2017 Sec 3 Physics EOY Examination Answers

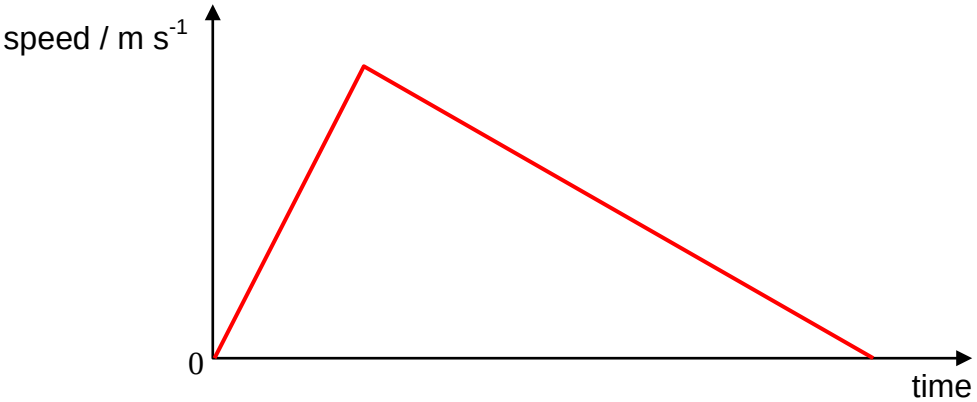
Paper 1

1 …… 5	6 ….. 10	11 ….15	16 ….20	21 ….25	26 ….30
CBDCA	DABCC	ACBBA	ACDAB	BBAAD	CBDDC

Paper 2 Section A (40 marks)

1(a) $v^2 = u^2 + 2as$ ➔ $v = \sqrt{[0^2 + 2(35)(0.70)]}$
$= 7.0 \text{ m s}^{-1}$ (2 s.f.)

(b) 1st section: straight line from zero
2nd section: straight line back to zero (with smaller gradient)



2(a)
From t = 0 and t = 0.8 hour, the helicopter travels at uniform speed of 75 m s^{-1}.
From t = 0.8 hour to t = 0.9 hour, it decelerates uniformly to rest in air.

It then hovers (remains at rest) in the air from t = 0.9 hour to t = 1.6 hour (to rescue people).

From t = 1.6 hour to t = 1.7 hour, it accelerates uniformly in a direction opposite to its initial flying direction. Its speed increases from 0 to 90 m s^{-1}.
From t = 1.7 hour to t = 2.5 hour, it flies with a uniform speed of 90 m s^{-1}.

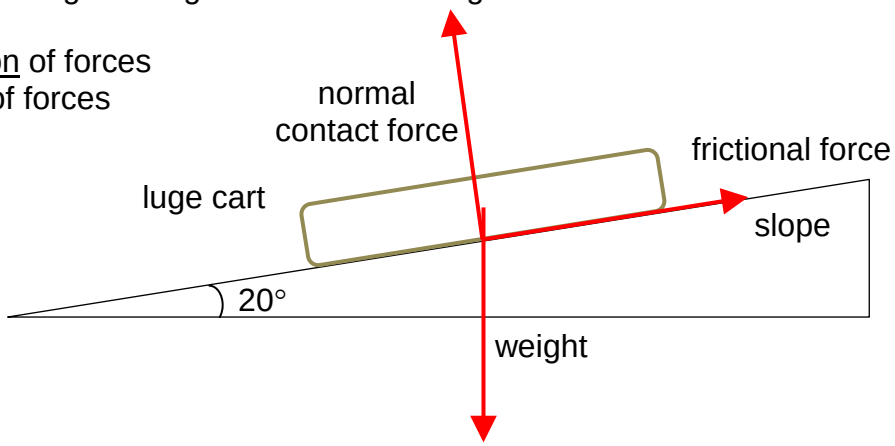
(b) Displacement = area under graph $= ½ \times 3600 \times [(0.8 + 0.9) \times 75]$
$= 229\,500 \approx 230$ km (2 s.f.)

