2025 DHS H2 Physics Prelim Paper 1 Suggested Solutions

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

Worked Solutions & Explanations:

1 **B**

$< \rho > = (1002 + 998 + 997 + 1001 + 999)/5 = 999.4$ kg m^{-3}, closer to 1000 kg m^{-3}

difference from true value = 1000 – 999.4 = 0.6 kg m^{-3}

$\Delta \rho = \rho_{max} - \rho_{avg} = 1002 - 997 = 5$ kg m^{-3}

2 **D**

Maximum velocity when $R = mg$

$$0.60\, v = 3.0(9.81)$$

$$v = 49 \text{ m s}^{-1}$$

At 12 m s^{-1}, $F_{net} = mg - R = ma$

$$a = \frac{3.0(9.81) - 0.6(12)}{3.0} = 7.4 \text{ m s}^{-1}$$

3 **C**

The total area under the velocity-time graph is the change in displacement.

4 **B**

For an object to float in equilibrium, $U = m_{ice}\, g$

Since the pressure of the water increases with depth, there is a pressure difference between the top and bottom surface of the ice which results in an upward force on the ice that results in upthrust

5 **C**

Clockwise moments = Anticlockwise moments about the hinge

$(10000x)(2.0) = (50x9.81)(2.5)$ --- Eqn (1)

$(10000x')(2.0) = (40x9.81)(5.0) + (50x9.81)(2.5)$ --- Eqn (2)

Eqn (2) - Eqn (1), $x' - x = 0.0981$ m

6 **C**

The net force on the sledge is zero when it slides down at constant velocity.

The vector triangle of forces on the sledge forms a closed polygon.

7 **A**

Work done by the pump = Fd = PAd = (5000)(600 x 10^{-4})(0.40) = 120 J

8 **D**

$E_{input} = GPE = mgh$

$P = \frac{1.3\times10^{9}\times9.81\times2.0}{24\times60\times60} = 300$ kW

9 **B**

Minute hand makes one complete revolution in 1 hour.

$$v = r\omega = 3.00\left(\frac{2\pi}{3600}\right) = 5.24 \times 10^{-3} \text{ m s}^{-1}$$

10 **D**

Such a motion is possible. **(Option A is incorrect)**

In a binary star system, the centre of mass of two stars of unequal mass will not be at the midway point. It will be closer to star with mass *M*. Hence the radius of orbit of *M* is smaller than 2*M*. **(Option C is incorrect)**

For an orbit centred around its common centre of mass, position of centre of mass is fixed in space. For this condition to be satisfied, the two stars have to constantly be on opposite sides of the common centre of mass. Hence, they will have the same period of rotation and hence same angular velocity. **(Option D is the answer)**

Since they have the same angular velocity and different radius, the speed at which each star orbits will also be different from $v = r\omega$. **(Option B is incorrect)**

11 **B**

At point P, $F_{net} = 0$

$$\frac{GM_E m}{r^2} = \frac{GM_M m}{(R-r)^2}$$

$$\frac{r}{R-r} = \sqrt{\frac{M_E}{M_M}}$$

Rearranging and making r the subject,

$$r = \frac{R}{\sqrt{\frac{M_E}{M_M}} + 1}$$

12 **A**

In moving from Q to P,

$$\frac{\phi_Q}{\phi_P} = \frac{r_P}{r_Q}$$

$$\phi_Q = \frac{r}{2r}(-800)$$

$$= -400 \text{ kJ kg}^{-1}$$

$$\Delta GPE = m\Delta\phi$$

$$= 1.0[-800 - (-400)]$$

$$= -400 \text{ kJ}$$

13 **D**

From the equation: θ (K) = θ (°C) + 273.15

Gradient = 1

y-intercept = 273.15

14 **B**

When the basketball is pumped, work is done on the air in the ball to cause an increase in pressure. Work done on the gas is positive.

Since this process is a fast process, little to no heat exchange happens and hence $Q = 0$

By 1st law of thermodynamics, the internal energy increases which accounts for the increase in temperature of the system.

15 **B**

In lightly damped oscillations, the amplitude of the oscillations decreases exponentially. (i.e. $A \propto e^{-x}$)

Since the total energy is proportional to the square of the amplitude, the total energy also decreases exponentially. (TE $\propto e^{-2x}$)

16 **A**

Intensity received by ear $= \frac{P}{4\pi r^2} = \frac{2000}{4\pi(78)^2} = 0.0262$ W m^{-2}

Power received by ear $= P \times A_{ear} = 0.0262 \times 2.1 \times 10^{-3} = 5.49 \times 10^{-5}$ W

17 **D**

Using Malus' Law, $I = I_0 \cos^2 \theta$,

$I = 0$ when $\theta = 90°$

$I = 0.5\, I_0$ when $\theta = 135°$

$I = I_0$ when $\theta = 0°$

18 **B**

Fundamental frequency is $f_0 = v / 2L$

Frequencies of n-th harmonics = $n f_0 = nv / 2L$

19 **D**

For first order diffraction, $d \sin\theta = \lambda$

$$\lambda / d = \sin(28.6°)$$

For 2nd order maxima, $d \sin\theta_2 = 2\lambda$

$$\theta_2 = \sin^{-1} [2 \sin(28.6°)] = 73.2°$$

To find maximum n, $d \sin 90 = n_{max} \lambda$

$$n_{max} = d / \lambda = 2 \text{ (rounded down to nearest integer)}$$

Therefore, maximum number of intensity maxima observed is 5

20 **A**

The upward electric force F_E on each sphere must be equal and opposite to each of its weight. (i.e. $qE = mg$)

Since the same electric field E is experienced by both spheres, $\frac{q_x}{m_x} = \frac{q_y}{m_y} = \frac{g}{E}$

When the plates are brought closer together, E increases, F_E is now more than weight and the two charges will move upward.

