2016 Sec 3 End of Year PHYSICS Paper ANSWERS

Paper 1

1…….5	6…...10	11....15	16….20	21….25	26.....30
CBBBA	CABCB	AABAA	BCCBA	DDDBD	DCBAA

10	[B] Inertia is dependent on the mass and not on the pull of gravity. The mass of a body is the same on earth as on the moon. So, the inertia on the same body is the same on earth as on the moon.	11	[A] When the cable breaks, the lift and the man will both be falling freely. Net force on the man, F_R = 800 N Since F_R = W – R with R as the normal contact force and W as the weight. R = W – F_R = 800 N – 800 N = 0N
12	[A] Let frictional force be f Net force = P – f = ma When multiplied by 3 on both sides, 3(P – f) = 3ma 3P – 3f = 3ma ….. (1) When force is increased to 3P, Net force = 3P – f = ma_x …….(2) Comparing (2) with (1), a_x must be more than 3a	21	[D] The pressure from liquid P and liquid are equal at the liquid levels that are exposed to atmospheric pressure. Hence 2*l* d_P g = 1 *l* d_Q g Therefore, density of Q, d_Q is 2 times density of P, d_P. *Note: The liquid pressure at the base on the left is NOT equal to the liquid pressure at the base on the right because they are filled with different liquids.*
27	[C] The man runs forward with velocity 2.5 ms^{-1}. His image is moving towards him with velocity -2.5 ms^{-1}. So, he will see himself running towards his image with a velocity 5.0 ms^{-1}.	28	[B] In an optical fibre, a light ray changed direction due to total internal reflection and not refraction.

Paper 2

1a) A pair of vernier calipers or vernier caliper (accept caliper or calipers)

1b) Student should have recorded the average length to 3 significant figures instead of 4.

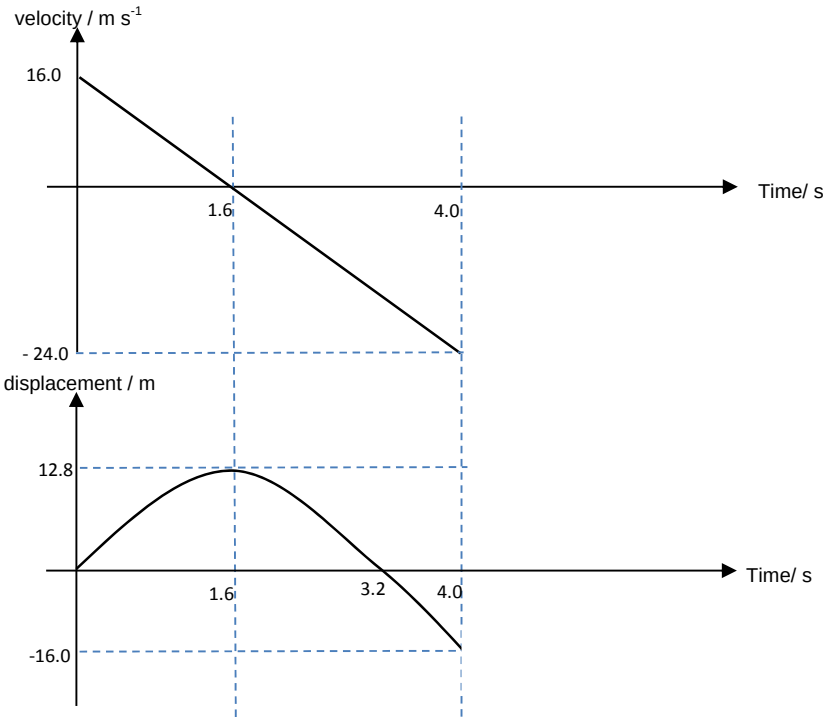
1ci) g = W/m = 0.236/ 0.0239 = <u>9.87 ms^{-2}</u>

1cii) density = m/v = 23.9/ (2.24 × 1.91 × 2.05) = <u>2.72 g cm^{-3} or 2720 kg m^{-3}</u>

2a) using t = (v – u)/a = (0-16.0)/10 = <u>1.6 s</u>

2b) using v = u + at = 16 + (-10)(4.0) = <u>-24 m s^{-1}</u>

2c)



3a) The principle of conservation of energy states that energy cannot be created or destroyed but only changes from one form to another.

