2023 YIJC Preliminary Examination H2 Physics Paper 1 Answer Key

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

S/N	Ans	Explanation
1	**C**	$V = 4/3\ \pi r^3$ $= 4/3\ \pi\ (d/2)^3$ $\Delta V/V \times 100\% = 3\Delta d/d \times 100\%$ $= 3(0.01/6.00) \times 100\%$ $= 0.5\%$
2	**D**	The goods train will overtake the express train after time *t* when their displacement from the station is the same. For the good train: $s_1 = ut = 10t$ For the express train: $s_2 = ut + ½\ at^2$ $= 0 + ½\ (0.50)t^2$ When $s_1 = s_2$, $10t = ½\ (0.50)t^2$ $t = 40$ s
3	**B**	Backward push by back wheel on the road Action and reaction pair will be forward push by road on the back wheel
4	**A**	Looking at FBD of whole system $\Sigma F = ma$ $(5)(9.81) – (2)(9.81) \sin 30 – 7.0 = 7a$ $a = 4.61\ m\ s^{-2}$ Looking at FBD of 5.0 kg block, $\Sigma F = ma$ $(5)(9.81) – T = 5(4.61)$ $T = 26$ N

5	**B**	The bar is in equilibrium and the load (weight = *W*) is a constant. The position of the pivot is also fixed. Let it be a distance h away from the fixed load. Taking moments about the pivot, $Wh = Fx$ *Wh* is a constant since *W* and *h* are constants. Hence, *Fx* = constant $F \propto 1/x$ Graph B shows this relationship.
6	**C**	A body in equilibrium and acted on by three forces (*R*, *W* and tension in the thread), the line of action of these three forces must pass through a common point. Only option C is correct.
7	**C**	(A) While the direction of the velocity of the ball can change after bouncing, the kinetic energy remains positive (no direction for kinetic energy). (B) The power generated by the engine can be equated to the gravitational potential energy gained per unit time and rate of work done against friction. (C) Since the appliance is an electric heater, all the energy output can be lost in terms of thermal energy. Thus, it is possible to have the electric heater at 100% efficient. (D) Momentum must be conserved in a collision.
8	**A**	For object moving in uniform circular motion, the net force (centripetal force) points towards the centre of the circle. Since there is no displacement in the direction of the net force, work done by *F* is zero.
9	**B**	The glue will snap at the lowest position of the vertical circular motion. $T - W = mr\omega^2$ $18 - 3 = (3/9.81)(0.85)\ \omega^2$ ω = 7.6 rad s^{-1}
10	**B**	Moving at right angle to the vertical gravitational field implies that the object is still at the same level as before. Since the field is uniform, there is no change in the gravitational potential energy of the object.
11	**B**	At constant power, a longer line means a longer time duration and therefore more heat transfer. Q is melting and S is boiling. Since S is longer, the specific latent heat of vaporisation is larger than the specific latent heat of fusion.
12	**B**	For total amount of gas, $$PV = nRT$$ $$(3.9 \times 10^5)(2.5 + 1.6) \times 10^3 \times 10^{-6} = (0.34 + 0.20)(8.31)T$$ $$T = 360\ K$$
13	**B**	Amplitude x_0 = 600 / 4 = 150 mm = 0.150 m Frequency *f* = 50 / 47 = 1.064 Hz

		Angular frequency $\omega = 2\pi f = 2(\pi)(1.064) = 6.684$ rad s^{-1} Max KE = ½ $m\omega^2 x_0^2$ = ½ × (5.0×10^{-3}) × $(6.684)^2$ × $(0.150)^2$ = 2.51×10^{-3} J
14	**B**	$v = f\lambda$ 24 = 15 λ λ = 1.6 m phase difference = $\frac{2.0}{1.6} = 1.25$ cycle The two points 2.0 m apart has a phase difference of a quarter of a cycle.
15	**B**	With $x = \frac{\lambda D}{a}$, to increase the distance between the fringes, • the wavelength of the light source should be increased. Hence its frequency should be decreased. • the distance between the slits and the screen should be increased. • the distance between the slits should be reduced Increasing the distance between the light source and the slits does not affect the fringe separation.
16	**D**	Using single slit diffraction, $\sin\theta = \frac{\lambda}{b}$ $\sin\theta = \frac{600 \times 10^{-9}}{0.20 \times 10^{-3}}$ θ = 0.0030 rad $s = r\theta = 2.0 \times 0.0030 = 0.0060$ m width of central maximum ≈ 2s = 2 × 0.0060 = 0.012 m = 12 mm
17	**C**	Since Q experiences no net force, Force on Q by 4.0 C = Force on Q by 9.0 C $\frac{4.0Q}{(1-x)^2} = \frac{9.0Q}{x^2}$ $\frac{x^2}{(1-x)^2} = \frac{9}{4}$ x = 0.60 m
18	**B**	Since the charge is held stationary, net force on the oil drop = 0 Electric force = weight of oil drop $qV/d = mg$ $ne = mgd/V$ $n = mgd/eV$
19	**C**	For X: $R = \frac{\rho L}{A_X}$

