body temperature – 10^{2} K

2 **D**

$d_2 - d_1 = 3.46$ mm
$\Delta(d_2 - d_1) = \Delta(d_2) + \Delta(d_1) = 0.03 + 0.02 = 0.05$ mm

$$\frac{\Delta(d_2 - d_1)}{d_2 - d_1} \times 100\% = \frac{0.05}{3.46} \times 100\% = 1.4\%$$

3 **C**

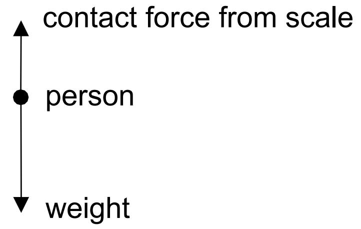
Initial velocities for both stones, $u = 0$

$s = ut + ½ gt^2 = ½ gt^2$

For the same time interval, Δt, both stones fall down by the same distance, s.

Therefore the distance between them will always remain the same as that at the point of release.

4 **D**



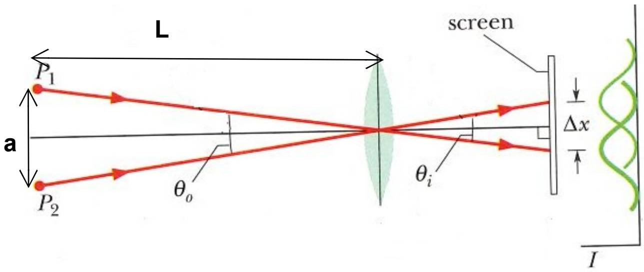
Since bathroom scales reading (which is equal to contact force from scale on person) is less than weight, the net force on person is downwards. The acceleration of the person is directed downwards. This applies either when the person is moving downwards is speeding up, or when the person is moving upwards and slowing down.

A and C are wrong as the person has acceleration, so cannot be moving at constant speed.
B is wrong. When movement is downwards and slowing down, acceleration is upwards.

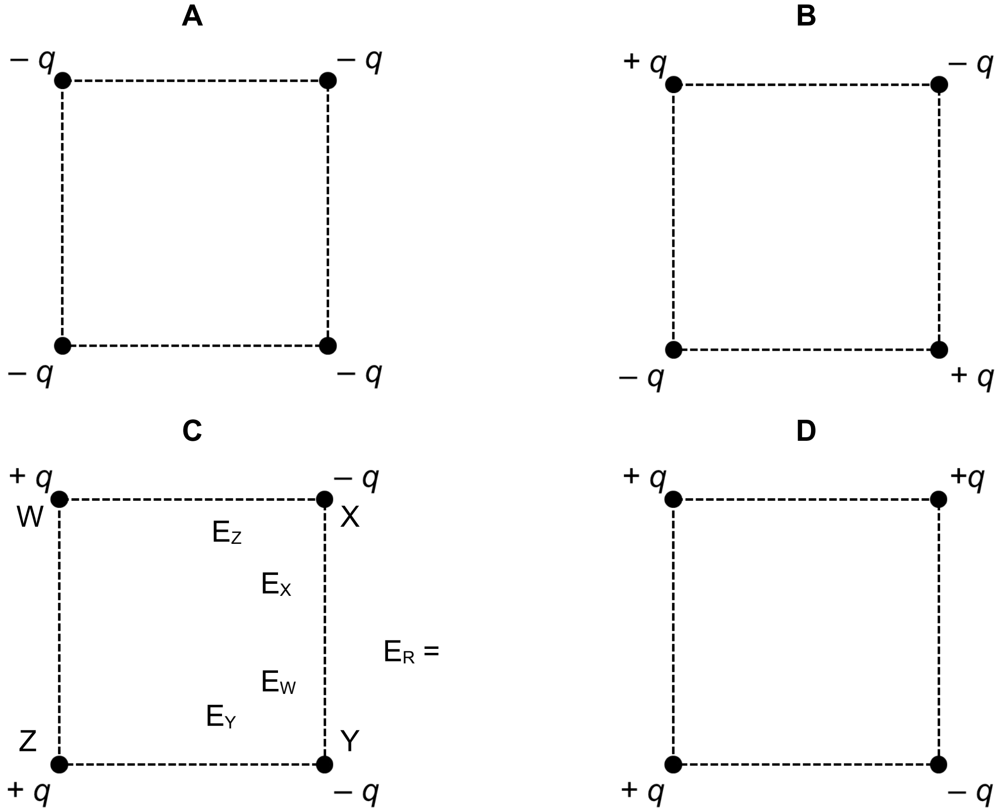
5	**A** System of two mass: F = 3 (a) a = System of 1 kg mass: T = (1.0) () =
6	**B** For elastic collisions, the relative speed of approach equals relative speed of separation $u - 0 = v_2 - v_1$ $v_2 = u + v_1$ (1) From conservation of linear momentum $mu + 0 = mv_1 + 4mv_2$ (2) Substituting (1) into (2) $mu = mv_1 + 4m(u + v_1)$ $5v_1 = -3u$ $v_1 = -\frac{3}{5}u$
7	**D** To have only rotational motion, net force = 0 but net moment $\neq$ 0. B and C are wrong as net force is not zero, so system causes linear movement of the rod. A is wrong as moments about any point is zero, hence no rotational movement. D is correct as moments about any point is not zero, hence there is rotational movement.
8	**B** $P = Fv = F(u + at) = F(0 + at) = Fat$ Since F and a are constants, P varies linearly with t.
9	**D** Both boats travel the same distance s and experience the same force F. Hence the total work done by the force F between the starting line and the finishing line is the same for each boat – they will have the same final kinetic energy. Boat with mass m will experience a larger acceleration, and will thus reach the finish line first. Note: Boat with mass m will also have a higher speed, since the two boats have the same final kinetic energy.