3(a) $F_{net} = ma$ ➔ $a = F_{net} / m$ $= 20 / (24 + 14 + 12)$
$= 0.40 \text{ m s}^{-2}$ (2 s.f.)

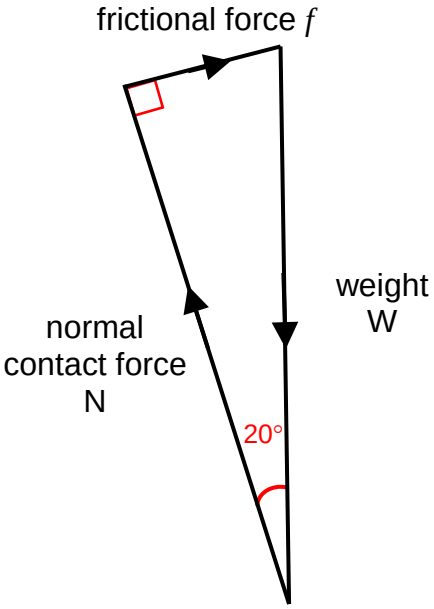
(b) 12 kg block: $F_{net} = ma$ ➔ $20 - T = 12(0.40)$
$T = 15.2 \approx 15$ N (2 s.f.)

(c) 14 kg block: $F_{net} = ma$ ➔ $T = 24(0.4) = 9.6$ N
The tension in string 1 is larger than that in string 2.

4(a) correct direction of forces
correct name of forces



(b) The component of the weight down the slope causes the luge cart to move down the slope.

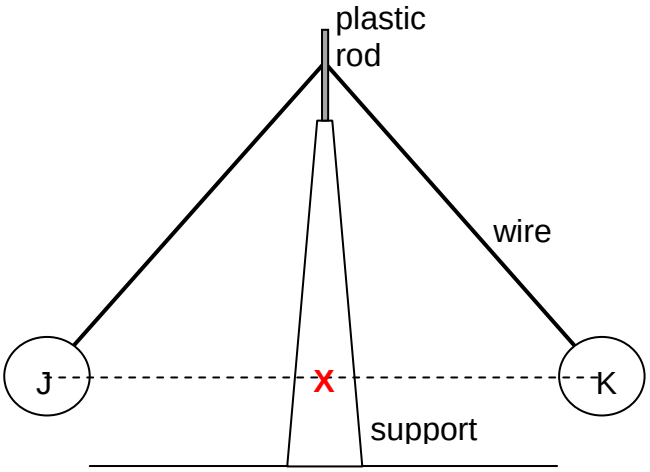


(c) correct orientation of forces
correct directions shown by arrows
angle 20° not required

(d) f / W = sin 20°
➔ f = mg × sin 20° (or mg × cos 70°)
= 25 × 10 × sin 20° = 85.51 ≈ 86 N

5(a) It is a point where the entire weight of an object appears to act.

(b) correct c.g.