		$R = \frac{\rho L}{V / L} = \frac{\rho L^2}{V}$ ---------- (1) For Y: $R_Y = \frac{\rho(2L)}{V / 2L} = \frac{4\rho L^2}{V}$ ---------- (2) Same volume V. Hence $A_Y = V / 2L$. Also, same metal hence, ρ is the same. Therefore, $R_Y = 4R$
20	**A**	$I = E$ / Total resistance $I = E / (R + r)$ ---------- (1) Since, E and R are constant, an <u>increase in r results in a decrease in current I</u>. Terminal pd $V = E - Ir$ ---------- (2) $V = E - [E / (R + r)]\, r$ Simplifying, we obtain $V = ER / (R + r)$ Since, E and R are constant, an <u>increase in r results in a decrease in pd V</u>.
21	**B**	Let current through 70 Ω resistor branch be I_1 Let current through the 50 Ω, 30 Ω and 60 Ω resistors branch be I_2 R_{70} // ($R_{50} + R_{30} + R_{60}$) So $V_{70} = V_{50,30,60}$ $I_1 R_{70} = I_2 (R_{50} + R_{30} + R_{60})$ $70 I_1 = 140 I_2$ $I_1 = 2 I_2$ ---------- (1) But $I_1 + I_2 = 1.5$ -------- (2) Solving (1) and (2), $I_2 = 0.50$ A
22	**C**	Use right hand grip rule at Q. Current cannot be at P as that would produce a horizontal B field at O.
23	**D**	If current Y doubled, B field at X due to Y will double. (B field at Y due to X not affected). F on wire X will be doubled since B field at X due to Y is doubled. F on wire Y will be doubled since current Y is doubled.
24	**A**	Area of coil A = $\pi (0.16 / 2)^2 = 0.0201$ m^2 Induced emf V = $\Delta\phi / \Delta t$ $= A\, \Delta B / \Delta t$ $= 0.0201 \times (5.00 - 0) / 10.0 \times 10^{-3}$ $= 10.053$ V Current = $V / R = 10.053 / 4.0 = 2.51$ A

		To oppose change in B field, coil will induce B field into the page. Using right hand grip rule, induced current in clockwise direction.
25	**A**	Reducing speed by half will decrease emf by half, and hence the coil experiences a lower rate of change of magnetic flux linkage, therefore current will decrease. Pushing north into the left end of coil will result in the coil being induced a N-S magnet. Pushing south into the right end of the coil will also result in the coil being induced a N-S magnet. Hence the induced current direction must be the same in both cases. (i.e. needle points to the left)
26	**B**	Mean power dissipated in the alternating current = $i_{rms}^2 R$ Mean power dissipated in the steady current = $I^2(2R) = 4R$ I = 1.4 A
27	**D**	(A) Evidence for wave nature of particles (B) Evidence for wave nature of electromagnetic radiation (C) Evidence for wave nature of electromagnetic radiation (D) Evidence for particulate nature of electromagnetic radiation
28	**D**	$E_p = \Phi + KE_{max}$ $6.63 \times 10^{-34} \times f = (6.63 \times 10^{-34} \times 4.0 \times 10^{14}) + (1.6 \times 10^{-19} \times 1.5)$ $f = 7.6 \times 10^{14}$ Hz
29	**D**	Alpha particles are deflected by the nuclei of the metal atoms in the foil. These nuclei are small, heavy and positively charged.
30	**C**	If a 10 g sample of ancient wood causes a count rate of 50 counts per minute, then a 5 g sample of the same wood would cause a count rate of 25 counts per minute. Thus for a fixed mass, the count rate of the ancient wood is ¼ of the count rate of living wood. This means that two half-lives have passed and so, the age of the ancient wood = $2 \times 5600 = 11200$ years.