EUNOIA JUNIOR COLLEGE
JC2 June Common Test 2020
General Certificate of Education Advanced Level
Higher 1

PHYSICS 8867

MARK SCHEME

June/July 2020

Paper 1
Multiple Choice

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

1 Estimate the kinetic energy using t = 10 s
E_k = ½ (80)(10)^2 = 4000 J

2 units of $\frac{1}{2}xy^2$ is same as units of pressure

$$\text{units of } y = \sqrt{\frac{\text{units of } P}{\text{units of } x}}$$
$$= \sqrt{\frac{\text{N m}^{-2}}{\text{kg m}^{-3}}} = \sqrt{\frac{\text{kg m s}^{-2}\ \text{m}^{-2}}{\text{kg m}^{-3}}}$$
$$= \sqrt{\text{m}^2\ \text{s}^{-2}}$$
$$= \text{m s}^{-1}$$

3

$$r = 1.70 \pm 0.005 \text{ cm}$$
$$V = \frac{4}{3}\pi r^3 \Rightarrow \frac{\Delta V}{V} = 3\frac{\Delta r}{r}$$
$$\Delta V = \left(\frac{4}{3}\pi r^3\right)\left(3\frac{\Delta r}{r}\right) = 4\pi r^2 \Delta r$$
$$= 4\pi(1.70)^2(0.005)$$
$$= 0.2 \text{ (1 s.f.)}$$

4 F = mA
Direction of acceleration is always the same as the direction of the net force

5 At terminal velocity, height is dropping at a constant rate.
The velocity is the gradient of the graph

6 Area under *F*-*t* graph gives change in momentum. Considering from *t* = 2 s:

$$\Delta p = \frac{1}{2}(5)(1) = +2.5 \text{ N s}$$
$$\Delta v = \frac{\Delta p}{m} = \frac{2.5}{2} = +1.25 \text{ m s}^{-1}$$
$$v = 5 + 1.25 = 6.3 \text{ m s}^{-1}$$

7 Y will always have a lower velocity than X.
Using the eqn: v = u + at
As a result the distance between X and Y will always be increasing.

8 System has common acceleration, a

$$|F_B| = |T| = m_B a = 2a$$
$$F_{\text{down ramp, A}} - T = m_A a = 4a$$
$$m_A g \ \sin 25° - (2a) = 4a$$
$$a = \frac{4g \ \sin 25°}{6} = 2.8 \text{ m s}^{-2}$$

9 Since it is an totally-inelastic collision, there is bound to be less total KE after collision so must avoid conserving KE of bullet as work done against friction.

By PCLM,
$$m_{\text{bullet}} u = M_{\text{total}} v$$
$$v = \frac{m_{\text{bullet}} u}{M_{\text{total}}}$$
By conserving energy,

$$\frac{1}{2} M_{\text{total}} v^2 = F.s$$
$$s = \frac{1}{2F} M_{\text{total}} v^2 = \frac{1}{2F} M_{\text{total}} \left(\frac{m_{\text{bullet}} u}{M_{\text{total}}}\right)^2$$
$$= \frac{1}{2FM_{\text{total}}} (m_{\text{bullet}} u)^2$$
$$= \frac{\left((20 \times 10^{-3})(230)\right)^2}{2(30)\left((20+500) \times 10^{-3}\right)}$$
$$= 0.68 \text{ m}$$

10 When man accelerates upwards,
N1 > mg
When man accelerates downwards,
N2 < mg
When man is not accelerating,
N3 = mg

11 The 2 objects will experience the same force by virtue of Newton's 3rd Law.
2 x a = 5 x 10
a = 25 m s^{-2}

12 Eliminate C and D as the sum of the three forces ≠ 0
Eliminate A because the line of action of the 3 forces do not intersect

13 If the two forces act about the same point there will be no torque

14 Pivot about where beam attaches to wall.

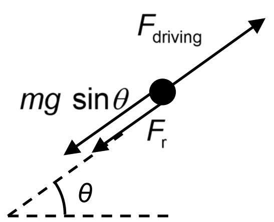
By POM,
$$\sum \circlearrowright \text{ moments} = \frac{L}{2} W_{\text{beam}} + 0.2 L W_{\text{boy}}$$
$$\sum \circlearrowleft \text{ moments} = LT \ \sin 60°$$
$$T = \frac{\frac{1}{2} W_{\text{beam}} + 0.2 W_{\text{boy}}}{\sin 60°}$$
$$= \frac{\frac{1}{2}(200) + 0.2(500)}{\sin 60°}$$
$$= 230.9 \text{ N}$$

15 Elastic Potential Energy = ½ k x^2
½ k $(60 \times 10^{-3})^2$ = 15 J
k = 8333
½ k $(90 \times 10^{-3})^2$ = 33.75 J
Δ EPE = 33.75 – 15 = 18.75 J

16 d sin 30° = 1.5
d = 3 m
Work done against friction = 150 x 3
Gain in GPE = 200 x 1.5
Total work done = 150 x 3 + 200 x 1.5
= 750 J

17 On level ground at constant speed, driving force is same magnitude as resistive force
$$P = Fv$$
$$|F_r| = |F_{\text{driving}}| = \frac{P}{v} = \frac{370 \times 10^3}{14.7}$$

