National Junior College 2022 Preliminary Examination

9749 H2 Physics

Paper 1

Answer Key

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

Suggested Solutions

1 (B)

Mass of sprinter = 65 kg

Speed of sprinter = 24 km h^{-1} = 6.7 m s^{-1}

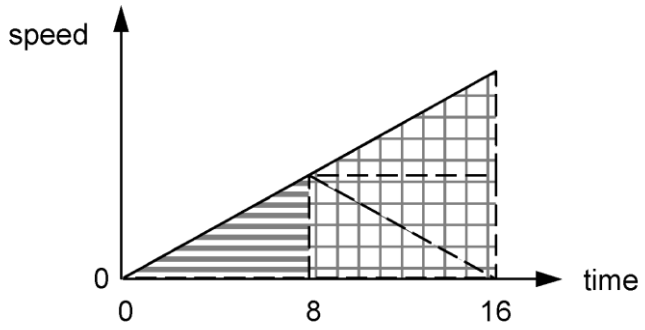
KE = 1500 J

2 (D)

3% of 327.66 = 9.8… = 10 m s^{-1}

3 (C)

[Method 1]



ratio = 3 parts / 1 part = 3

[Method 2]

Between 0 and 8 s, distance travelled $= 0 \times 8 + \frac{1}{2}a(8)^2 = 32a$ and speed $= 0 + a(8) = 8a$

Between 8 s and 16 s, distance travelled $= 8a \times 8 + \frac{1}{2}a(8)^2 = 96a$

Ratio $= 96a/32a \ = 3$

4 (B)

horizontal velocity after 4 s $= 35\ cos\ 40° = 26.8$

vertical velocity after 4 s $= 35\ sin\ 40° + (-9.81)(4.0) = -16.7$

speed after 4 s $= \sqrt{(35\ cos\ 40°)^2 + (35\ sin\ 40° - 9.81 \times 4)^2} = 32\ m\ s^{-1}$

5 (C)

F – f = ma

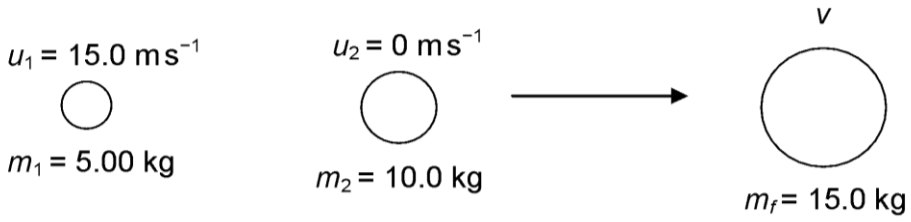
mg sin 15° – f = ma, thus

mg sin 20° – f = 2ma

f = mg (sin 20° – 2 sin 15°)

f = 0.86 N

6 (B)



Using conservation of momentum,

$m_1u_1 + m_2u_2 = m_fv$

$5.00(15.0) + 10.0(0) = 15.0(v)$

$v = 5.00$ m s^{-1}

Loss of kinetic energy = $\frac{1}{2}m_1{u_1}^2 - \frac{1}{2}m_f v^2$

$= \frac{1}{2}(5.00)(15.0)^2 - \frac{1}{2}(15.0)(5.00)^2$

$= 375$ J

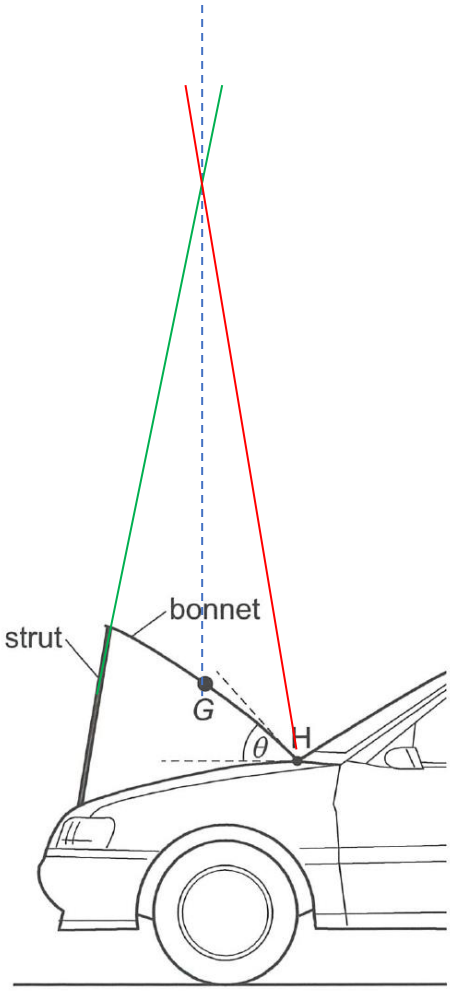
7 (D)

Pressure of oxygen = atm pressure + pressure of mercury

= 1.01 x 10^5 + 1.52(13.6x10^3)9.81 = 3.038 x 10^5 Pa

$\frac{\text{pressure of oxygen}}{\text{pressure of atmosphere}}$ = 3.038 x 10^5/1.01 x 10^5 = 3

