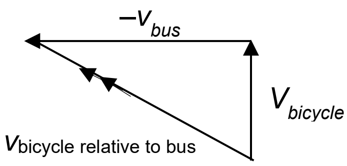
Tampines Meridian Junior College

2025 JC2 H2 Physics Preliminary Examination Paper 1

Suggested Solution

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

Q1 Ans: D

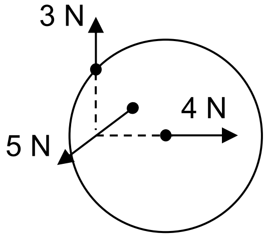


Q2 Ans: B

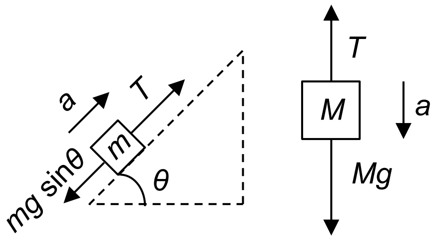
Gradient of the graph started with maximum magnitude before slowing decreasing and becoming zero. Acceleration (given by gradient of V-t graph) of an object falling in the presence of air resistance will decreases until terminal velocity is reached and become zero. Thus option B is the answer.

Q3 Ans: C

To ensure rotational equilibrium, the line of action of the forces must pass through a single point.



Q4 Ans: D



Let T be tension in string

$T - mg\sin\theta = ma$ …………(1)

$Mg - T = Ma$ …………(2)

$(2) + (1)$

$Mg - mg\sin\theta = Ma + ma$

$$a = \frac{Mg - mg\sin\theta}{M+m} = \frac{(M - m\sin\theta)}{(M+m)}g$$

Q5 Ans: B

Torque by 30 N couple = 30 (2)(0.065) = 3.9 N m (anti-clockwise)
Torque by 25 N couple = 25 (2)(0.12) = 6.0 N m (clockwise)
Torque by 15 N couple = 15 (2)(0.10) = 3.0 N m (clockwise)
Net torque = 3.0 + 6.0 – 3.9 = 5.1 N m (clockwise)

Q6 Ans: B

Area under the graph gives the elastic potential energy of the spring. As extension is doubled from x_1 to x_2, area changes from ½ F_1x_1 to ½ F_2x_2. Hence change in EPE= ½ F_2x_2 - ½ F_1x_1

Q7 Ans: B

$v = r\omega$

$8.4 = (16)\omega$

$\omega = 0.525$ rad s^{-1}

$\theta = \omega\, t = (0.525)(8.0) = 4.2$ rad

Q8 Ans: D

Angular speed and the linear speed are different ways of describing the same motion; they do not cause each other.

By Newton’s second law, net force causes acceleration and hence changes in both angular speed and the linear speed simultaneously.

Q9 Ans: C

For an object of mass *m* orbiting around Earth,
Gravitational force provides for centripetal force

$$G\frac{M_{Earth}m}{r^2} = \frac{mv^2}{r}$$

$$GM_{Earth}\left(\frac{1}{r}\right) = v^2$$

Since they are both orbiting around same Earth,

$$\left(\frac{1}{r}\right) \propto v^2$$

$$\left(\frac{v_{ISS}}{v_{satellite}}\right)^2 = \frac{r_{satellite}}{r_{ISS}}$$

$$v_{ISS} = v_{satellite}\sqrt{\left(\frac{r_{satellite}}{r_{ISS}}\right)} = 3.1\sqrt{\left(\frac{4.2\times10^4}{6.8\times10^3}\right)} = 7.7 \text{ km s}^{-1}$$

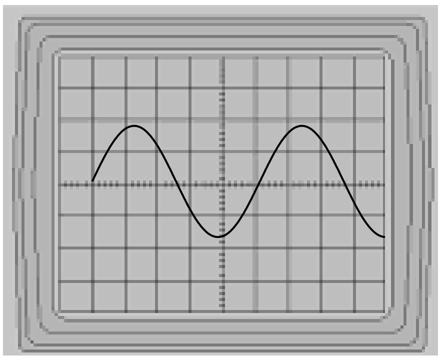
Q10 Ans: A

The potential energy – time graph should be a sinusoidal squared graph. As the displacement at t_1, t_2, t_3 is zero, the speed is the maximum, kinetic energy is maximum, and hence potential energy is zero.

