Year 12 Physics
Mid Course Examination
Marking Scheme and Answers

Section 1 – Multiple Choice

Question	Answer	Notes
1	C	Weight is the force of gravity
2	C	Gravity is inversely proportional to the radius squared
3	A	In this example the radius is decreasing which means GPE is decreasing
4	D	The space probe's GPE has increased so its radius must have increased
5	D	The angle at which they are launched is different
6	D	This choice provides constant horizontal velocity and vertical acceleration
7	B	The only correct option
8	A	The acceleration increases at an increasing rate due to loss of mass
9	C	Force is proportional to velocity squared
10	C	Slower satellites orbit at higher altitudes
11	B	Accelerating the marbles downwards reduces the apparent weight
12	C	Use Kepler's equation and solve for T
13	A	Light from Laser 2 has a longer distance to travel
14	A	Use $F=BIl\sin\theta$ and the right hand palm rule
15	D	These conductors are parallel to the field lines
16	D	Force is the weight of the counterbalance
17	C	Torque is zero when the plane of the coil is perpendicular to the field lines
18	D	Only correct option
19	B	Insulates the coil from the axle and prevents short-circuiting
20	A	Only correct combination of current and magnetic pole

Section 2 – Extended Answers

Marks

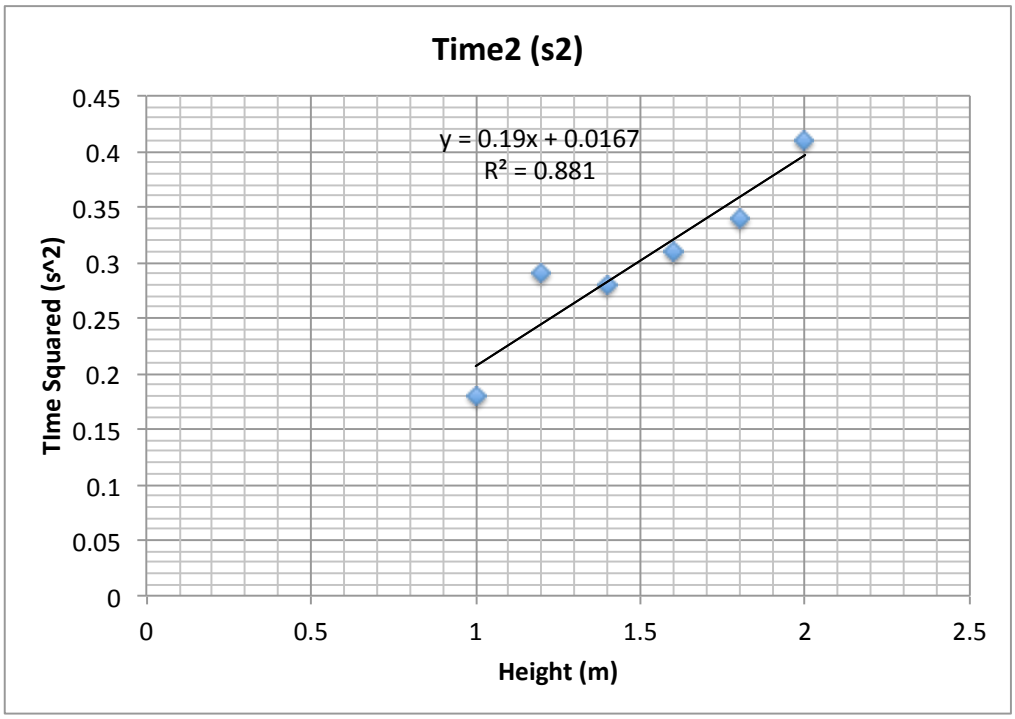
21 (a)

Height (m)	Time (s)	Time^2 (s^2)
1.0	0.42	0.18
1.2	0.54	0.29
1.4	0.53	0.28
1.6	0.56	0.31
1.8	0.58	0.34
2.0	0.64	0.41

1

Correct values with 2 d.p. only [1 mark]

(b)



3

Plotting points correctly [1 mark]
Labelling and constructing scale on each axis [1 mark]
LoBF without including outlier [1 mark]

Marks

(c) **2**

$$s = ut + \frac{1}{2}at^2$$

$$s = \frac{gt^2}{2} \text{ since u = 0 and a = g}$$

$$\frac{t^2}{s} = \frac{2}{g}$$ Rearranging equation [1 mark]

$$0.19 = \frac{2}{g}$$ Calcuation of gradient and acceleration [1 mark]

$$g = 11 \text{ ms}^{-2}$$

(d) The data is not very reliable as there is a significant variation between each of the plotted points and the line of best fit [1 mark]. The values for time measured at 1.2 m is most likely a measurement error and could be considered an outlier [1 mark]. **2**

