DUNMAN HIGH SCHOOL
2023 H2 PHYSICS (YEAR 6)

Answers to Prelim Exam H2 Physics Paper 1

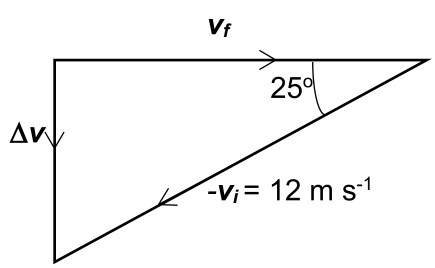
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
A	B	B	D	A	B	C	C	D	C
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	C	D	B	D	D	B	A	B	B
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
D	C	A	D	C	C	A	A	B	D

1 A

energy = power x time
$= 3.0 \times 10^{9} \times 2.0 \times 10^{-12}$
$= 6.0 \times 10^{-3}$ J
$= 6.0 \times 10^{-15}$ TJ

2 B

Recall: $\Delta \boldsymbol{v} = \boldsymbol{v_f} - \boldsymbol{v_i}$



The horizontal component of $\boldsymbol{v_i} = \boldsymbol{v_f}$ since there's no horizontal acceleration, so $\Delta \boldsymbol{v}$ is vertical.

$\Delta \boldsymbol{v} = 12 \sin 25^{\circ} = 5.1$ m s^{-1}

3 B

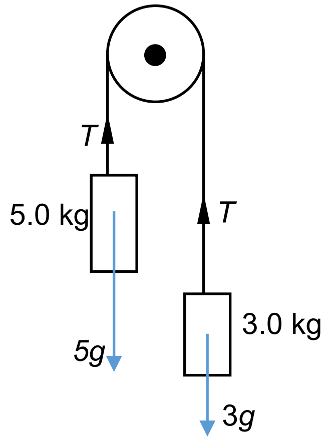
Before time instant B, the cars are moving towards each other. After time instant B, they are moving away from each other.

4 D

Kinetic energy is conserved only if the collision is elastic.

Hence, only momentum and total energy is conserved as there are no net external forces acting on the system when the two objects collide.

5 A

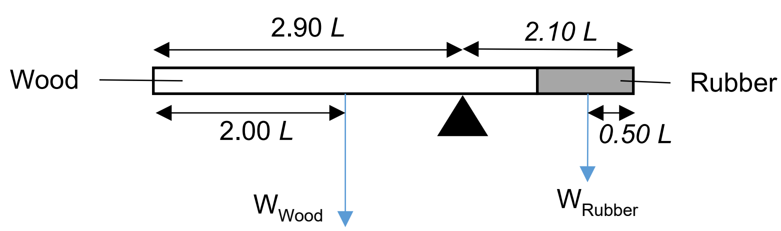


By considering the free body diagrams of the 5.0 kg and 3.0 kg masses:

$$5g - T = 5a$$
$$T - 3g = 3a$$

$$\therefore 2g = 8a$$
$$a = \frac{1}{4}g$$
$$= 2.5 \text{ m s}^{-1} (\text{to 2 s.f.})$$

6 B



Taking moments about the pivot,

$$\text{W}_{wood}(0.900L) = W_{rubber}(1.60L)$$
$$[\rho_{wood}(4.00L)(A)g](0.900L) = [\rho_{rubber}(L)(A)g](1.60L)$$
$$\rho_{wood}(4.00)(0.900) = \rho_{rubber}(1.60)$$
$$\frac{\rho_{rubber}}{\rho_{wood}} = \frac{4.00(0.900)}{1.60}$$
$$= 2.25$$

7 C

$\Delta p = h\rho g = (0.50)(1000)(9.81) = 4910$ Pa

8 C

The work done by the driving force F was used to increase the car's kinetic energy as it gains speed from u to v. Hence the useful work done by the force F is equals to the increase in KE of the car.

9 D

$D = kv^2$,where k is a constant of proportionality

At 12 m s^{-1}, the driving force provided by the 2 engines is equal and opposite to the total drag.

$$P = Dv$$
$$36000 \times 2 = k(12)^3$$
$$k = \frac{720000}{(12)^3}$$

If only 1 engine is on, the new maximum speed v' can be found by:

$$360000 = \frac{720000}{(12)^3}(v')^3$$
$$v' = \sqrt[3]{\frac{360000}{720000}(12^3)}$$
$$= \frac{12}{\sqrt[3]{2}} = 9.5 \text{ m s}^{-1}$$

10 A

At Q, $N + mg = \frac{mv^2}{r}$

As the bead is just in contact with the wire, N = 0. Thus, $v^2 = rg = 0.20g$

Using conservation of energy,

$$mgh = \frac{1}{2}mv^2 + mg(0.40)$$
$$mgh = \frac{1}{2}m(0.20g) + mg(0.40)$$
$$h = 0.50 \text{ m}$$

11 A

period of rotation = 365 days

$$\omega = \frac{2\pi}{T} = \frac{2\pi}{(365 \times 24 \times 60 \times 60)} = 1.99 \times 10^{-7} \text{ rad s}^{-1}$$

$$v = r\omega = (1.50 \times 10^{11})(1.99 \times 10^{-7}) = 2.99 \times 10^{4} \text{ m s}^{-1}$$

12 C

Gravitational field strength $g = \frac{GM}{r^2}$ (vector)

Due to different masses of the Earth and Moon, the field strength due to the Earth (points to the left) is larger than the field strength due to the Moon (points to the right). Hence the resultant field strength is not zero and points towards the Earth. A and B are wrong.

