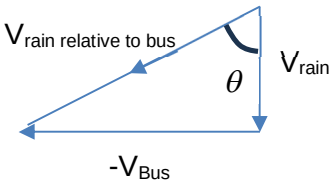
2024 YIJC JC2 Prelim Exam H1 Physics Paper 1 Solution

Question	Answer
1	B
2	C
3	C
4	B
5	A
6	B
7	C
8	B
9	B
10	B

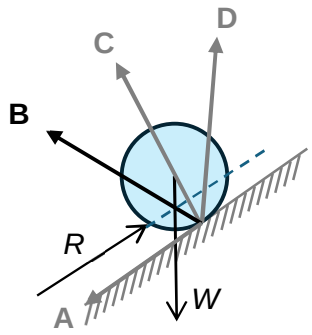
Question	Answer
11	B
12	C
13	B
14	D
15	D
16	B
17	A
18	B
19	C
20	D

Question	Answer
21	B
22	A
23	C
24	B
25	B
26	B
27	C
28	B
29	C
30	C

MCQs Solutions

Qn	Answer	Explanation
1	B	Option A: container ship can go up to about 40km h^{-1} = 11 m s^{-1} Option B: Usain bolt complete 100 m at 9.63 s Olympic sprinter can go up to about 10 m s^{-1} = 0.01 km s^{-1} Option C: The modern F1 car can reach speeds of roughly 220mph = 100 m s^{-1} = 10000 cm s^{-1} Option D: The top speed of a snail is about 0.04 km h^{-1}
2	C	 $\tan\theta = \frac{60\times10^3}{3600}\frac{1}{8}$ $\theta = 64^o$
3	C	Taking average can only reduce random error. For systematic error, the error has to be known and then to be added/subtracted from all measurements.

4	**B**	The slope of the *v-t* graph is equals to the acceleration. Downward velocity is taken to be positive. So acceleration downward is positive too. In region OP, decreasing (positive slope) acceleration with downwards direction. In region PQ, terminal velocity is reached, acceleration (slope) is zero. In region QR, increasing (negative slope) acceleration with upwards direction. In region RS, new reduced terminal velocity, acceleration (slope) is zero.
5	**A**	As angle θ increases from zero, the range increases. *R* reaches a maximum value, then starts to drop to zero when angle θ is 90°, where the projectile is shot straight upwards. Taking upwards positive, $-V\sin\theta = V\sin\theta - gt$ $t = \frac{2V\sin\theta}{g}$ Taking rightward positive, $R = (V\cos\theta)t = \frac{2V^2\sin\theta\cos\theta}{g}$ $= \frac{V^2}{g}\sin 2\theta$
6	**B**	Taking downwards as positive, $s_y = u_y t + \frac{1}{2}a_y t^2$ $2.0 = \frac{1}{2}\times 9.81\times t^2$ $t \approx 0.639$ s $s_x = u_x t$ $2.5 = u_x \times 0.639$ $u_x \approx 3.92$ ms^{-1}
7	**C**	Impulse = area under the *F-t* graph. Since the graph shown is *a-t*, we can multiply the y-axis value by the mass to obtain the *F-t* graph. Area under $F-t$ graph $= (1.2)\times$ area under $a-t$ graph $= (1.2)\frac{1}{2}(3.0)(2.0+3.0)$ $= 9.0$ N s OR The area of a-t = change of velocity = 7.5 m s^{-1} Impulse = m Δv = 1.2 x 7.5 = 9.0 N s

8	**B**	Assuming the 3.0 kg mass accelerates downwards, the 5.0 kg mass will accelerate rightwards at the same rate. Let the acceleration be *a*. for the 5.0 kg mass, taking right as $+ve$ $T - 20 = 5.0a$ (1) for the 3.0 kg mass, taking down as $+ve$ $3.0g - T = 3.0a$ (2) solving simultaneously, $(1) + (2)$ $3.0g - 20 = 8.0a$ $a = 1.2\ \text{m s}^{-2}$
9	**B**	A – tension is the force the rope acts on the two different boys. Since there are three systems (rope and 2 boys), the tension acting on the two boys cannot be an action-reaction pair. C – the centripetal force is a net force (sum of all forces) and can never be one of the forces in an action-reaction pair. D – the buoyancy force acts upwards on the boat, while the thrust pushes the boat forward (horizontally) so they are in different directions.
10	**B**	For an object in equilibrium, the forces must be concurrent. 
11	**B**	At maximum tension, taking moments about P, Sum of anti-clockwise moment = sum of clockwise moments $20(2.0\sin 40°) = 5.0(9.81)(x_{\text{max}}\sin 70°) + 1.0(9.81)(1.0\sin 70°)$ $x_{\text{max}} = 0.36\ \text{m}$ A – forget to account for weight of rod. C – did not resolve all distance/forces appropriately. D – did not resolve correctly for tension.

