Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Mark Schemes

Q1.

(a) rate = 1.40 to 1.75 (V s^{-1}) $_1$✔

for $_1$✔ accept 2 sf 1.5, 1.6 and 1.7 (V s^{-1})

rate = 1.50 to 1.65 (V s^{-1}) $_2$✔

for $_2$✔ accept >3 sf rounding to value in range;
accept 2 sf 1.6;
expected answer is 1.57(2) (V s^{-1})

2

(b) maximum 1 mark per marking point (see $_1$✔ to $_4$✔ below)

reduces impact of statistical error (involved in reading and recording data manually) $_1$✔

data can be collected at a high(er) rate or wtte $_2$✔

idea that data (in digital form) may be easily processed $_3$✔

two (or more) sets of data (*I* and *V*) can be made simultaneously or wtte $_4$✔

treat suggestions that data logging improves 'precision' / 'resolution' / reduces 'uncertainty' / eliminates 'systematic' / 'parallax errors' / 'anomalous readings' as neutral

for > 2 ideas mark as a list

for $_1$✔ allow reducing 'human error' / 'random error' / 'improving accuracy' as same idea;
idea that random error / uncertainty can be eliminated is talk out;
condone 'no human error / reaction';

for $_2$✔ condone 'quickly' / 'works faster'
'collect data at a steady rate'/ 'saves time' / comments about 'reaction time' are neutral

for $_3$✔ eg can be transferred to / graphed with / analysed using a digital device or application eg computer / spreadsheet
allow 'can be processed automatically'
treat the following as neutral since they are not specifically applicable to this experiment:
can carry out experiment 'remotely' / 'in inaccessible or dangerous environments' / 'automatically' / 'without any human (being present)' or wtte;
can 'start / stop data collection at some suitable (future) time' / 'collect large amount of data' or wtte;

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'a wide variety of sensors are available' / 'data logging is (increasingly) cheap'

Max 2

(c) identifies that **circuit 2** can produce the data because the pd can be varied between 0 V and 12 V $_1$✔

for $_1$✔ allow 'can achieve 12 V range' or wtte; reject 'can produce 0 V and 12 V'

identifies that **circuit 1** cannot produce (all of) the data shown on **Figure 2** $_2$✔

*for $_2$✔ allow '**circuit 1** is not suitable' / 'not **circuit 1**';*

award $_1$✖$_2$✔ for 'neither can produce the data'

2

for **circuit 1** with **X** set to maximum resistance

calculates (minimum) *I*

OR

calculates (minimum) *V* $_3$✔

for $_3$✔ (at least one) result should be evaluated to min 2 sf but condone '≈ 0.7' if decimal intermediate result is ok;

do not accept rounding to 0.69;

allow use of 17.2 without justification;

minimum $I\left(=\frac{12}{17.2}\right)$ *= 0.70 A OR*

minimum $V\left(=12\times\frac{2.3}{17.2}\right)$ *= 1.6 V*

their minimum *I* or minimum *V* for **circuit 1** compared with value of first (or second) point in **Figure 2** $_4$✔

for $_4$✔ could say their minimum I > 0.36 / I for first data point < 0.7(0) / 0.70 > 0.36 etc

allow 'cannot produce I < 0.7(0) in Fig 2';

'cannot produce all the values' is not enough

2

(d) *P* = 6.82 in row 2 $_1$✔

I = 1.77 in row 4 $_2$✔

P = 17.0 in row 4 $_3$✔

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	V / V	I / A	P / W
	3.30	1.07	3.53
$_1$✔	5.17	1.32	**6.82**
	7.69	1.59	12.2
$_2$✔$_3$✔	9.58	**1.77**	**17.0**
	11.47	1.94	22.3

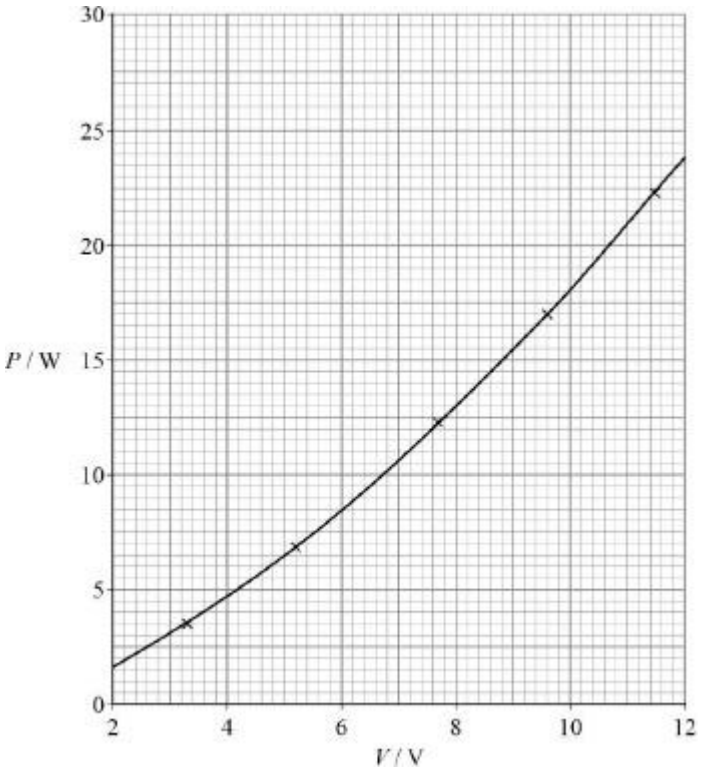
for $_1$✔ CAO
for $_2$✔ allow 1.77 ± 0.01
for $_3$✔ ECF for their (incorrect) I × 9.58;
*deduct MAX 1 mark if any are **not** to 3 sf*