10	**B**

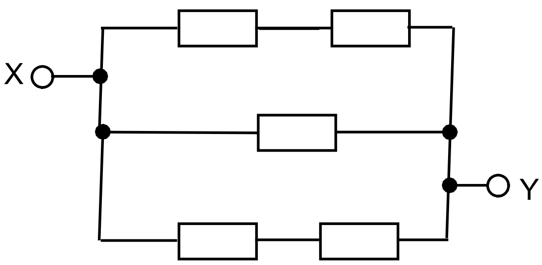
	Compare mechanical enery at hilltop to that at top of loop. By Conservation of Energy, $$\text{gain in KE} = \text{loss in GPE}$$ $$\frac{1}{2}mv^2 - 0 = mg(h_{hilltop} - h_{top\ of\ loop})$$ $$F_{net} = \frac{mv^2}{r} = \frac{2mg(85-40)}{20}$$ $$N + mg = \frac{9}{2}mg \text{ (at top of loop)}$$ $$N = 3.5mg = 3.5W$$
11	**A** Since $\Delta\phi = \frac{E}{m}$, magnitude of g = $\frac{\Delta\phi}{x} = \frac{E}{mx}$ Potential at P > potential at Q since mass loses potential energy as it moves from P to Q. Hence, direction of g is from P to Q, higher potential to lower potential.
12	**B** Rate of heat removed = rate of water flow $\times$ c $\times$ temp change Q/t = (m/t) c $\Delta\theta$ m/t = $\frac{\frac{6.7\times10^9}{60}}{4200\times(14-6)}$ kgs^{-1} = $\frac{6.7\times10^9}{4200\times8\times60}$ kgs^{-1}
13	**A** Let A = cross-sectional area of piston Since no change in temperature, $p_1V_1 = p_2V_2$ p_2 = (100 kPa $\times$ 80 mm $\times$ A) / (160 mm $\times$ A) = 50 kPa $\therefore F$ = (atm pressure – p_2)A = (100 – 50) $10^3 \times 3 \times 10^{-3}$ =150 N
14	**A** For the object to remain in contact with the platform throughout the motion, its acceleration must not be greater than 9.81 m s^{-2}. $$a_{max} = \omega^2 x_0$$ $$x_0 = \frac{a_{max}}{\omega^2} = \frac{a_{max}}{(2\pi f)^2} = \frac{9.81}{(2\pi(1.5))^2} = 0.11\text{ m}$$
15	**A**