On slope, component of weight downramp is in same direction as resistive force



$$F_{\text{driving}} = F_r + mg \ \sin\theta$$
$$\frac{P}{v_{\text{slope}}} = F_r + mg \ \sin\theta$$

$$\theta = \sin^{-1}\left[\left(\frac{P}{v_{\text{slope}}} - F_r\right)\left(\frac{1}{mg}\right)\right]$$

$$= \sin^{-1}\left(\frac{\frac{370\times10^3}{10} - \frac{370\times10^3}{14.7}}{(26.5\times10^3)(9.81)}\right)$$

$$= 2.6^\circ$$

18 By conserving energy,
loss in GPE = gain in KE

$$mg\Delta h = \frac{1}{2}mv_B^2$$

$$2g(L - L\cos 60^\circ) = v_B^2$$

Considering circular motion at B,

$$F_c = T - mg$$

$$T = \frac{mv^2}{r} + mg$$

$$= mg\left(\frac{2L}{L}(1 - \cos 60^\circ) + 1\right)$$

$$= mg(1+1) = 2mg$$

19 $\frac{GMm}{r^2} = mr\omega^2$

$T = 2\pi\sqrt{\frac{r^3}{GM}}$

When 4 r,

$2\pi\sqrt{\frac{(4r)^3}{GM}} = 8 \times 2\pi\sqrt{\frac{(r)^3}{GM}} = 8\ T$

20 T = ke

$ke = \frac{m_1 v^2}{(L+e)}$ ------------- (1)

$k(2e+L) = \frac{m_2 v^2}{(2L+2e)}$ -----------(2)

(1)/(2):

$m_2 = m_1 \times 2 \times \frac{(2e+L)}{e}$

21 The elevation of a mountain is insignificant compared to the radius of Earth. Hence there is no change.

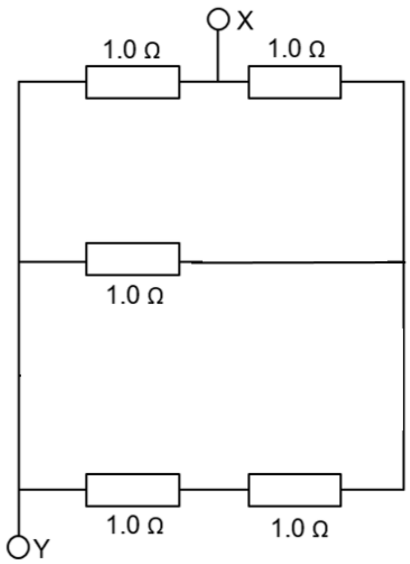
22 $E = Ir + IR$
$E = 3r + 3$ ---------- (1)
$E = 2r + 4$ ---------- (2)
Solve (1) & (2):
$r = 1\ \Omega$ and $E = 6$ V

23 R = ρ L/A
Maximum R corresponds to larger length and smallest area.

24 P = I V
100 k W = I x 10 kV
I = 10 A
Power = I^2R
= 10^2 x 5 = 500 Ω

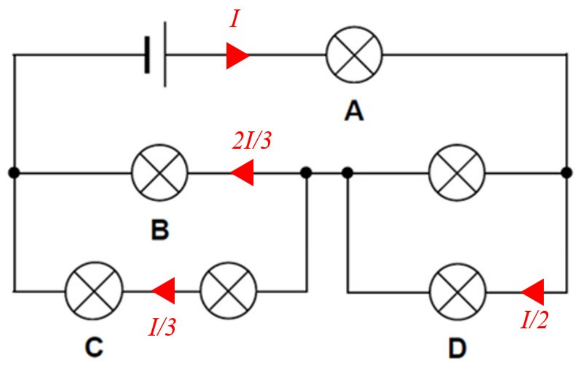
25 Resistance of ammeter = 0 Ω

Resistance of voltmeter = ∞ Ω



1 Ω // 2 Ω = 0.66667 Ω
1 Ω // 1.66667 Ω = 0.625 Ω
= 0.63 Ω (2 SF)

26



27 Eliminate A and C which are electrically equivalent.

In parallel circuits, the effective resistance will be smaller than the branch with the least resistance so eliminate D: QS (can also be used to eliminate A and C as well); all 3 options involve one branch with only 1 resistor.

28 Using Right Hand Grip Rule, the induced magnetic field direction is going into the paper.

29 For velocity selector,

$$Bqv = qE$$
$$v = \frac{E}{B}$$
$$= \frac{20000}{0.25}$$
$$= 80000 \text{ m s}^{-1}$$

For charged particle in circular motion within magnetic field

$$Bqv = \frac{mv^2}{r}$$
$$r = \frac{mv}{Bq}$$
$$= \frac{116\left(1.66 \times 10^{-27}\right)(80000)}{0.25\left(1.6 \times 10^{-19}\right)}$$
$$= 0.385 \text{ m}$$

Distance = Diameter = $2r$ = 0.770 m

30 In a current balance, the sum of clockwise moment = sum anticlockwise moment about pivot.

BIL x d_1 = mg x d_2
0.022 x I x 0.4 x 0.8 = 2 x 10^{-3} x 9.81 x 0.9
I = 2.5 A