3b) Loss in height = $(1.44^2 - 1.20^2)^{1/2}$ = 0.796 m
Loss in GPE = (0.450)(10)(0.796) = <u>3.58 J</u>

3c) Gain in KE = Loss in GPE
½ mv^2 = mgh; v = $(2gh)^{1/2}$ = <u>3.99 ms^{-1}</u>

3d) The law still applies, the carpet is rough and energy was dissipated as heat as the ball rolled across the carpet. (or work was done against friction)

4a) This **lowers the centre of gravity** of the toy **to below the support Y,** so that the toy is in a state of **stable equilibrium**.

4b) The **weight of the toy** creates **an anticlockwise moment about the pivot**.
Therefore, the toy **rotates anticlockwise** and eventually **returns to its original position**.

5a) The angle of incidence is equal to the angle of reflection. The incident ray, the reflected ray and the normal at the point of incidence, all lie on the same plane.

5b)(i)

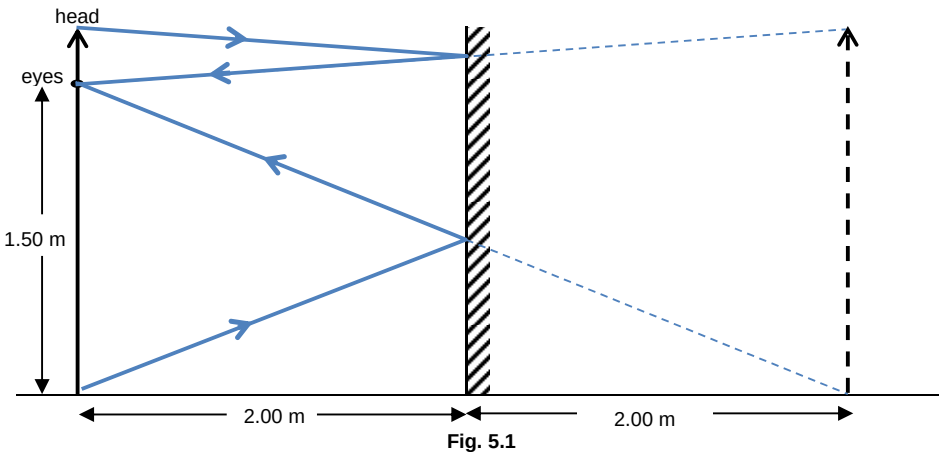
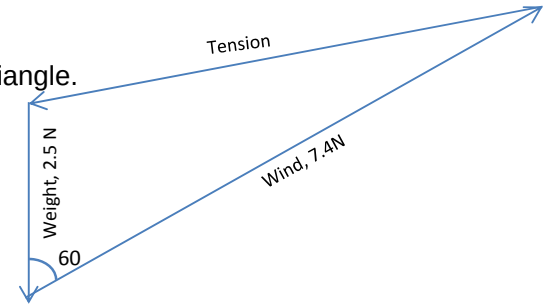


Fig. 5.1

5b)(ii) Using similar triangles, the min length of mirror = 1.5/2 + 0.1/2 = <u>0.8 m</u>

5c)(iii) Using similar triangles, height above the ground = 1.50/ 2 = <u>0.75 m</u>

6 Scale: 1.0 cm: 0.5 N or 1.0 cm:1.0 N
Arrow direction indicated to show a closed triangle.
Magnitude = <u>6.5 ± 0.1 N</u>



7a) As the balloon rises up, the **external atmospheric pressure decreases**.
To equalise the pressure difference, the **volume of the balloon increases as the internal air pressure decreases.**

7b) Using $P_1 V_1 = P_2 V_2$,
P_1 = 1 atmosphere, $V_1 = 4.2 \times 10^{-6}$ m^3, P_2 = 0.30 atmosphere
Therefore, $P_1 (4.2 \times 10^{-6}) = 0.3\ P_1 V_2$
$V_2 = 4.2 \times 10^{-6}$ m^3 / 0.3 = <u>1.4×10^{-5} m^3</u>

Section B

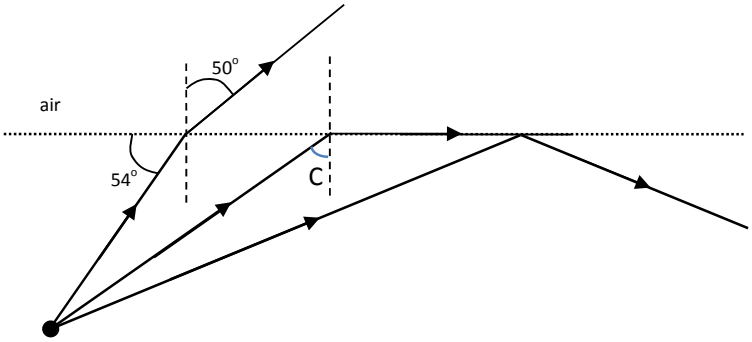
8a) Reflected ray with arrow in correct direction and correct angle;
Refracted ray with arrow in correct direction and correct angle.