8 (C)



9 (D)

Power = Work done/time = Fs/t = Fv

10 (C)

F = mrw^2 = (2)(5)(2π/3)^2 = $\frac{40\pi^2}{9}$ N

11 (C)

Let third particle be *x* from M_1.

$$\frac{GM_1m}{x^2} = \frac{GM_2m}{(d-x)^2} \Rightarrow \frac{x}{\sqrt{M_1}} = \frac{d-x}{\sqrt{M_2}} \Rightarrow x = \frac{d\sqrt{M_1}}{\sqrt{M_1}+\sqrt{M_2}}$$

12 (D)

Gravitational potential at Y $= \frac{GM}{2L} = \frac{1}{2} \times \frac{GM}{L} = \frac{1}{2} \times (-8) = -4\ kJ\ kg^{-1}$

Change in gravitational potential from X to Y $= (-4) - (-8) = 4\ kJ\ kg^{-1}$

Change in gravitational potential energy of 2 kg moved from X to Y $= 2 \times 4 = 8\ kJ$

13 (B)

There is still heat flow, but the net heat flow is zero.

14 (D)

A: $pV = nRT \Rightarrow T \propto pV$, $(pV)_A = 8000$, $(pV)_B = 18000$, so temp of B > A, so internal energy changes

B: gas expands, so work is done by gas

C: From A, average k.e. for B > A

D: $q = \Delta U - w = +ve - (-work\ done\ by\ gas) > 0$

15 (B)

A: only true for ideal gas system

C: During change of phase, i.e boiling, internal energy increased but temperature remained constant.

D: U = KE + PE

16 (A)

$F = -\frac{\Delta E_p}{\Delta r} = -gradient\ of\ E_p - r\ graph$

17 (B)

$v = f\lambda$

$\lambda = \frac{320}{400} = 0.80\ m$

$\frac{\Delta\phi}{2\pi} = \frac{0.2}{0.8}$

$\Delta\phi = \frac{\pi}{2} rad$

18 (A)

Path S_2P is 5.0 m

p.d. = 5.0 – 3.0 = 2.0 m = 1 λ

Since the source starts antiphase and has a path difference of 1 wavelength, they meet destructively to give 0 amplitude.

19 (C)

When one end is closed,

L = ¼ λ

V = fλ

$f = \frac{v}{4L}$

When both ends are opened,

L = ½ λ

V = f'λ

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

20 (A)

field strength towards –*Q* on top left

field strength towards –*Q* on top right

field strength towards –*Q* on bottom left

So, resultant field strength towards top left

21 (B)

Positive charge experience upward electric force to balance the weight. The lower plate at higher potential than the top plate.

When *V* is decreased, P falls towards the lower plate.

– Gravitational potential energy will decrease.

– P gains electric potential moving towards lower plate, so gain electric potential energy

When *V* is increased, P rises towards the upper plate.

– Gravitational potential energy will increase.

– P losses electric potential moving towards upper plate, so loses electric potential energy

22 (D)

For closed circuits, terminal p.d. is lower when there is internal resistance in the source (non-ideal).

23 (C)

At X, voltmeter measure emf of battery.

At Y, voltmeter measure emf of battery. Voltmeter and lamp is connected in series.

At Z, it is a open circuit. Voltmeter reads 0 V.

24 (A)

N-pole of magnet experience a force in the same direction of field line.

S-pole of magnet experience a force in the opposite direction of field line.

Magnet will turn anticlockwise.

Field line of closer spacing indicates higher magnetic field strength. Force at S > force at N. So component of resultant force to the left and magnet accelerates left.

25 (C)

Average induced e.m.f = 2.1 (610 -120) x 10^{-4} / (16 x10^{-3}) = 6.4 V

26 (C)

T = 4 x 5 x 10^{-3} = 20 ms

$\omega = \frac{2\pi}{T} = \frac{2\pi}{20x10^{-3}}$ **= 314 =310**

27 (C)

energy of electron $E = eV$

energy of electron converted to a single photon $E = hf = \frac{hc}{\lambda_0} \Rightarrow \lambda_0 = \frac{hc}{eV} \Rightarrow \lambda_0 \propto \frac{1}{V}$

ratio $= \frac{(\lambda_0)_{6\,kV}}{(\lambda_0)_{8\,kV}} = \frac{8}{6} = 1.3$

28 (A)

$\Delta p \Delta x = h \Rightarrow \Delta p = \frac{6.63\times10^{-34}}{1.00\times10^{-10}} = 6.63 \times 10^{-24}\ kg\ m\ s^{-1}$

29 (C)

ratio of diameter of nucleus to atom should be small for most of the alpha particles to pass through undeflected.

30 (A)

alpha: few cm of air, about 1 mm of aluminium

beta: few mm of aluminium (about 5 mm)

gamma: a few cm of lead, thus several more cm of aluminium