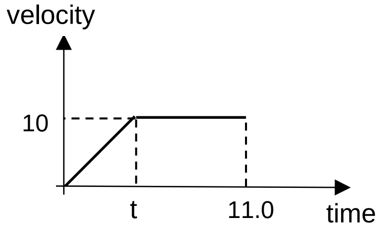
Anderson Serangoon Junior College 2023 JC1 H2 Physics Promo Mark Scheme

Paper 1 (20 marks) **E – Easy, A – Average, D – Difficult**

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
B	A	D	D	C	B	A	B	A	C
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	A	A	C	C	D	B	A	B	D

1	**B** When a train leaves a station, the initial speed is 0. The average speed of a train is 60 km h^{-1} which is about 17 m s^{-1} The time taken to reach this average speed is about 15 s. So acceleration is = 17 / 15 = 1.111 ≈ 1 m s^{-2}. Additional consideration : we know *g* is 9.81 m s^{-2}, so acceleration should be about the same order but less than *g*.	**D**
2	**A** $v = \frac{s_2 - s_1}{t_2 - t_1}$ $\frac{\Delta v}{v} = \frac{\Delta s}{s} + \frac{\Delta t}{t} = \frac{1+1}{270} + \frac{0.02+0.02}{2.00} = \frac{2}{270} + \frac{0.04}{2.00}$	**A**
3	**D** Method 1: Total distance = area under velocity vs time graph  $100 = \frac{11.0 + (11.0 - t)}{2} \times 10$ t = 2.0 s a = 10/t = 10/2.0 = 5.0 m s^{-2} Method 2: let a = acceleration, t = time to accelerate from rest to 10 m s^{-1} total distance = ½at^2 + 10 (11.0 – t) 100 = ½at^2 + 10 (11.0 – t) ………(1) v = at 10 = at ………..(2) From (1) & (2) , a = 5.0 m s^{-2}	**A**

4	**D** Gradient of graph gives the velocity. Graph D shows the speed of the object increasing from zero to a constant maximum value.	**E**
5	**C**  Since blocks remain in contact as they accelerate, they have the same acceleration *a*. Option A is wrong because *F* is not the net force acting on X. The acceleration of X = $\frac{F - F_{YX}}{m_X}$. Option B is wrong because if $F_{XY} = F$, then by Newton's 3rd Law, $F_{YX} = F$ since F_{XY} and F_{YX} form an action-reaction pair. This will lead to the net force on X to be zero and it will not accelerate. Option D is wrong because F_{XY} and F_{YX} form an action-reaction pair so they have the same magnitude. Option C is correct because the acceleration of X = $\frac{F - F_{YX}}{m_X}$. Hence F_{YX} is less than *F*. This implies that F_{XY} will also be less than *F* from Newton's 3rd Law.	**A**
6	**B** From Newton's 2nd Law, $F_{net} = F_{net} = \frac{dp}{dt}$ The resultant force is represented by the gradient of momentum-time graph. Since the resultant force is slowly increased, the gradient of the graph must also become steeper. Hence only option B is correct. Options A and C have decreasing gradient, while option D has constant gradient.	**D**
7	**A** Constant velocity implies $X = Y + Z$. The weight of an air bubble is tiny so this must be *Y*. The upthrust must be *X* as it is the only force with the correct direction, so *Z* must be the drag.	**A**
8	**B** Since the ground is frictionless, force R is the normal contact which acts vertically upwards. Options C and D are incorrect. Weight always acts vertically downwards towards the ground (Earth), option A is wrong.	**D**

9	**A** $\text{Efficiency} = \frac{\text{Useful Output Power}}{\text{Input Power}} \times 100\%$ $= \frac{U}{E_{in}} \times 100\%$	**E**
10	**C** Option A: on the platform before the jump (EPE = 0, KE = 0) Option B: on the way down before the cord has started to extend (EPE = 0) **Option C: net force acting on the jumper is zero (GPE, EPE and KE not zero)** Option D: when the cord is stretched to a maximum (KE = 0)	**D**
11	**C** $\omega = \frac{\theta}{t} = \frac{2\pi}{12 \times 3600} = 1.45 \times 10^{-4}\ rad\ s^{-1}$	**E**
12	**A** Friction provides centripetal force required to keep the child in circular motion, and this force acts towards the centre of the turntable. There is no need to draw the centripetal force separately in the force diagram.	**A**
13	**A** gravitational force = $\frac{G(2M)M}{(3x)^2} = \frac{2GM^2}{9x^2}$ Hence, k = 2/9 = 0.22	**A**
14	**C** For a satellite in orbit, kinetic energy = $\frac{GMm}{2r}$ and gravitational potential energy = $-\frac{GMm}{r}$. When the radius of the orbit increases, kinetic energy decreases and gravitational potential energy increases (less negative).	**A**
15	**C** For a geostationary satellite, it travels from west to east and remains vertically above a fixed point on the Equator. It has an orbital period of 24h (same as Earth's period of rotation), meaning the angular velocity must be the same as Earth's rotation about its axis. Hence, the linear speed of the satellite must be larger than that of a point on Earth's equator as it is at a further distance away from Earth's centre.	**A**

16	**D** At t = 0, y is at equilibrium position where velocity is highest, thus KE highest. Since y-t graph is a sine curve, v-t graph would be a cosine curve ($v = \frac{dy}{dt}$) and KE graph would be a $\cos^2$ curve (KE = ½ mv^2).	**A**
17	**B** With damping, the amplitude is lower everywhere except at zero frequency where it is the same as the driver.	**A**
18	**A** Intensity is proportional to square of amplitude. $$\frac{I}{I_1} = \frac{a^2}{a_1^2}$$ $$I_1 = \frac{a_1^2}{a^2} I$$ $$I_1 = \frac{(a\,cos60^o)^2}{a^2} I$$ $$I_1 = \frac{(0.5a)^2}{a^2} I$$ $$I_1 = 0.250\,I$$ OR recall Malus' Law, $I = I_o \cos^2 \theta$ $I_1 = I \cos^2 60.0^o = 0.250I$	**A**
19	**B** Increasing the frequency of the vibration bar causes the wavelength to decrease (since velocity of water wave is constant; $v = f\lambda$). When (plane) water waves pass through a gap of width much larger relative to their wavelength, there is insignificant observable diffraction effect.	**A**
20	**D** d = (1×10^{-3}) / 500 = 2.0×10^{-6} m For diffraction grating, using $d \sin\theta = n\lambda$, $(2.0 \times 10^{-6})(1) = n\,(600 \times 10^{-9})$ n = 3.33 $\Rightarrow$ highest order of image is at the 3rd order (on each side) Thus, total number of images = 3 + 3 + 1 (central maximum) = 7	**A**