Q11 Ans: B

2 kHz has a period of 0.5 ms.

A typical CRO screen has 10 horizontal divisions of 1 cm each. The period will span over 5 divisions with a 0.1 ms cm^{-1} setting.



Q12 Ans: A

The two supports have to be node. Taking distance between 2 walls as *L*, the wavelength of the given wave is 2*L*, and the next possible stationary wave has wavelength *L*.

$$v = f\lambda$$

$$f = \frac{v}{2L}$$

$$f' = \frac{v}{L} = 2f$$

Q13 Ans: C

$$d\sin\theta = n\lambda$$

$$3\lambda_x = 5\lambda_y$$

$$\frac{\lambda_x}{\lambda_y} = \frac{5}{3}$$

Q14 Ans: B

Using first law of thermodynamics $\Delta U = Q + w$, *Q* = 0 and *W* = +ve for adiabatic compression. Hence ΔU and temperature increased.

Q15 Ans: A

Using $Q = mc\Delta\theta = 0.200 \times 390 \times 30 = 2300$ J
since final temperature at thermal equilibrium is 50 °C.

Q16 Ans: D

KE = 3/2 Nk T

$$(c_{rms})^2 \alpha\ T$$

$$\frac{T_2}{T_1} = \frac{1.2^2 c^2{}_{rms}}{c^2{}_{rms}}$$

$$T_2 = 1.44 \times 350$$

$$= 500 \text{ K}$$

Q17 Ans: C

Force on a charge in the field is given by $F = q\,E$. Since it's a uniform electric field, E is constant. Both proton and electron have the same magnitude of charge q.
Therefore the proton should experience the same magnitude of force as the electron.

The other options are correct statements because

Option A: Since the work done by the electric force on both the electron and proton is positive, therefore change in electric potential energy is negative for both ($W_{by\ electric\ force} = -\Delta U$)
Hence they both lose electric potential energy.

Option B: The proton experiences an upward electric force that is of same magnitude as that on the electron but has a larger mass.
Therefore it will experience a smaller acceleration and undergo a smaller deflection.
Hence the work done by electric force is smaller for proton, giving it a smaller $|\Delta U|$.

Option D: The proton loses less electric potential energy than the electron. By conservation of energy, the gain in kinetic energy must be less than that of the electron.

Q18 Ans: D

The resistors are connected in parallel to the power supply.

$$R_{effective} = \left(\frac{1}{1300} + \frac{1}{1900}\right)^{-1} = 772\ \Omega$$

$$I = \frac{240}{772} = 0.31\ \text{A}$$

$$P_{total} = \frac{240^2}{1300} + \frac{240^2}{1900} = 75\ \text{W}$$

Q19 Ans: C

At about 2.4 V, the graph of the diode and lamp intersects. Hence the V and I values are the same. Since $R = V/I$, the diode and lamp have the same resistance.

Q20 Ans: B

For the voltmeter reading to be highest, the combined resistance of the thermistor and LDR has to be lowest (by potential divider principle).
High brightness (i.e. high intensity of light) would give LDR lowest resistance. High temperature would give thermistor lowest resistance.

Q21 Ans: C

As electron moves to the left, conventional current (middle finger) will be to the right. Using right hand grip rule for wire, magnetic field acting on electron will be out of paper. Applying Flemming's left hand grip rule, force on electron

Q22 Ans: B

For wire to start to lift off, magnetic force= weight of wire.

$$mg = BIL\sin\theta$$
$$0.004(9.81) = 0.040(0.30)(\sin 30^o)I$$
$$I = 6.54A$$

Q23 Ans: A

To determine the induced e.m.f.:
$\varepsilon = BLv\cos\theta$ where v is the velocity of rod at the bottom of slope, and L is length of rod.