8b) Angle of deviation = 180°– (55° × 2) = 70°

8c) Angle of incidence = 55°; Refracted angle = 27°
Refractive index = sin 55°/sin 27° = <u>1.80</u>

8d) Total internal reflection can only occur when the light ray is travelling from an optically denser medium to an optically less dense medium.

8ei)



8eii) Refractive index of G = sin 50° / sin 36° = 1.303
1.303 sin C = 1.0 sin 90°; C = <u>50.1°</u>

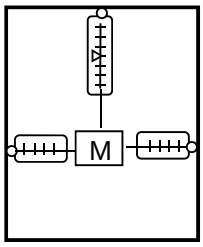
9ai) Tension upwards and weight downwards. Vector for tension is longer than that for weight.

9aii) As the object accelerates upward, a greater tension is exerted on the spring.
The spring extends further.

9aiii) resultant force = 6.2 N – 5.0 N = 1.2 N
F_{net} = m a; T – W = m a
a = (T – W)/m
acceleration = 1.2 N / 0.50 kg = <u>2.4 m s^{-2}</u> (2 s.f.)

9b) The object could be moving at **constant velocity** or **at rest.**

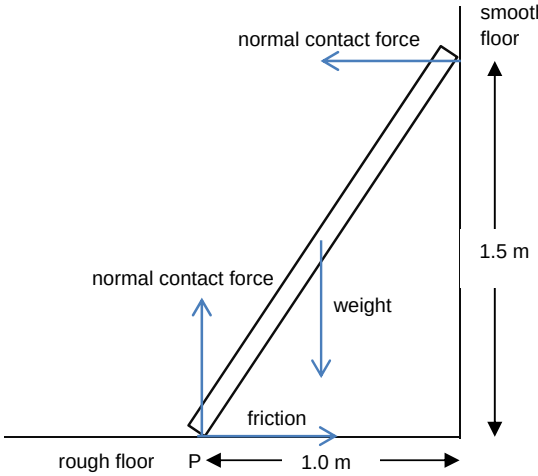
9c) Attach 2 springs **horizontally** from **the side of object to the box** to detect the sideway motion as shown in the following diagram



10 Either

10a) The centre of gravity of an object is the point through which the entire weight of the object appears to act.

b)



c) 100 N

d) (i)Take moments about P: 100 N × 0.50 m = NCF × 1.50 m
NCF = 33 N
(ii) Frictional force = NCF = 33 N

e) As the man climbs upward, the **total clockwise moments of the man's weight and weight of the ladder about P increases.**
The **normal contact force** by the wall on the ladder **will increase** and may **exceed he frictional force acting at the bottom of the ladder**.

10 Or

a) Atmospheric pressure is due to the force per unit area exerted against a surface by the weight of the atmosphere above that surface. The S.I. unit is **pascal** (Pa) or **newton per square metre** ($N\ m^{-2}$).

bi) A & D, B & C

bii) Since the pressure at point B = the pressure at point C
using $P = h \rho g$, $(9.0\ cm)(8.20\times10^{2}\ kg\ m^{-3}) = J\ (1.00\times10^{3}\ kg\ m^{-3})$
J = 7.4 cm (2 s.f.)

c) (i) $F/A = 0.017\ N / \pi\ (6 \times 10^{-3}\ m)^2$ = 150 Pa

c) (ii) Since the pressure at point B = the pressure at point C
using $P = h \rho g$,
$150\ Pa + (0.090\ m)(8.20\times10^{2}\ kg\ m^{-3})(10\ N\ kg^{-1}) + (0.028\ m)(1.00\times10^{3}\ kg\ m^{-3})(10\ N\ kg^{-1})$
$= (K\ m)(1.00\times10^{3}\ kg\ m^{-3})(10\ Nkg^{-1})$
$K = 0.1168\ m$ = 0.117 m