22 (a) $u_y = 28\sin 30$ [1 mark] **3**

$$v = u_y + at$$

$$0 = 28\sin 30 - 9.8 \times \frac{t}{2}$$ [1 mark]

$$t = 2.86 \ s$$

$$s_x = u_x t$$

$$= 28\cos 30 \times 2.86$$ [1 mark]

$$= 69 \text{ m to 2 s.f.}$$

(b) The acceleration due to gravity would be been less that that on the Earth [1 mark]. This would increase Sally's time of flight and her range [1 mark]. **2**

23 (a) **2**

$$E_p = -\frac{GMm}{r}$$

$$= -\frac{(6.67 \times 10^{-11}) \times (6.0 \times 10^{24}) \times 1500}{(6378000 + 1500000)}$$ Correct substitution [1 mark]

$$= -7.6 \times 10^{10} \text{ J}$$ Correct answer with units [1 mark]

(b) This satellite is in a Low Earth Orbit and will undergo orbital decay as a result of collisions with the particles that make up the outer reaches of the Earth's atmosphere [1 mark]. The satellite will do work to overcome this resistance and in doing so will lose gravitational potential energy [1 mark]. This energy will be converted into heat energy causing the satellite to heat up [1 mark] and kinetic energy as the satellite loses altitude and increases its orbital speed [1 mark]. **4**

Marks

24 The forces acting on Sophie are her chair pushing upwards, *R,* and her weight acting downwards, *mg* [1 mark]. The net force acting on Sophie is given by the equation: **4**

$F_{net} = R - mg$

Sophie's apparent weight is the force she feels due to the chair pushing up on her, *R*. [1 mark]

$R = F_{net} + mg$ [1 mark]

Since the net force on the rocket is increasing as it loses burnt fuel, Sophie's apparent weight will increase, as her actual weight remains constant [1 mark].

25 (a) **3**

$$\frac{mv^2}{r} = \frac{GMm}{r^2}$$ Equating centripetal and gravitational force [1 mark]

$$v^2 = \frac{GM}{r}$$ Cancelling [1 mark]

$$v_{orbital} = \sqrt{\frac{GM}{r}}$$ Correct equation [1 mark]

(b) **2**

$$v_{orbital} = \sqrt{\frac{GM}{r}}$$

$$= \sqrt{\frac{(6.67\times10^{-11})\times(6.0\times10^{24})}{384403000}}$$ Correct substitution [1 mark]

$$= 1020 \text{ ms}^{-1}$$ Correct answer with units [1 mark]

26 (a) An apparatus was used containing a mirror that split a monochromatic light beam into two separate beams that travelled different paths in the inferometer [1 mark]. One beam travelled across the ether and the other travelled directly into the ether [1 mark]. They expected that light would have a velocity relative to the ether and that when the two beams recombined; one would arrive after the other as it would take longer [1 mark]. **3**

(b) Light waves travelling in phase show constructive and destructive interference at crests and troughs, respectively, which on a screen and are observed as bright and dark fringes [1 mark]. If the two beams in this experiment were out of phase as a result of one taking longer than the other, the interference pattern would change [1 mark]. **2**

27 (a) **2**

$$\tau = nBIA\cos\theta$$

$$= 500\times0.5\times2.0\times0.1\times0.2$$ Correct substitution [1 mark]

$$= 10 \text{ Nm}$$ Correct answer with units [1 mark]

(b) The radial magnetic field keeps the magnetic field lines parallel to the plane of the coil for the full rotation of the coil [1 mark]. Because cos0=1, this keeps the torque at maximum for the full rotation of the coil [1 mark]. **2**

Marks

28 (a) **2**

$$l_v = l_o\sqrt{1-\frac{v^2}{c^2}}$$

Correct substitution [1 mark]

$$= 1.6\sqrt{1-0.7^2}$$

$$= 1.14 \text{ m}$$

Correct answer with units [1 mark]

(b) As Sam swims, the water is applying a constant force and doing work to cause her to accelerate or increase velocity[1 mark]. This also causes an increase in her kinetic energy as long as the net force is applied [1 mark]. As her speed becomes relativistic, her acceleration must decrease to zero as she approaches the speed of light or her speed will become infinite which defies the law of conservation of energy [1 mark]. Some of the work being done (energy) is converted to mass according to $E=mc^2$ rather than kinetic energy [1 mark]. This ensures that her velocity does not increase infinitely and explains the increase in her mass. **2**