3

(e) vertical axis labelled *P* / W $_1$✔

suitable vertical scale for their data $_2$✔

5 points plotted AND smooth curve of increasing gradient $_3$✔



for $_1$✔allow P (W), P in W;
reject comma separator, eg P, W;
allow words, eg power for P / watt(s) for W
for $_2$✔ expect 1 cm interval = 2 W OR 2 cm intervals = 5 W
vertical scale must
• be linear
• be marked in integer values

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• be marked with a frequency of not less than 4 cm intervals

• cover the range of plotted points

assume P = 0 at unmarked origin

2

for ₃✔ check the plotting of any obviously suspect point;

*points must **not** be thick / faint / dots / blobs;*

line must

*• be a continuous **curve***

• be neither thick or faint

• (at least) extend from the first to the fifth point

• be a reasonable best-fit for their data; withhold mark if line deviates by ≥ 2 minor squares from examiner's best line (by eye)

if I / A is plotted award ₂✔ if the effective range of vertical scale is ≥ half height of grid

1

(f) evidence that P_r read-off to ± 1 minor grid square ₁✔

for ₁✔ best-fit line must be extrapolated to V =

12 V (at the right-hand margin of the grid);

P_r correct to ± half a minor grid square;

expect P_r = 23.8 W for a curve but accept a read-off obtained from a straight best-fit line

reads off P_2 corresponding to 6 V;

evaluates $\frac{2 \times \text{their } P_2}{\text{their } P_r}$ × ₂✔

₂✔ is not contingent on ₁✔

for ₂✔ expect P_2 = 8.5 W for a curve;

expected % in range 70% to 73%

*if no read-off evidence is seen on **Figure 3** check for the possibility that **Figure 1** was used to obtain P_r and P_2 eg by drawing a curve through points to intersect at V = 12 V, then*

using V (= 12) × I (= 1.98) P_r = 23.7

using V (= 6) × I (= 1.42) P_2= 8.5(2)

would lead to 72%

2

[16]

Q2.

(a) Diagram with 1 AU, 1 pc **and** $\frac{1}{3600}$° labelled ✔

*Allow 1 arc second **or** 1" **or** 2.8 x 10^{-4} °*

***or** 4.8 x 10^{-6} rad for angle.*

1 AU can be shown as Sun-Earth distance.

Condone 'au' for 'AU'.

1 pc can be either long side. Condone label d for 1 pc.

1

(b) B ✔

1

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(c) evidence of 10^x seen

OR

evidence of 0.11 - (-7.84) seen✔

condone 0.11 + 7.84 provided m-M seen.

d = 390 (pc) ✔

Calculator value is 389.0451

2

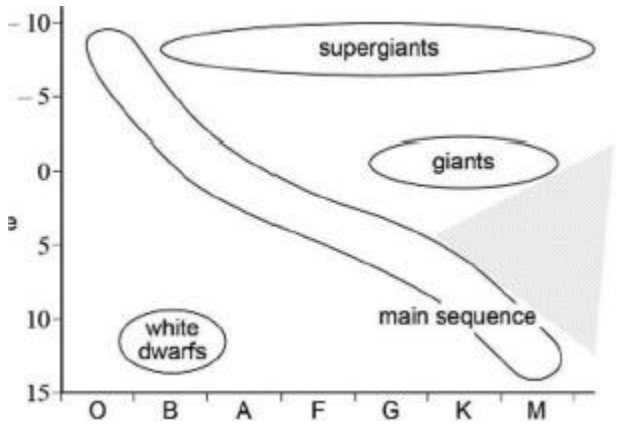
(d) Line coming in from the right to mag 5/class G

then to giants and

then to white dwarfs (in that order) ✔

Condone lack of arrow.

The shaded area shows the acceptable region for the initial line (from protostar).



1

(e) (GRB produced when) supergiant collapses ✔

(and) forms a neutron star **OR** a black hole ✔

Ignore references to 'supernova'

2

[7]

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