To determine v:
$$v^2 = u^2 + 2as$$
$$v^2 = 0 + 2(g\sin\theta)y$$
$$v = \sqrt{2y(g\sin\theta)}$$

Hence,
$$\varepsilon = BLv\cos\theta = BL\left[\sqrt{2y(g\sin\theta)}\right]\cos\theta = BL\sqrt{2yg}\left[\left(\sqrt{\sin\theta}\right)(\cos\theta)\right]$$

	θ / °	*Induced emf* / V
A	35	0.620 $BL\sqrt{2yg}$ (largest)
B	40	0.614 $BL\sqrt{2yg}$
C	45	0.595 $BL\sqrt{2yg}$
D	50	0.563 $BL\sqrt{2yg}$

Q24 Ans: D

Inserting an iron core concentrates the magnetic field lines and provides better linkage between coils P and Q. Hence the flux linkage through both coils will be larger and amplitude of the induced voltage in coil Q will increase.

Option A is incorrect – although increasing the frequency will increase the amplitude in coil Q (due to a faster rate of change of flux linkage), the number of cycles per unit time (i.e. frequency) will also increase.

Option B is incorrect – decreasing the cross-sectional area of coil P will have no effect on the flux density created by coil P. Hence no change to the flux linkage of both coils.

Option C is incorrect – decreasing the number of turns in coil Q will result in a lower amplitude as $\frac{V_Q}{V_P} = \frac{N_Q}{N_p}$.

Q25 Ans: C

Option A: Mean power dissipated = $\frac{\left(\frac{V_0}{\sqrt{2}}\right)^2}{8.0} = \frac{\left(\frac{60}{\sqrt{2}}\right)^2}{8.0} = 225$ W

Option B: Mean power dissipated = ½ (225) = 112.5 W

Option C: Mean power dissipated = $\frac{V_0^2}{8.0} = \frac{(60)^2}{8.0} = 450$ W

Option D: Mean power dissipated = ½ (450) = 225 W

Q26 Ans: B

Current from the a.c. supply can flow in both directions around the circuit.
But the setup of diodes result in current flowing through R to be only in the upward direction.

Q27 Ans: B

$$\frac{1}{2}mv^2 = 9.3 \times 10^{-16}$$

$$\frac{1}{2}\left(9.11 \times 10^{-31}\right)v^2 = 9.3 \times 10^{-16}$$

$$v = 4.52 \times 10^7 \text{ m s}^{-1}$$

$$\lambda = \frac{h}{mv} = \frac{h}{\left(9.11 \times 10^{-31}\right)\left(4.52 \times 10^7\right)} = 1.6 \times 10^{-11} \text{ m}$$

Q28 Ans: D

$\Delta x \Delta p \approx h$

$(7.2\times10^{-9})(\Delta p) \approx (6.63\times10^{-34})$

$\Delta p \approx 9.2\times10^{-26}$ kg m s^{-1}

Since the uncertainty in the position is the slit width (y-direction), the uncertainty in momentum is also in the y-direction.

Q29 Ans: C

Most particles passed through undeflected or with a small deflection

Since very few of the particles were scattered through large angles, the probability of the particle getting close to the centre of the positive charge is small. This shows that the atom consists of mostly empty space.

Small fraction (<1%) of α-particles are deflected through large angles;

To produce such a large deflection, there must be a large force

All the positive charges in the atom are concentrated as a nucleus in a small region of space as compared to the diameter of the atom.

Few particles are reflected backwards, through an angle close to 180°

As such, the nucleus is small and very massive.

Q30 Ans: D

Property	**α-particles ($^{4}_{2}\text{He}$)**	**β-particles ($^{0}_{-1}\text{e}$)**	**γ-rays (γ)**
Stopped by	10^{-2} mm aluminium or a few cm of air	5 mm aluminum	100 mm lead

Since the radiation is not affected by the 7 mm aluminum sheet, beta radiation is absent.

Since the presence of 0.1 mm aluminum sheet decreases the count rate, alpha radiation must be present and is blocked by the sheet.

Since the 10 cm lead reduces the radiation to nearly zero, gamma radiation must be present and is blocked by the lead.