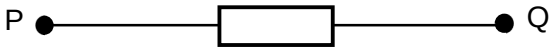
12	**C**	Taking vertical direction, $mg = 0.2g + 0.5g = 0.7g$ Let distance P to centre of mass = x Taking moments about P, $0.5g(1.0) = 0.7g(x)$ $x = 0.71\,\text{m}$ or Mass of the rod = Sum of reading = 200 + 500 = 700 gram Let distance P to centre of mass = x Taking moments about P, $500g(1.0) = 700g(x)$ $x = 0.71\,\text{m}$
13	**B**	The elastic potential energy stored in the spring is equal to the area under the *F-s* graph. Area = ½ (30)(0.06) = 0.90 J Therefore, compression = 0.06 m
14	**D**	Work done in pushing crate horizontally = *Fs* = (70)(6.0) = 420 J Work done in lifting crate vertically = *mgh* = (50)(9.81)(1.2) = 589 J Total work done = 420 + 589 = 1009 J (1000J in 2 s.f.)
15	**D**	WD by man = *Fs* = (200)(10.5) = 2100 J WD in lift load = *Wh* = (480)(3.5) = 1680 J Efficiency = (useful work in lifting / work exerted by man)x100% = (1680/2100)x100 = 80%
16	**B**	The angular velocity is a vector quantity but its direction of rotation is constant and so it is a constant. KE is a scalar quantity and it is a constant because the speed is constant. The linear velocity, linear momentum and linear acceleration are all vector quantities and their directions are always changing as the body rotates.
17	**A**	The frictional force *f* provides the centripetal force for the mass *m* to undergo circular motion. Both masses have the same angular velocity ω because they are placed on the same rotating disc. $\frac{f_1}{f_2} = \frac{m_1 r_1 \omega^2}{m_2 r_2 \omega^2}$ $= \frac{(3.0)(2.0)}{(6.0)(5.0)}$ $= \frac{1}{5}$
18	**B**	$v = r\omega$ At the latitude, radius of rotation is $R\cos\theta$ where *R* is radius of Earth $v = (6.38\times10^6)(\cos 30^o)\,(2\pi/24\text{x}3600)$ $= 401.0 = 400\ \text{m s}^{-1}$ (2 s.f.)
19	**C**	The object (as is the space capsule) is orbiting the Earth. Thus, a centripetal force is acting on the object and it is due to the gravitational force acting on the object by the Earth's gravitational field.

20	**D**	As *V* increases, the **ratio** between *V* and *I* increases. When *V* is 0, current is non-zero, so resistance is 0.
21	**B**	Wire P: $R = \frac{\rho L}{A} = \frac{\rho l}{\pi(d/2)^2} = \frac{4\rho l}{\pi d^2}$ $\quad d^2 = \frac{4\rho l}{\pi R}$ Wire Q: $\frac{1}{4}R = \frac{\frac{1}{3}\rho(2l)}{\pi(d_Q/2)^2} = \frac{2}{3}\frac{4\rho l}{\pi d_Q^2}$ $\quad d_Q^2 = \frac{8}{3}\frac{4\rho l}{\pi R} = \frac{8}{3}d^2$ $d_Q = 1.6d$

22 **A**

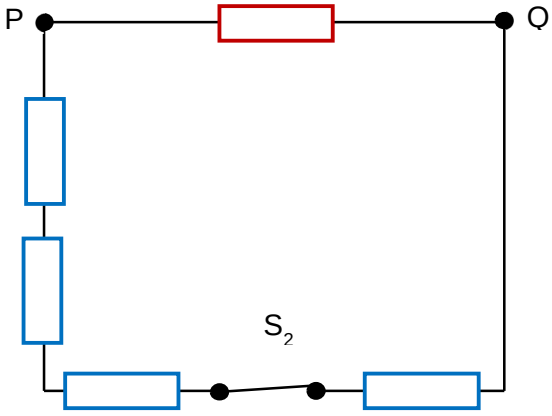
For resistors in parallel, the effective resistance will always be smaller than the resistance in branch with the smallest resistance.