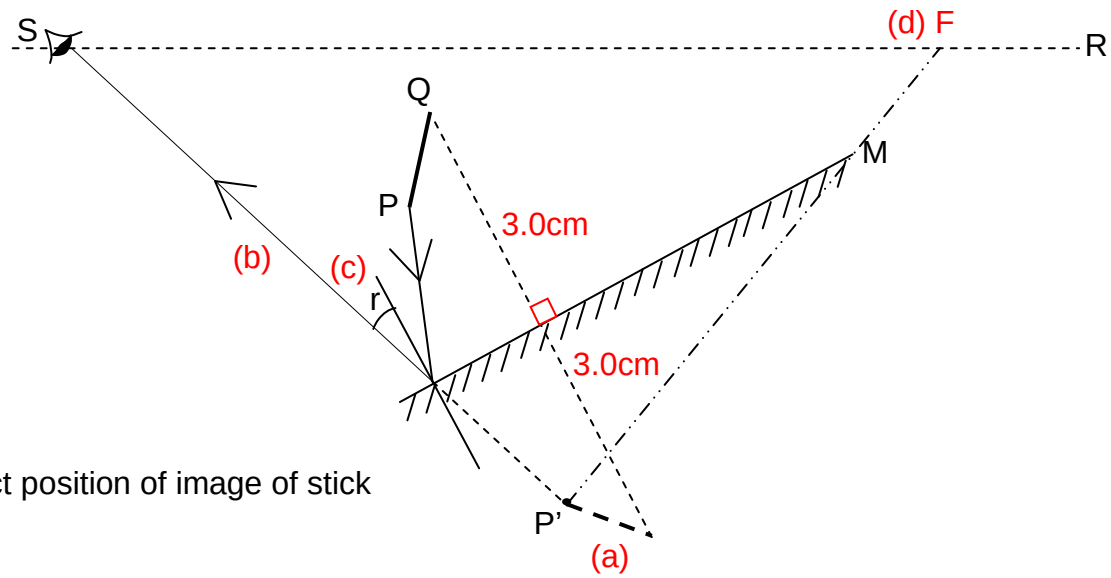


(c) When K is pushed, the c.g. moves to the left of the support.
The weight of the toy then sets up an anti-clockwise moment (which returns K to the right).

6(a) 1. It is incompressible / It has a constant density/volume.
2. It transmits pressure equally in all directions.
(b) P = F/A = 155 000 N / 13.0 m^2
= 11900 Pa or 1.19 x 10^4 Pa or 11.9 kPa

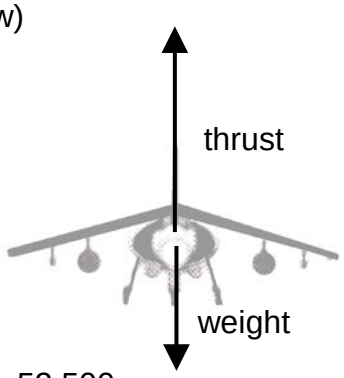
7(a) Energy cannot be destroyed or created, but only changed from one form to another.
(b) Electrical energy is converted to kinetic energy to gravitational potential energy.
(c) (i) Gain in g.p.e. = mgh = 1250 x 10 x 380
= 4.75 x 10^6 J or 4750 kJ
(ii) Power = gain in g.p.e. / t = 4.75 x 10^6 J / 25 s = 1.90 x 10^5 W or 190 kW
(d) Some energy is used to overcome friction and lost as thermal energy to the surroundings. / Some energy is lost as sound produced in the motor to the surroundings.

8



(a) correct position of image of stick

(b) line joining P' to S (dashed line from mirror to P' & arrow)
line joining P to mirror (arrow)
(c) mark the angle of reflection and label it *r*
(d) label position F (dashed line from F to P')