Gravitational potential $\phi = -\frac{GM}{r}$ (scalar)

Due to different masses of the Earth and Moon, the potential does not add to zero at point P. That would eliminate D.

13 D

Heat gain by A = heat loss by water

$m_A\, c_A\, (1) = m_w\, c_w\, (4)$

Heat gain by B = heat loss by water

$m_B\, c_B\, (2) = m_w\, c_w\, (3)$

Hence, $c_A = 2.7\, c_B$

14 B

Internal energy of a system is the sum of all the kinetic energy and potential energy of all the atoms of the system.

15 D

$$pV = nRT$$
$$p = \frac{nRT}{V}$$
$$= \frac{mRT}{M_R V}$$
$$= \frac{(1.5)(8.31)(273.15+25)}{\left(\frac{20}{1000}\right)(3.7)}$$
$$= 50222 \text{ Pa} = 50 \text{ kPa}$$

16 D

energy of oscillator $\propto (\text{amplitude})^2$

fraction of initial energy remained in the first 4.0 s, $f = \left(\frac{1.25}{5.00}\right)^2 = \frac{1}{16}$

fraction of initial energy lost in the first 4.0 s $= 1 - f = \frac{15}{16}$

17 B

Initially, the angle between the polarising filters is 90°.

After rotating 30°, the angle between them is 60°.

Using Malu's law,

$$I = I_o \cos^2 60^\circ$$
$$\frac{I}{I_o} = \frac{1}{4}$$

Since intensity is proportional to square of amplitude,

$$\frac{A'}{A} = \sqrt{\frac{I}{I_o}} = \frac{1}{2}$$

18 A

Standing wave on a rope has nodes at both ends.

$$L = n\frac{\lambda}{2} = 1.0$$

For wavelength 0.4 m, this corresponds to the 5th harmonic (n = 5) mode, thus A is correct.

B is wrong as there are 6 nodes for the 5th harmonic.

C is wrong as the fundamental wavelength is 2 m.

D is wrong as the midpoint of the rope may be moving (e.g. for fundamental mode, the midpoint is the antinode.

19 B

Diffraction is the most pronounced when the size of the opening is comparable to the size of the wavelength. Option B is correct because halving the frequency means doubling the wavelength to 1.0 m which is the size of the doorway.

20 B

$V = \dfrac{Q}{4\pi\varepsilon_0 r}$ and $E = \dfrac{Q}{4\pi\varepsilon_0 r^2}$, therefore, $E = \dfrac{V}{r}$

21 D

Option C is incorrect since the current is the same in both sections.

Since $R = \dfrac{\rho l}{A} \Rightarrow \dfrac{R}{l} = \dfrac{\rho}{A} \Rightarrow \dfrac{R}{l} \propto \dfrac{1}{A}$ (ρ is constant for same material), resistance per unit length of the narrow section is twice that of wide section since the constant current flows through the narrow section.

Since $V \propto R$ for constant I, the resistor with the larger resistance has a larger p.d. across it. Hence, the narrow section (with larger resistance per unit length), has larger p.d. per unit length across it. Hence options A and B are wrong.

22 C

Effective resistance of the 3 parallel resistors,

$$R_{\text{eff}} = \left(\frac{1}{1.0} + \frac{1}{2.0} + \frac{1}{5.0}\right)^{-1} = 0.588\,\Omega$$

Potential difference across each resistor, $V = IR_{\text{eff}}$ = (5.0)(0.588) = 2.94 V

Current through 2.0 Ω resistor, $I_2 = V/R$ = 2.94/2.0 = 1.47 ≈ 1.5 A

23 A

The bulb with the largest current flowing through it will brightest as power = I^2R. Hence bulb P is the brightest.

24 D

The direction of the force is given by Fleming's left-hand rule. The direction of the force is 90° to the plane containing the magnetic field and the current.

25 C

Before the rod lands on the slope, it is traveling in the direction of the Earth's magnetic field. There is zero change in magnetic flux linking the rod. As the rod lands and rolls down the slope, the rate of change of magnetic flux increases uniformly. The magnetic flux changes constantly after it rolls off the slope.

26 C

$$\langle P \rangle = \frac{1}{2} I_0^2 R = P$$

$$\langle P \rangle = \frac{1}{2} [(I_0)_{\text{new}}]^2 (2R) = 4P$$

$$\rightarrow (I_0)_{\text{new}} = \sqrt{2}\, I_0, \quad I_{rms} = \frac{1}{\sqrt{2}} (I_0)_{\text{new}} = I_0$$

27 A

$p = \frac{h}{\lambda}$, momentum of photon is independent of the intensity of light.

28 A

As a result of wave-particle duality, we cannot simultaneously know both the position and momentum of a particle, such as a photon or electron, with perfect precision.

29 B

By conservation of charge and mass number, X = 2.

No. of hydrogen nuclei = 0.001 / (1.008 x 1.66 x 10^{-27}) = 5.98 x 10^{23}

Energy released, in MeV, in 1 reaction = 1.6 x 10^{12} / (5.98 x 10^{23} x 1.6 x 10^{-13})
= 16.73 MeV

Total $BE_{He\text{-}4}$ – $BE_{Li\text{-}7}$ = energy released, 16.73 MeV (note BE of H-1 is 0, as it is only 1 proton by itself)

2 x 28.3 – $BE_{Li\text{-}7}$ = 16.73

$BE_{Li\text{-}7}$ = 39.9 MeV

30 D

$$\frac{\text{number of atoms of X}}{\text{number of atoms of Y}} = \frac{(\frac{1}{2})^{\frac{3T}{T}}(N_0)_X}{(\frac{7}{8})(N_0)_X} = \frac{1}{7}$$