	Intensity = $I\cos^2\theta = I\cos^2(60.0°) = 0.250\,I$
16	**D** Since intensity, I varies proportionately with (amplitude, A)^2 Let each unit for displacement be *y*. $\frac{I_{new}}{I_{old}} = \left(\frac{A_{new}}{A_{old}}\right)^2$ $\frac{0.5I_{old}}{I_{old}} = \left(\frac{A_{new}}{4y}\right)^2$ $A_{new} = 2.8y$
17	**C** d sinθ = nλ, so sin 30° = λ/d x = λD/a = λD/ 500d = (1.0/500) sin 30° = 1.0×10^{-3} m
18	**C**  P_1 and P_2 are the double stars. The angular separation θ_o of the 2 stars equals the angular separation θ_i of the images. i.e.$\theta_o = \theta_i$ If the images are to satisfy Rayleigh's criterion for resolvability, then $\theta_o = \theta_I = \theta_R = \frac{\lambda}{D}$, where D = diameter of the lens Hence $\frac{a}{L} = \frac{\lambda}{D}$, taking λ = 500 nm for visible light $\frac{a}{20 \times 9.5 \times 10^{15}} = \frac{500 \times 10^{-9}}{3.0}$ a = 3.2×10^{10} m
19	**B** In order to hold the positively-charged particle P halfway between the two plates, the upper plate must be at a lower potential with respect to the lower plate (so that electric force acts upwards which is balanced by the gravitational force acting downwards). By decreasing *V* and causing the positively-charged particle P to move towards the lower plate (which is at a higher potential), the EPE of the particle increases (since a positive charge's EPE increases with electric potential). However, as the particle has fallen to a lower position, its GPE decreases.

<table>
<tr><td>20</td><td>C

Let E_R denote the resultant electric field strength at the centre of the square.

</td></tr>
<tr><td>21</td><td>B

Use $I = evAn$

$An = I/ev$ where An is the number of protons per unit length.</td></tr>
<tr><td>22</td><td>C


$$\frac{1}{R_{eff}} = \frac{1}{2R} + \frac{1}{R} + \frac{1}{2R}$$
$$R_{eff} = \frac{R}{2}$$</td></tr>
<tr><td>23</td><td>D

2Ω and 4Ω are connected in series, and they are connected parallel with the cell.
V_{out} is the p.d. across 4Ω</td></tr>
</table>

	$V_{out} = \frac{4}{4+2}(E)$ Using potential divider, $\frac{V_{out}}{E} = \frac{2}{3}$
24	**D** The direction of the flux density due to coil 1 and 2 must be in the same direction while direction of flux density due to coil 2 and 3 must be in opposite direction. By using Right Hand Grip Rule, we can conclude that the current in coil 1 and 2 must be CCW such that magnetic flux is out of the plane while current in coil 3 must be CW to achieve near zero magnetic flux density.
25	**B** As magnet leaves the coil, induced emf acts in the opposite direction, hence galvanometer deflects in the opposite direction. Magnitude is larger than 10 units due to acceleration of the magnet during the fall.
26	**A** $I = I_0 \sin \omega t = \sqrt{\frac{P_0}{R}} \sin \frac{2\pi}{T} t = \sqrt{\frac{150}{6.0}} \sin \frac{2\pi}{0.020} t$ $I = 5.0 \sin 100\pi t$
27	**C** $\frac{V_S}{V_P} = \frac{5}{1} \quad \Rightarrow \quad V_S = 5 \times 240 = 1200\text{ V}$ Power delivered to the resistive load $P = \frac{V^2}{R} = \frac{1200^2}{1000} = 1440\text{ W}$ Ideal transformer implies 100% efficiency. Power supplied by primary circuit $P = VI = 240I = 1440 \quad \Rightarrow \quad I = \frac{1440}{240} = 6.0\text{ A}$
28	**B** The number of photoelectrons emitted per second ($\frac{N}{t}$) is directly proportional to the intensity of incident radiation. Since the intensity of radiation is constant, the number of photoelectrons varies proportional with time.
29	**B** The potential energy gained by the electron = $qV = 3.2 \times 10^{-15}$ J $\frac{hc}{\lambda} = 3.2 \times 10^{-15}$ J $\lambda = 6.2 \times 10^{-11}$ m
30	**D** Beta decay occurs when a neutron in the nucleus decays to produce a proton, a beta electron and an anti-electron-type neutrino. With each beta decay, the mass number of the daughter nucleus remains unchanged

	but the atomic number increases by one. Hence, after double beta decay, the mass number of the daughter nucleus remains unchanged at 130 and the atomic number increases by two to 54. ${}^{130}_{52}Te \rightarrow {}^{A}_{Z}Xe + 2\,{}^{0}_{-1}\beta$ Therefore, Z = 54 and A = 130.