Both open



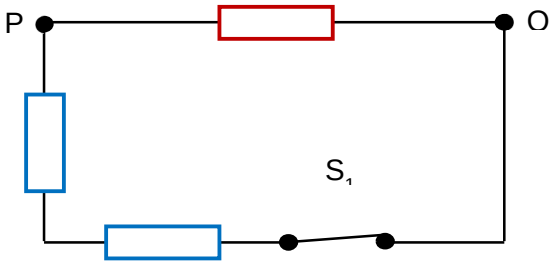
$R_{eff} = R$

S_1 Open, S_2 closed



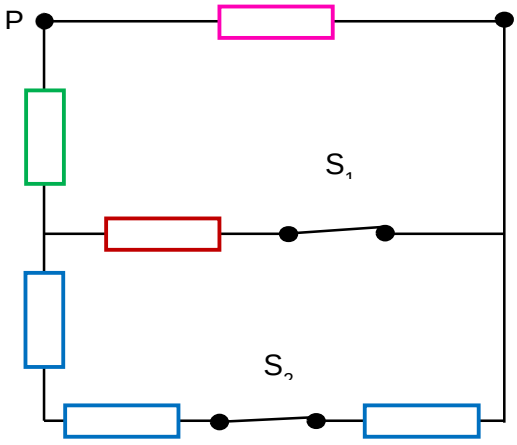
$$R_{eff} = \left(\frac{1}{4R} + \frac{1}{R}\right)^{-1} = \frac{4}{5}R = 0.80R$$

S_1 closed, S_2 open



$$R_{eff} = \left(\frac{1}{2R} + \frac{1}{R}\right)^{-1} = \frac{2}{3}R = 0.667R$$

Both closed



$$R_{eff} = \left[\frac{1}{\left(\frac{1}{3R} + \frac{1}{R}\right)^{-1} + R} + \frac{1}{R}\right]^{-1} = 0.636R$$

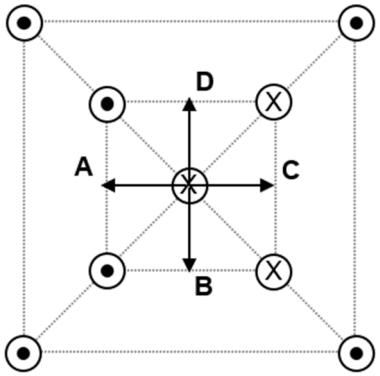
23 **C**

When the variable resistor is at 0 kΩ,

$V = 24$ V

When the variable resistor is at 50 kΩ,

$$V = \left(\frac{20}{20+50}\right)24 = 6.9 \text{ V}$$

24	**B**	For parallel wires with current flowing in the opposite directions, the wires will repel each other. If the currents are flowing in the same direction, the wires will attract each other. Since side PS is nearer than side QR, force of repulsion is greater than attraction and thus the loop will move to the right.
25	**B**	Gravitational force always acts in the same direction as the gravitational field. If the force is opposite to the field, the charge must be negative as the electric force acts in the opposite direction to the electric field.
26	**B**	The coil will produce a magnetic field into the plane of the page at P. Using Fleming's Left Hand Rule, the force is pointing upwards.
27	**C**	 Consider the four outer current carrying conductors. Each exerts an opposing force on the centre which results in a zero force. Consider the four inner current carrying conductors. Parallel currents attract while antiparallel currents repel. The resultant force at the centre is in the direction of C.
28	**B**	After 17100 years, 3 half-lives have passed. So $\frac{1}{2^3} = \frac{1}{8}$ the number of Carbon-14 nuclei is left. $\frac{\text{Number of Carbon-14 nuclei}}{\text{Number of Nitrogen-14 nuclei}} = \frac{1/8}{7/8} = 0.143$
29	**C**	α-particles cannot penetrate through a sheet of paper.
30	**C**	$\text{mass defect} = \text{mass of constituents} - \text{mass of nuclei}$ $= \left[(37)(1.0073u) + (85-37)(1.0087u)\right] - 84.9118u$ $= 0.7759u$