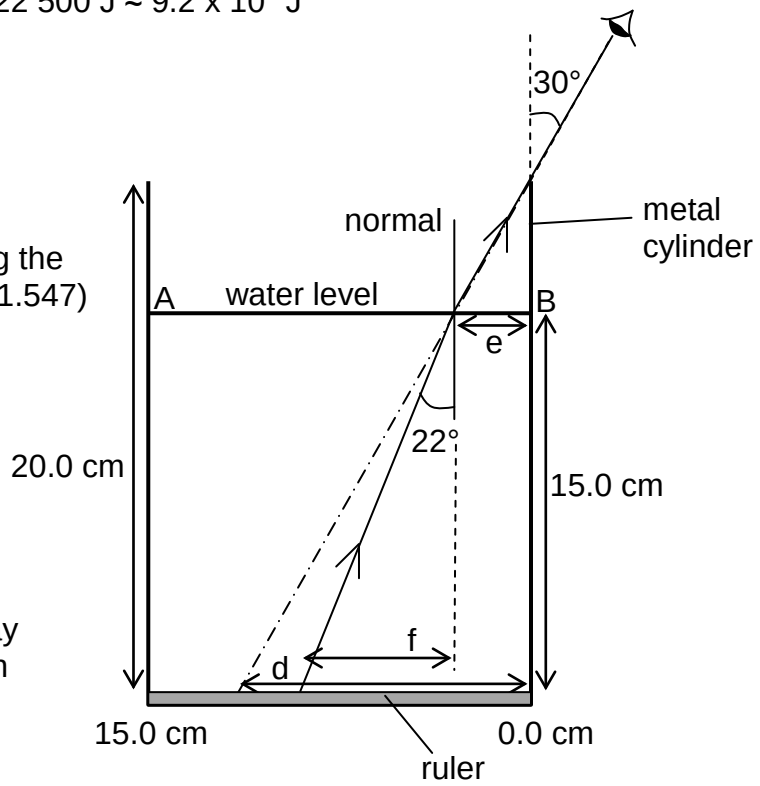
Section B (30 marks)

9(a) F_{net} = ma = 5250 x 2.0 = 10 500 ≈ 11000 N
(b) label and directions correct

(c) thrust – weight = F_{net} ➔ thrust = F_{net} + weight = 10 500 + 52 500
= 63 000 N
(d)(i) $v^2 = u^2 + 2as$ ➔ a = $(v^2 - u^2)/2s = (0 – 3^2)/2(18)$
= - 0.25 m s^{-2} deceleration ≈ 0.25 m s^{-2} (2 s.f.)
(ii) thrust – weight = ma ➔ thrust = ma + weight = 5000(0.25) + 50 000
= 51 250 N ≈ 51 000 N (2 s.f.)
(iii) work done = F x d = thrust x height = 51 250 x 18
= 922 500 J ≈ 9.2 x 10^5 J

10

(a) d: smallest reading seen,
use right-angled triangle
d / 20.0 = tan 30°
➔ d = 11.547 ≈ 11.5 cm
However, due to metal cylinder blocking the eye's view, a slightly larger reading (>11.547) would be seen, so d = <u>11.6 cm</u>



(b)(i) Use Snell's law: $n_1 \sin \theta_1 = n_1 \sin \theta_1$
From water to air:
1.33 sin *i* = (1.0) sin 30°
➔ sin *i* = (1.0) sin 30°/1.33
i = 22.1° or 22°

(ii) Path of light ray showing refraction away from normal at water level with direction <u>from ruler to water level to eye</u>.
<u>Arrow</u> must be shown.

(iii) e = 5.0 tan 30° = 2.887 cm
f = 15.0 tan 22° = 6.060 cm
smallest reading = e + f = 2.887 + 6.060 = 8.947 ≈ 8.9 cm

(c) The <u>smallest reading will decrease</u>.
(Note: The emergent angle in air must remain at 30° for the girl to see the reading.)
Since a higher optical density liquid (or liquid with a higher refractive index) <u>causes a larger change in direction of the incident ray</u> / <u>larger deviation of light ray</u>
<u>the angle of incidence must decrease</u>.

(d) The <u>angle of incidence is 0°</u> or <u>incident ray is along the normal</u>
OR <u>angle of incidence is greater (or equal) to critical angle</u>

11 EITHER

(a)(i) change in pressure = 1.0 – 0.4 = 0.60 x 10^5 Pa (s.f. not penalised here)
or 6.0 x 10^4 Pa OR 60 kPa

(a)(ii) $\Delta p = \Delta h \rho g$ ➔ 6.0 x 10^4 = 9500 x ρ x 10
ρ = 0.6316 ≈ 0.63 kg m^{-3}