The net force on each object is equal to the increase in F_E (i.e. $q\Delta E = ma$)

Since the charge to mass ratio $\frac{q}{m}$ of the two spheres is the same, the acceleration is also the same.

21 **D**

Resistance of P is given by the expression $\rho \frac{x}{xt} = 4.0\ \Omega$

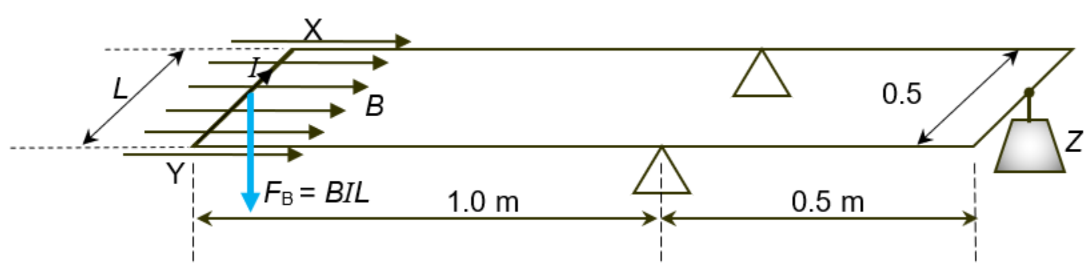
Resistance of Q is given by the expression $\rho \frac{2x}{0.5xt} = 4R_P = 16\ \Omega$

Since the sheets are in series to each other, the total resistance is 20 Ω.

22 **B**

As the currents are in phase, attractive force exists between the conductors and this force varies sinusoidally with double the frequency.

23 **B**



use Fleming's left rule to determine the direction of current I: from Y to X

frame horizontal $\Rightarrow$ net moment about the pivot axis $= 0$

$\Rightarrow (BIL)(1.0\text{ m}) = Z(0.5\text{ m})$

$\Rightarrow \frac{Z}{I} = 2BL = 2(0.050)(0.5\text{ m}) = \frac{1}{20}$

24 **C**

E and B_1 form a velocity selector: $B_1Qv = QE \Rightarrow v = \frac{E}{B_1}$

So, ions P and Q have the same speed upon entering uniform magnetic field B_2

Inside B_2, both ions travel in circular paths. Magnetic force provides the centripetal force:

$$B_2Qv = \frac{mv^2}{r}$$
$$\Rightarrow r = \frac{mv}{QB_2} = \frac{mE}{QB_1B_2}$$

Since E, B_1, B_2 are constants, we have

$$r_Q = r_P\left(\frac{m_Q}{m_P}\right)\left(\frac{Q_P}{Q_Q}\right) = 3.7\left(\frac{1}{1.5}\right)\left(\frac{2}{1}\right) = 4.9\text{ cm}$$

25 **A**

According to Fleming's LHR, the electrons in the rotating metal disc experience a magnetic force directed **radially outward**.

Along the radius PQ, this force drives the electrons towards the rim of the disc, resulting in a net negative charge at the rim (P) and a net positive charge at the center (Q). Consequently, P has a lower electric potential than Q.

Along the radius PQ, the current flows from the rim (P) to the center (Q) within the disc.

26 **D**

Initially,

$$\frac{V_1}{I_p} = \frac{R}{(N_2/N_1)^2}$$

If the number of turns in the primary is doubled, then

$$\frac{V_1}{I_{p,new}} = \frac{R}{(N_2/2N_1)^2} = 4\frac{R}{(N_2/N_1)^2} = 4\frac{V_1}{I_p}$$

$\Rightarrow I_{p,new} = \frac{I_p}{4}$ so the answer is option D.

Q26 Alternative Explanation:

When the number of turns in the primary is doubled, then V_s will be halved.

Since the load resistor is the same, from $V_s = I_s R$, the I_s will also be halved.

Therefore, since $\frac{I_{p,f}}{I_{s,f}} = \frac{1}{2}\frac{I_{p,i}}{I_{s,i}}$ due to the change in turns ratio, and $I_{s,f}$ is half of $I_{s,i}$, the new $I_{p,f}$ is ¼ of the original $I_{p,i}$.

27 **A**

$E_{difference} = E_{photon} = \frac{hc}{\lambda} = \frac{6.63\times10^{-34}\times3.0\times10^{8}}{633\times10^{-9}} = 1.96 \text{ eV}$

This energy gap corresponds to the energy difference between W and X

28 **C**

$$\begin{aligned}
\Delta x &\geq \frac{h}{\Delta p} \\
&= \frac{h}{0.01p} \\
&= \frac{h}{0.01\sqrt{2m_p E}} \\
&= \frac{6.63}{0.01\sqrt{2\left(1.67\times10^{-27}\right)\left(1.00\times10^{6}\times1.60\times10^{-19}\right)}} \\
&= 2.87\times10^{-12} \text{ m}
\end{aligned}$$

29 **A**

α particles are easily stopped. So β or γ particles are a better choice. To prevent harm to human and the environment, activity should fall quickly.

30 **C**

$$\begin{aligned}
\text{energy released} &= \text{total BE of products} - \text{total BE of reactants} \\
&= 2.54\times3 - 2\left(1.09\times2\right) \\
&= 3.26 \text{ MeV}
\end{aligned}$$