(b)(i) pressure P = F/area ➔ F = P x area = 0.4 x 10^5 x 0.65
= 26 000 N

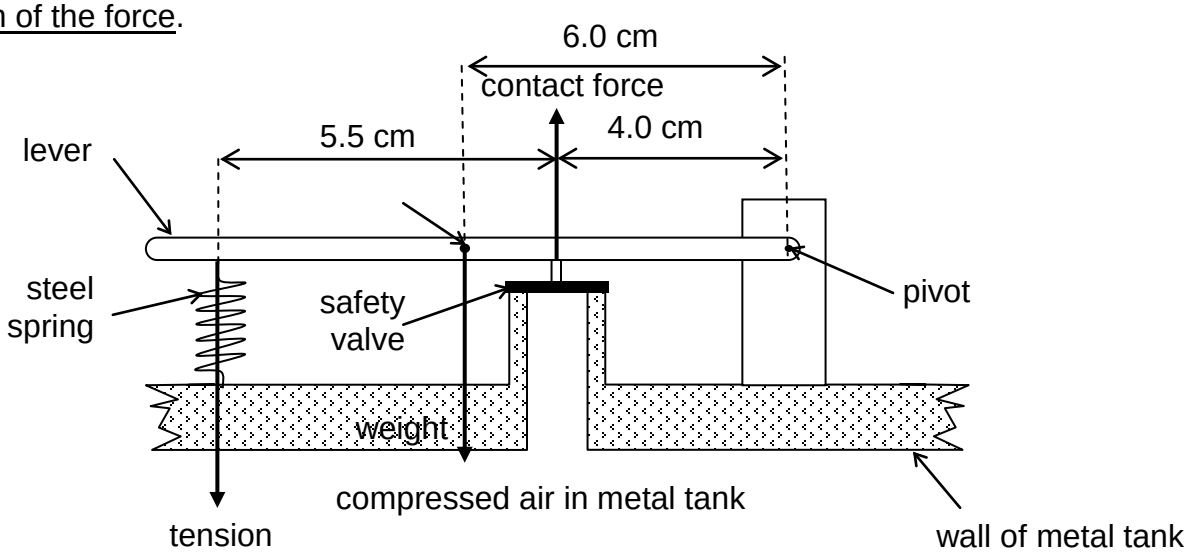
(b)(ii) F = P x area = 90 x 10^3 x 0.65 = 58500 N
net force = 58500 – 26000 = 32500 N

(c) Pressure inside the cabin is reduced so that
the <u>difference in air pressure</u> inside and outside the aircraft <u>is smaller</u> resulting in <u>smaller net force acting</u> on the aircraft cabin windows and other <u>body parts</u> / <u>less stress</u> on the aircraft body parts
OR the <u>system for maintaining air pressure needs less power to work</u> and <u>conserves energy / fuel</u> for the aircraft

(d) The air pressure is returned to normal atmospheric pressure 101 kPa so that the <u>cabin doors</u> can be <u>opened safely</u>
/ the passengers will not experience <u>breathing difficulties / sudden change in air pressure</u> when landing / opening doors.

11 OR

(a) It is the <u>product</u> of a <u>force</u> and the <u>perpendicular distance from the pivot to the line of action of the force</u>.



(b) identify type of forces correctly & indicate correct directions

(c) Moment = 2.8 x 6.0 = 16.8 ≈ 17 N cm (2 s.f.)

(d) Moment due to spring = 3.8 x 9.5 = 36.1 N cm
36.1 + 16.8 = F x 4.0
Force acting on valve = 13.2 ≈ 13 N (2 s.f.)

(e) The safety valve will open at a higher pressure for Fig. 11.3 and at a lower pressure for Fig. 11.4.
For Fig. 11.3, the c.g. will be further from the pivot and the moment due to the weight of the lever will increase.
A larger force must be exerted by the safety valve to counter this increase in moment before it opens (as the distance of the safety valve from the pivot is fixed.)
The reverse happens for Fig. 11.4.